

HIGH-QUALITY ELECTRICAL CONNECTIONS

**FOR FUNCTIONALITY
AND LONGEVITY**

**How Specialty Plugs and Receptacles
Save Time and Money While Withstanding
Extreme Conditions and Abuse**



This white paper explores the real-life conditions, harsh environments, and pressures that affect the function and longevity of industrial use plugs and receptacles. The investigation contained within highlights the significant benefits of using environmentally robust plugs and receptacles. The results and recommendations are supported with test data compiled during a 13-month investigation conducted in the environmentally challenging location of Guam. The connections studied not only ensure functionality and longevity but also save time and money by reducing failure rates and maintenance requirements.

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ABSTRACT

Rugged, specialty plug and receptacle connections are vital for industries requiring flexible, robust, and reliable power, communication, and control solutions, such as industrial, defense, food production, oil and gas, shore power, and public works. These connections not only ensure functionality and longevity but ensure uninterrupted downtime while saving time and money by reducing failure rates and maintenance requirements.

This white paper discusses the pressures on plug and receptacle connections in harsh environments and highlights the significant benefits of using MELTRIC Multipin plugs and receptacles, supported by a 13-month United States Coast Guard (USCG) trial investigation conducted in the environmentally challenging marine location of Guam.

13
MONTHS



Some plug and receptacle electrical connections are specifically designed to withstand the extreme conditions often encountered in industrial and marine environments. They play a crucial role in ensuring continuous operation while reducing maintenance costs. Recent advancements in materials and technology have further enhanced their performance and durability.



INTRODUCTION

Some plug and receptacle electrical connections are specifically designed to withstand the extreme conditions often encountered in industrial and marine environments. They play a crucial role in ensuring continuous operation while reducing maintenance costs. Recent advancements in materials and technology have further enhanced their performance and durability.

Currently, advanced Switch-Rated and Multipin devices are plug and receptacle connections that offer not-only rugged durability, but unique safety and ease-of-use features. They boast watertightness, electrical hazard mitigation, and safety features that protect users, such as lockout/tagout and arc flash mitigation. These features allow the devices to be effectively used to stand up in harsh environmental, industrial, and washdown conditions.

With these durability features, the useful longevity of electrical plugs and receptacles is significantly extended. This increased lifespan translates into substantial savings in both money and time.

Beyond durability, the modular design nature of Multipin plugs and receptacles double down on their use as an ideal economical and sustainable solution for a wide variety of control and power applications. They maximize performance by offering as many as 37 contacts in one space efficient, compact device.

Organizations that select Multipin devices benefit from reduced replacement costs, fewer maintenance interventions, and less downtime, which contribute to improved operational efficiency. By investing in high-quality, durable electrical connections, industries can ensure safer and more reliable systems, ultimately enhancing productivity and reducing overall operational costs.

BACKGROUND

PRESSURES ON PLUG AND RECEPTACLE CONNECTIONS IN HARSH ENVIRONMENTS

Plug and receptacle connections in harsh environments experience challenges that compromise functionality and longevity. Without proper weatherproofing, environmental elements lead to corrosion, water ingress, and short-circuiting, ultimately causing equipment failure and downtime.

In addition to environmental issues, physical impacts and routine wear and tear can damage electrical connections. The rugged nature necessitates impact-resistant designs to ensure that plugs and receptacles can withstand accidental drops, collisions, and constant usage without becoming compromised.

High failure rates present significant challenges, as traditional connections often struggle under harsh conditions. Failures not only disrupt operations but

also increase the need for regular replacement. This leads to a considerable rise in costs adding to both the material and labor expenses.

The cost of replacement is compounded by the additional man-hours required to maintain and repair electrical systems in these settings. Over time, repairs can drain operational budgets and diminish overall productivity.

To combat these challenges, plug and receptacle connections require advanced weatherproofing and impact-resistant materials. Enhancements ensure reliable performance, reduce the likelihood of failure, and significantly cut down on both replacement costs and maintenance hours.

ENVIRONMENTAL RESISTANCE

In environments subject to extreme weather and environmental conditions, the durability of connections becomes critically important. Resistance to high humidity, spraying water, and corrosive agents, such as cleaning agents and salt-water means the difference between operational efficiencies versus downtime and expenditures

- **Extreme Weather**

Plug and receptacle connections are often exposed to the elements. Conditions such as heavy rainfall, high humidity, extreme temperatures, and saltwater spray can severely compromise integrity. Without adequate weather resistance, these connections are prone to corrosion, short circuits, and eventual failure.

- **Watertight Design**

Utilizing weatherproof and watertight plug and receptacle design is crucial. Watertight design prevents moisture ingress and protects against the harsh impact of varying weather conditions, ensuring reliable operation while prolonging the lifespan of the connections.



IMPACT ROBUSTNESS

Connections in trying environments, such as industrial and marine settings, often endure significant physical abuse and heavy use. From frequent plug-ins and disconnections to accidental impacts and vibrations from nearby machinery, these connections must be robust enough to handle such stresses.

- **Heavy Use**

When heavy use is a given, the need for continuous operation and avoiding unexpected downtime can be a challenge. Choosing butt-style contacts, which maintain contact force over repeated use cycles, is advantageous over pin-and-sleeve contacts that deform over time.

- **Abuse**

In industrial environments, abuse inadvertently occurs. Robustly designed, impact rated connections, made with durable materials like fiberglass reinforced thermoplastic nylon, provide the necessary strength and resilience to withstand these physical demands.



Choosing plug and receptacle connections that meet these requirements ensure consistent, downtime-free performance.



FAILURE RATES

Traditional pin and sleeve devices experience various failure modes, including corrosion, mechanical wear, and contact deformation disrupting operations and posing safety risks.

- **Impact of High Failure Rates on Operations**

High failure rates in electrical connections can lead to operational inefficiencies, increased downtime, and elevated maintenance costs.

Conversely, durable and reliable connections can significantly reduce failure rates. This directly translates to more stable operations and less maintenance burden.

REPLACEMENT COSTS

Frequent replacements of electrical connections can be a substantial financial burden for organizations.



- **Costs Associated with Frequent Replacement**

Traditional connectors, with their limited lifespan and susceptibility to environmental factors, often require regular replacements, driving up costs. In contrast, investing in more durable connections may have a higher initial cost, but the long-term savings are substantial.

- **Long-term Savings Associated with Durable Connections**

Durable connections reduce the frequency of replacements, cutting down on both material and labor costs. Over time, investing in higher-quality devices can result in cost savings and a more reliable operational infrastructure.

MAN HOURS NEEDED FOR MAINTENANCE

Maintaining and repairing electrical connections is labor-intensive, often requiring skilled technicians to spend significant time on wiring and repairs.



- **Time and Labor Needed for Repair and Replacement**

Traditional connections that frequently fail need constant attention, diverting valuable human resources from other important maintenance activities.

- **Efficiency Gained with Specialty Connections**

By adopting specialty connections designed for durability and ease of maintenance, organizations can achieve substantial efficiency gains. These connections reduce the frequency of maintenance interventions and simplify the repair process, thereby freeing up technicians' time and allowing for more efficient allocation of labor resources.





INVESTIGATION



US COAST GUARD IN GUAM

The USCG in Guam operates in one of the most challenging environments on the planet. With its proximity to Typhoon Alley, Guam experiences extreme weather conditions, including heavy rainfall, high temperatures, and high humidity. These conditions place immense stress on electrical connections, which are crucial for maintaining operations and communications for moored cutters. To address ongoing issues with their current shore-tie connectors, the Coast Guard conducted a study to evaluate the performance of MELTRIC multipin plugs and receptacles compared to their regular standard (RS) connectors.

USCG INVESTIGATION SUMMARY

The US Coast Guard conducted a 13-month study comparing MELTRIC multipin plugs and receptacles with existing RSC shore-tie connectors. The study found that MELTRIC devices demonstrated superior performance, with **zero failures and minimal degradation**, while the RS products failed at eight months. MELTRIC connectors also provided greater conductor capacity, reducing the need for multiple connectors and resulting in significant cost and time savings.



At a cost of approximately \$500 per connector and maximum service life of an average of six months, it is time to find another solution.

– IT1 McGregor



USCG INVESTIGATION BACKGROUND

The USCG manages standards for the use of shore-tie connectors that provide Coast Guard Data Network (CGDN) and telephone service for moored cutters. This standard varies from Coast Guard Pacific Area (PACAREA) to Coast Guard Atlantic Areas (LANTAREA) and causes compatibility problems when cutters deploy to other districts. In addition to the non-standardization issues, the actual hardware used in the fabrication of these connectors is not well suited for the application.

The USCG Electronics Systems Support Detachment (ESD) Guam noted that current RS hardware, “mainly constructed of aluminum, is designed for indoor power applications, not a harsh marine environment.”

Moreover, larger cutters have a requirement for two or more shore ties to provide enough telephone and data circuits. “This doubles the cost and increases the possible failure rate,” stated IT1 Daniel P. McGregor, USCG ESD Guam.

“At a cost of approximately \$500 per connector and maximum service life of an average of six months, it is time to find another solution.” – IT1 McGregor

These problems prompted USCG ESD Guam to develop a study testing the durability of MELTRIC Multipin plugs

and receptacles head-to-head with their current RS connectors.

IMPETUOUS FOR THE INVESTIGATION

The primary issues facing the US Coast Guard were the high failure rate and maintenance demands of their RS shore-tie connectors. These connectors, originally designed for indoor electrical applications, were not suited for the harsh marine environment of Guam.

Specifically, the RS connectors:

- Had a high failure rate with an average service life of just 6 months.
- Required significant maintenance, consuming dozens of man hours for fabrication and repair.
- Were constructed from aluminum, making them vulnerable to corrosion and degradation in marine conditions.
- Had a limited conductor capacity, necessitating the use of multiple shore ties for larger cutters, thus increasing costs and failure points.

The goal of the study was to find a more durable and reliable solution that could withstand the harsh conditions, reduce maintenance time and costs, and improve overall operational efficiency.

CURRENT RS SHORE TIE



12 6
CONDUCTORS PAIRS

\$1975

Adjusted for inflation, 2008-2024,
rounded to the nearest dollar.

- Connectors designed for indoor electrical applications. Connectors constructed of aluminum.
- **Limited to 12 conductors (six pairs).** Forces larger cutters to utilize two shore ties.
- High failure rate. Average **service life of six months.** High maintenance. Dozens of man hours to fabricate/repair.
- **12 conductor cable (six pair).** Two shore ties are required for larger cutters.
- Average cost per shore tie: **\$1975**

MELTRIC®

SHORE TIE



24 **12**
CONDUCTORS PAIRS
\$900

Adjusted for inflation, 2008-2024,
rounded to the nearest dollar.

- Connectors are **designed for harsh outdoor Marine Environment**. Constructed of fiberglass reinforced thermoplastic nylon.
- **Up to 36 conductor capacity**. Three times that of current RS shore tie.
- **Zero failure rate during testing**. New shore tie in place for 13 months with no degradation in performance nor maintenance required.
- **24 conductor cable (12 pair)**. Eliminates the need for a second shore tie unlike RS connector.
- Average cost per shore tie: **\$900**

Due to Guam's location in the Western Pacific Ocean, and proximity to Typhoon Alley, the Coast Guard assets on the Island take a beating when the weather turns sour. Add to that an annual rainfall exceeding 110 inches, average temperatures in the 90's and humidity of 85-90 percent, Guam was selected as the perfect test bed for a new CG Shore tie connector.



STUDY DETAILS

MELTRIC connectors - made from a fiberglass, reinforced thermoplastic polyester, provide resistance to electrical shock, chemicals and UV rays - were selected for a 13-month head-to-head test study. A key feature of the MELTRIC connector is a Type 4X watertight rating, preventing saltwater intrusion versus existing RS connections that are designed for indoor environments. Further, MELTRIC connectors provide three times the available conductor terminal capacity versus the RS shore tie.



This unique conductor capacity feature cuts the cost of replacing shore ties in half, saving countless man hours in repairing and constructing new shore ties.

- IT1 McGregor





ESD Guam technicians constructed shore side connections utilizing the MELTRIC connectors, communication shore ties, and hybrid pig tail connectors utilizing the new connector, and the current RS connectors.



Also, a new, highly flexible 25 conductor shore tie cable was procured and put into service.



The Coast Guard implemented a 13-month study* to test the performance of MELTRIC multipin plugs and receptacles. These connectors were chosen for their robust construction, which included:

- Fiberglass reinforced thermoplastic nylon designed **specifically for harsh outdoor and marine environments**.
- **Up to 36 conductor capacity**, significantly more than the 12 conductors (six pairs) of the RS connectors, thereby reducing the number of shore ties needed.
- A **Type 4X watertight rating** to prevent saltwater intrusion and enhance durability.
- **Environmental Resistance** to electrical shock, chemicals, and UV rays.

The MELTRIC connectors were installed and monitored over the study period to evaluate their performance in real-world conditions.

** Note: Since implementation, the Guam based 110-foot Patrol Boats have had a zero percent failure rate with the new shore tie. Work continues with the manufacturer, to create a custom Coast Guard shore tie, and a single source for procurement. Units in the 14th District, 13th District, and 17th District have been solicited to perform Operational Testing of this new solution. Also, Engineering Change Requests have been submitted to standardize the fleet with this type of communications shore tie.*



MELTRIC RECEPTACLE
FRONT ⚡

BACK ⚡

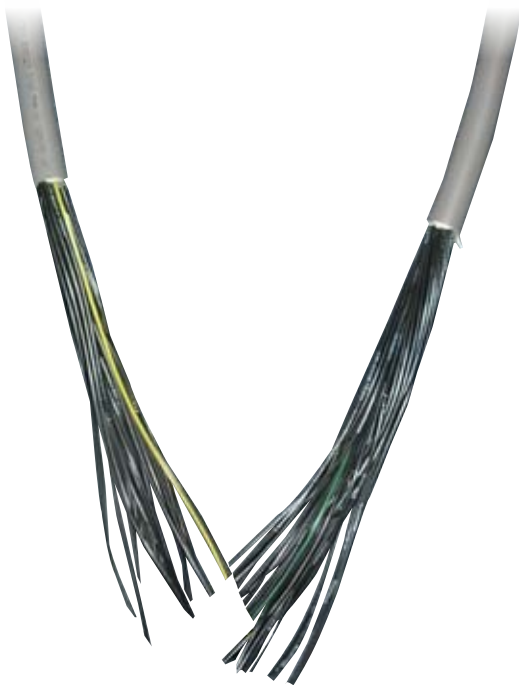


⚡ BACK

MELTRIC INLET ⚡
FRONT

TEST CONNECTOR FEATURES

- Fiberglass Reinforced Thermoplastic Polyester Casing
- Silver Nickel Contacts
- Protective Lid
- Pushbutton Pawl for Disconnect
- Up to 36 Conductors
- Type 4X, IP66/IP67 Rating
- Temperature Range -40°F to 140°F.



TEST CABLE FEATURES

- Flexible Stranding
- Premium Insulation and Insulation Armor
- Black Jacketed Numbered Conductors (Optional Color Code)
- Maximum Flexibility Cable Assembly Process.
- Premium Oil Resistant & Flame-Retardant Jacket
- 24 Conductors
- Temperature Range -25°C to 90°C.

FINDINGS

The results of the study were overwhelmingly positive, demonstrating the clear advantages of MELTRIC connectors over the existing RS connectors:



Zero Failures: Throughout the 13-month study, the MELTRIC connectors did not fail once, maintaining performance and appearance as if they were new. In comparison, the competitive multipin product exhibited failure after 8 months.



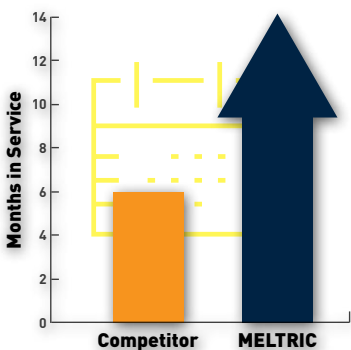
Cost Savings: The MELTRIC connectors reduced the average cost per shore tie from \$1975 to \$900. This cost reduction was due to the longer lifespan and higher conductor capacity, which minimized the need for multiple shore ties.



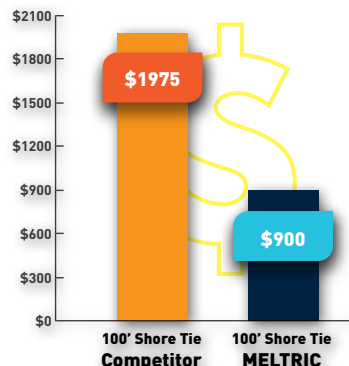
Reduced Maintenance: The study showed a significant decrease in man hours required for fabrication and maintenance. The time needed to fabricate a shore tie using MELTRIC connectors was cut in half, from 8 hours to 4 hours.

Furthermore, over the timespan of the study, the competitive device showed extreme signs of degradation and corrosion compared to the MELTRIC device.

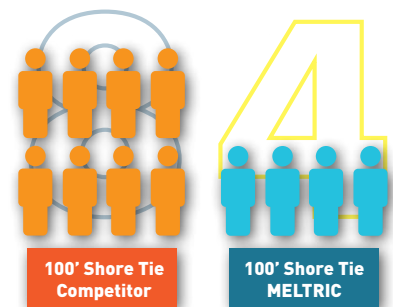
MULTIPIN LIFESPAN TEST COMPARISON



COST PER TEST SHORE TIE COMPARISON



MULTIPIN FABRICATION TIME COMPARISON



All cost comparisons are adjusted for inflation, 2008-2024, rounded to the nearest dollar.

COMPETITIVE CONNECTION ENVIRONMENTAL DEGRADATION



MELTRIC CONNECTION ENVIRONMENTAL ROBUSTNESS



Improved Operational Efficiency: With the **increased conductor capacity**, larger cutters no longer required two shore ties, simplifying the setup and reducing potential failure points.

Enhanced Durability: The MELTRIC connectors' **construction materials provided superior resistance** to the harsh marine environment, including protection against saltwater, UV rays, and physical impacts.

MELTRIC 37-PIN CAPACITY



VS

COMPETITIVE 12-PIN CAPACITY



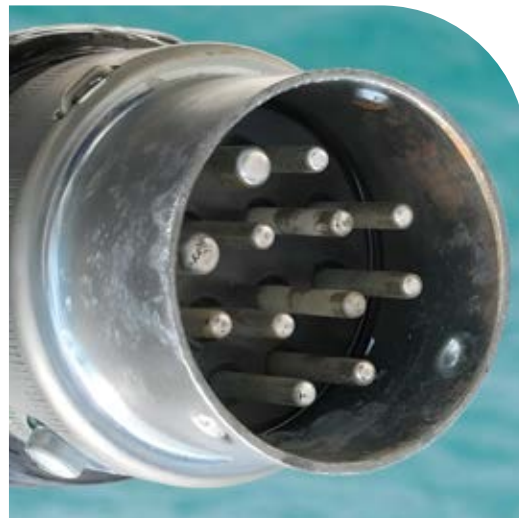
AFTER **2** IN USE WEEKS



MELTRIC



COMPETITOR



AFTER 7 MONTHS IN USE

MONTHS

MELTRIC



COMPETITOR



AFTER 13 MONTHS IN USE

MONTHS



MELTRIC



COMPETITOR





CONCLUSION



CONCLUSION

MELTRIC plugs and receptacles offer a substantially enhanced level of durability and longevity due to their robust construction and high-quality materials. MELTRIC Multipin connectors significantly reduce replacement and maintenance costs, enhance efficiency, and improve safety, making them an ideal choice for environmentally demanding applications.

Investing in high-quality electrical connections like MELTRIC plugs and receptacles is crucial for ensuring long-term functionality, cutting costs, and enhancing safety. By adopting these advanced solutions, industries can achieve significant operational benefits and maintain reliable power connections in harsh environments.



ABOUT USCG ESD GUAM

ESD Guam operates as part of USCG Sector Guam, which is a tenant command of US Naval Forces Marianas (COMNAVMAR). Situated on the island of Guam at 13°N, 143°E, ESD Guam is responsible for supporting the Information Technology and Electronics needs of Coast Guard assets across Guam, Saipan, Japan, and Singapore, both ashore and afloat. The team consists of a Chief Electronics Technician as the Supervisor, alongside three IT Specialists and three Electronics Technicians. ESD Guam's parent command is ESU Honolulu, located in Honolulu, Hawaii.



ABOUT MELTRIC® CORPORATION

MELTRIC® Corporation is a manufacturer, distributor, and supplier of a full line of industrial plugs and receptacles, including our signature brand of UL-listed Switch-Rated devices with DECONTACTOR™ technology and push-button circuit disconnection. These all-in-one devices combine the safety and functionality of a disconnect switch with the convenience of a plug and receptacle and can be safely connected and disconnected under full load.

MELTRIC also manufactures other safe and reliable industrial plugs and receptacles, including multipin, high amperage, single pole, and hazardous location devices. Additionally, we use our devices and third-party components to produce custom power distribution units, including portable rubber boxes, mobile or stationary multigang steel enclosures, dual voltage wall boxes, circuit-protected receptacles, and more.

As a safety leader in the electrical products manufacturing industry for over 40 years, MELTRIC designs and builds quality electrical connectors to ensure electrical and user safety. Since 1982, we have manufactured hundreds of thousands of electrical plugs and receptacles that are used safely and without incident in diverse applications in almost every industry. Our product safety record is pristine by design and we're proud of it.

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TRY A HIGH-QUALITY DEVICE, FREE OF CHARGE

MELTRIC offers a unique opportunity to try one of their rugged, robust, and safe Switch-Rated plugs and receptacles free of charge. MELTRIC will provide a standard DSN20 or DSN30 sample free of charge for potential new customers with appropriate application and volume opportunities.

To request a free product sample, please submit your contact and application information on the MELTRIC website at www.meltric.com/offer.

The Free Product Offer program is applicable in the USA and Canada only.



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