WHITE PAPER

RUGGED CONNECTORS

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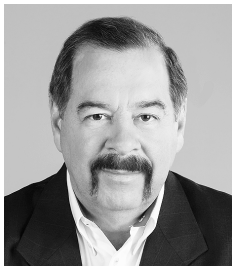
Fischer® CONNECTORS

REIMAGINING CONNECTIVITY TOGETHER

RUGGED CONNECTORS

TEN QUESTIONS ABOUT CONNECTORS FOR EXTREME ENVIRONMENTS

Rugged connectors are essential for applications that have to withstand extreme conditions. This document provides the ten most frequently asked questions about this type of connecting solutions. It covers topic such as sealing, sterilization, cable assemblies and all other necessary key features of rugged connectors and will assist engineers to choose the right rugged connector for their device.



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David Cianciolo is the Director of Engineering at Fischer Connectors, Inc. His electro-mechanical education and 30+ years working with medical device design and military connectors make him uniquely qualified to lead the US design team in interconnect design and assembly, including the critical pursuit of proper cable selection. Dave has been granted several design patents through his career. Focused on custom sealed durable interconnect solutions in rugged environments, David and his team are currently building innovative interconnect solutions for high-speed data connectivity and sealed military and medical applications, in addition to molded sterilizable silicone cable solutions for our medical customers.

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INTRODUCTION

Rugged connectors are specifically designed to withstand extreme conditions. They are available in power, signal, fiber optic and hybrid. There are however no one-size-fits-all type of rugged connectors. Each connecting solution has its own individual requirements to make sure that it will work in the respective application. Selecting the right rugged connectors is therefore not always easy. Following these ten questions will help you to find the right specifications for the connecting needs in your device to make sure that it will work under the most extreme environments.

1. WHAT IS A RUGGED CONNECTOR?

Rugged connectors are specifically designed to withstand extreme conditions such as high and/or low temperature, high vibrations, wet or muddy conditions and dirt. Rugged connectors can be circular or rectangular. Most rugged connectors are made of brass or aluminum and are sealed to protect against dirt and water and/or gasses. Most rugged connectors use copper alloy conductors and some integrate gold to further enhance conductivity.

2. WHAT TYPES OF RUGGED CONNECTORS ARE AVAILABLE?

Fiber optic, power, signal, hybrid are all available. In fact, most commercial-grade functions, including connectors for small air or water lines, can be designed for a rugged environment. You can select an offthe-shelf solution, or modify existing connectors. Most manufacturers who focus on rugged connectors will work with you to develop a custom connector for your application.

3. WHERE WOULD I USE A RUGGED CONNECTOR?

There are two things to keep in mind when deciding whether to use a rugged connector. The first is the application environment. Any time a connector comes into contact with water or dirt, or it needs to be sterilized or washed down, you will want to consider a rugged connector. The second consideration is risk-management. If you have no margin for error or a zero-error application, a rugged connector should be considered. Many military and medical applications fall into this category. Test and measurement applications often use rugged connectors to protect the integrity of the data they collect. Remote sensors also fall into this category. Typical operating Conditions for sealed connectors:

Substances to be blocked by sealing	Water (rain, soft) Water (sea) Dust
Temperature range	Normal -20°C to +60°C Military, extreme -50°C to + 150°C
Pressure differential	Typ <0.2 bar
Type of exposure	Most common is splash, but jets or immersion are possible
Duration of exposure	Typ <1 day

4. WHAT CHARACTERISTICS SHOULD I LOOK FOR IN A RUGGED CONNECTOR?

When you are first looking at your connector solution, you should work with your supplier to determine the right level of sealing, number of mating cycles, and temperature rating that you need for your unique application. When you fully understand the end-use application environment, you can select properties that will protect your solution from abrasion, corrosion and chemicals. Chart A contains information about characteristics you should consider when selecting a rugged connector.

Chart A

Characteristic	Considerations for rugged connectors
Sealing	- Environmental sealing: IP68 or greater, submersible - Hermetic sealing 1x10-5 mbar l/sec or better
Mating cycles	5,000+
Materials	- Nickel/chrome plated brass - Aluminum
Durability	Harsh Environment, Resistant to abrasion, chemicals, corrosion, impact or shock
Temperature	-50°C to +160°C
Keying	Features to prevent mis-mating. Color-coding and blind mating features are desirable
Locking	Push-pull, breakaway, twist lock, screw type
Accessories	Sealing caps, Protective boots
Shielding	EMI/RFI, 360 degree

5. WHAT MATERIALS SHOULD I LOOK FOR IN A RUGGED CONNECTOR?

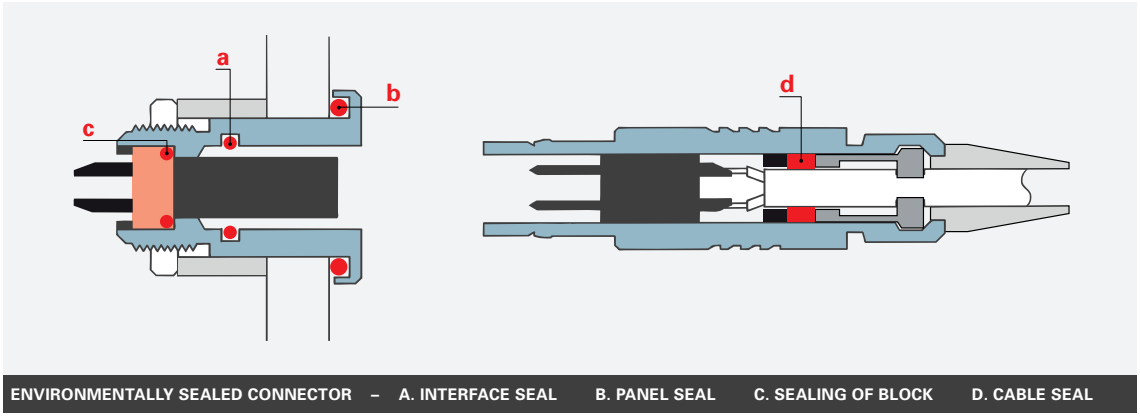
Traditionally, the toughest connectors are made up of nickel-plated brass. Today, however, aluminum and stainless steel, and even some composite plastics can be specified and still fall into a rugged connector category.

6. CAN RUGGED CONNECTORS BE STERILIZED?

High temperature (including steam autoclave), chemical and radiation sterilization methods all require rugged connectors that can withstand the sterilization process. Each sterilization method has its own connector requirements, so be prepared to discuss exactly how the end user plans to sterilize your finished device.

7. HOW ARE RUGGED CONNECTORS SEALED?

Sealing typically falls into two categories: environmental sealing against dust, water and other minerals, and hermetic sealing against gasses. With environmental sealing, an interface seal protects the junction between the two connectors, keeping harmful particles away from the connection area. Mounting panel seals, seals for protecting the contact areas, and cable sealing round out the areas that are needed to protect the connector and the connection. Sealing materials include Viton, a fluoropolymer with low permeation and excellent chemical resistance. EPDM (ethylene propylene rubber) is commonly used for interface o-rings designed to be mated and unmated in low temperatures. Hermetically sealed connectors are traditionally sealed with glass, ceramic inserts, or epoxy.



ENVIRONMENTALLY SEALED CONNECTOR – A. INTERFACE SEAL B. PANEL SEAL C. SEALING OF BLOCK D. CABLE SEAL

8. WHAT ROLE DO IP RATINGS PLAY?

IP ratings measure the level of protection against dust, dirt and water. Look for IP68 ratings or above for true waterproof connectors. Most IP designations have specific conditions, but IP68 ratings should be defined differently by each manufacturer, so be sure to ask what the rating represents. There is a big difference between an IP68 rating of 2 hours at 20 meters and an IP68 rating of 24 hours at 120 meters. You also want to understand whether the IP rating is for the connectors in a mated and/or unmated condition.

9. WHERE DO I GET CABLE ASSEMBLIES FOR MY RUGGED CONNECTOR?

Rugged connectors need to have equally rugged cable assemblies in order to work in tough environments. Medical device manufacturers often look for silicone cables with low-friction coatings. Very few OEM's attempt to make cable assemblies in-house. Most turn to a specialty cable assembly provider or to their connector manufacturer to recommend specific cables, overmolds and assemblies that will create a rugged interconnect solution.

10. WHAT TYPE OF LEAD TIME DO I NEED FOR MY RUGGED CONNECTOR?

Like any other product, lead times will vary, based on what you order. Popular-sized connectors are often available off the shelf and can be ordered quickly. Creating a custom connector that is unique to your application could take 12-16 weeks. Modifying an existing connector design falls somewhere in between. The best connector solutions are specified early in the design process so that you have the time to select the right size and weight connector solution for your application, possibly allowing you to build a smaller, lighter device.

ABOUT FISCHER CONNECTORS

Fischer Connectors has been designing, manufacturing and distributing high-performance connectors and cable assembly solutions for more than 60 years. Known for their reliability, precision and resistance to demanding and harsh environments, Fischer Connectors' products are commonly used in fields requiring faultless quality, such as medical equipment, industrial instrumentation, measuring and testing devices, broadcast, telecommunication and military forces worldwide.

Primary design and manufacturing facilities are located in Saint-Prex, Switzerland, with subsidiaries and distributors located worldwide.

Fischer® CONNECTORS

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