EMC Shielding Gaskets

The ultimate guide

COMPELMA

Summary

1 What is an EMC shielding gasket ?

EMC shielding gaskets ensure a sealing within an electronic assembly.

Depending on the chosen gasket, the assembly can be sealed against :

- To particles (dust)
- And/or fluids (air, water)
- And/or electronic (mass recovery) in the case of EMC shielding gaskets (electromagnetic compatibility)

This water resistance is assured between two moving parts of a piece of equipment. For example, between two parts of an assembled electronic box, between a closet door and its frame, or around the periphery of the cover of a piece of equipment.

Sealing against fluids and particles - IP index

The level of sealing against water and dust of an electronic equipment is given by its **IP** rating (Ingress Protection). This protection rating is standardised by the International Electrotechnical Commission.

It consists of the letters IP followed by **two numbers** (or a letter in certain specific cases).The first number indicates protection against **solids** (particles and dust).The second number indicates the protection against **liquids**. To comply with the rules, the tests must be done with water.

For example, an IP68 certified equipment is completely **dust proof** and **waterproof** to a specific depth and time duration specified by the manufacturer.

Electromagnetic sealing - Grounding

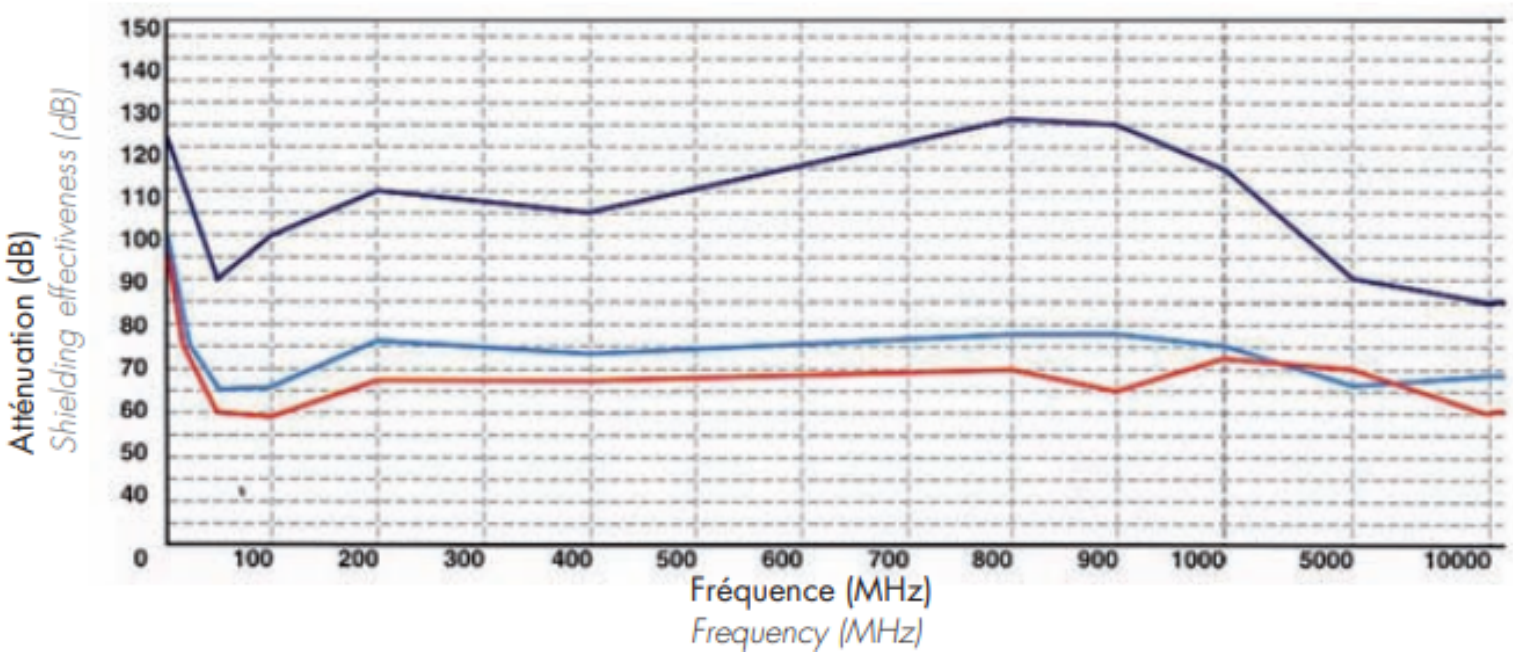
In addition to fluid proofing, the gaskets can be made of an electrically conductive material to provide an **electromagnetic shielding** through grounding.

Many fabrication methods make it possible to manufacture conductive gaskets:

- Using a metal particle charged silicone (Nickel and Carbon [Ni/C] or Silver and Aluminium[Ag/Al])
- Drown a metal mesh in silicone (Monel or aluminium type)
- Surround the joint with a conductive material (for example metallized fabric [Ni/Cu/Ni], therefore conductive)

Electromagnetic sealing - Grounding

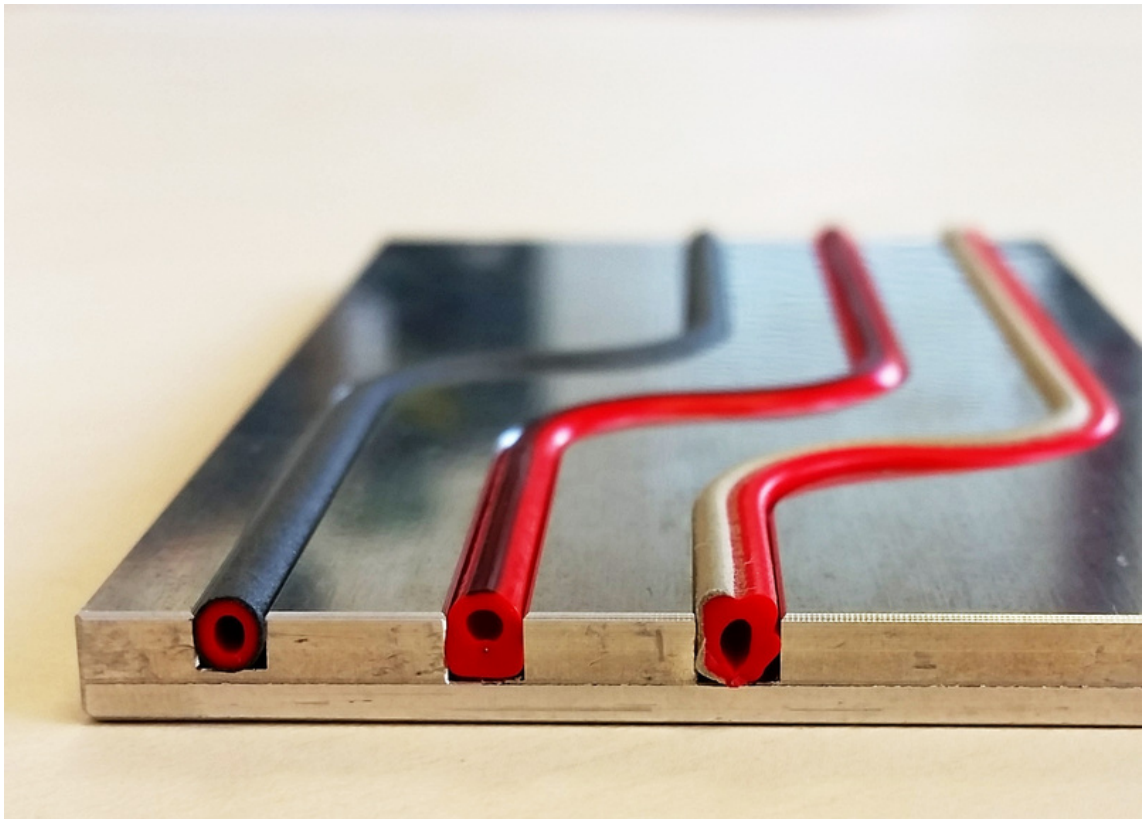
These different methods of gasket manufacturing ensure a shielding level up to 120dB for **EM** (electromagnetic) and **RF** (radio frequency).



Integration of EMC and IP gaskets in an electronic assembly

To achieve high performance levels, the gaskets must be properly integrated into the electronic design. This integration must be considered at the beginning of the project.

For example, to ensure IP68 sealing and ground continuity around an electronic enclosure's periphery: a **groove** must be designed to integrate the gasket. Without this groove, an IP68 level is difficult to achieve.



Several solutions exist to compensate for the detection of leaks in a piece of equipment after its conception. However, these methods are still not optimized and so not recommended. Indeed, the performance levels can only be lower.

For example: **Foam gaskets surrounded by a conductive fabric** allow grounding on openings or at certain locations of a piece of equipment (around a connector for example). These gaskets are placed directly on the **metallic surface** and are held in place by an adhesive. A groove is therefore not necessary. However, there must be enough space in the design.

These gaskets are **not suitable** for a high IP protection.

Beware of compressive forces !

In addition to the expected level of sealing, special attention must be paid to the compression forces in the electronic assembly.

If the **EMC** shielding gasket is too hard or **oversized**, your assembly may be degraded by unexpected mechanical stresses.

On the other hand, if the conductive gasket is too soft, too compressed or undersized, it may degrade rapidly (**deformation** or even tearing) and the EMC and/or IP tightness will no longer be guaranteed.

2 A few examples of EMI shielding gaskets

EMC foam shielding gaskets with conductive fabric

These EMC foam gaskets require **low compression forces** (due to the polyurethane foam).

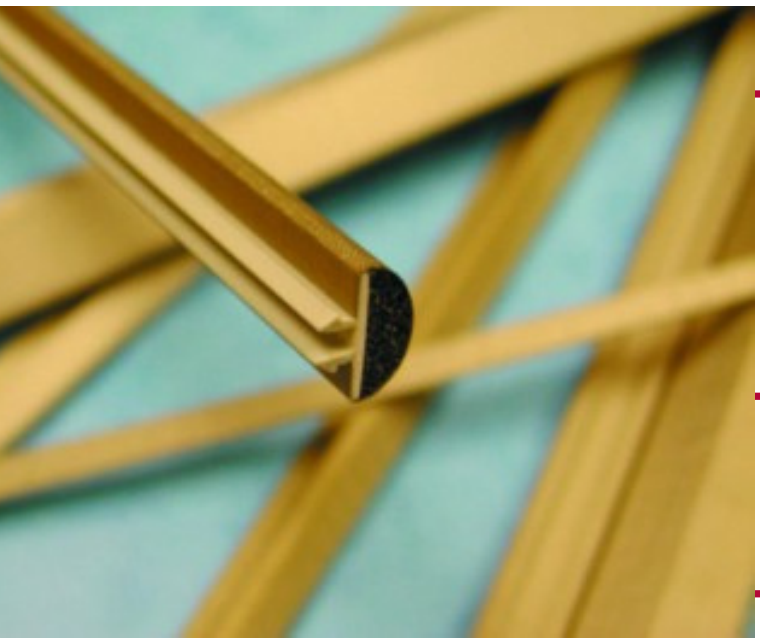
They can therefore be used in lengths of **several meters** without too much mechanical stress.

These EMC shielding gaskets also have good mechanical resilience and withstand abrasion and compression/decompression cycles. They are therefore suitable for **RFID** cabinet door openings, for example.

Manufacturing: specific profil of polyurethane foam is wrapped with a conductive metalized mesh.

Conductivity : <0.1 ohm-cm

Particle load : standard treatment of the conductive fabric: Ni-Cu-Ni



Nickel and Copper conductive fabric over polyurethane foam.

Really **low** compression force.

Standard & custom profils

2 A few examples of EMI shielding gaskets

EMC shielding gasket made of conductivesilicone (Ni/C or Ag/Al charged):

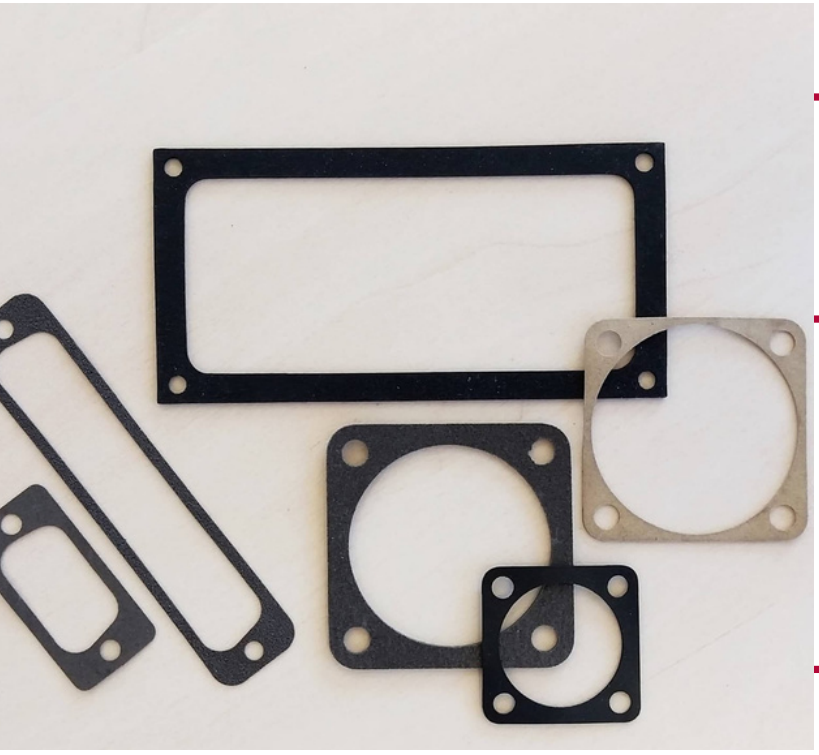
For certain demanding projects (nuclear, military or medical), neutral silicone gaskets are used. The advantage is that the flexibility of neutral silicone is retained and the electrical conductivity of the metal is added by the metal screening.

These gaskets (conductive and non-conductive) achieve very high levels of fluid and particle tightness (up to IP68 or IP69).

The metal screening is molded in the silicone during manufacture (usually Monel or aluminium). This type of gasket has excellent resilience and durability. It is only manufactured by molding or plate cutting.

Loaded Ni/C or Ag/Al

60 Shore A (+/-10)



Manufactured by molding or cutting

Widely used in **military**, **medical** or **telecom** projects.

IP 68 to **IP 69**

2 A few examples of EMI shielding gaskets

Bi-material EMC shielding gaskets (neutral and loaded silicone)

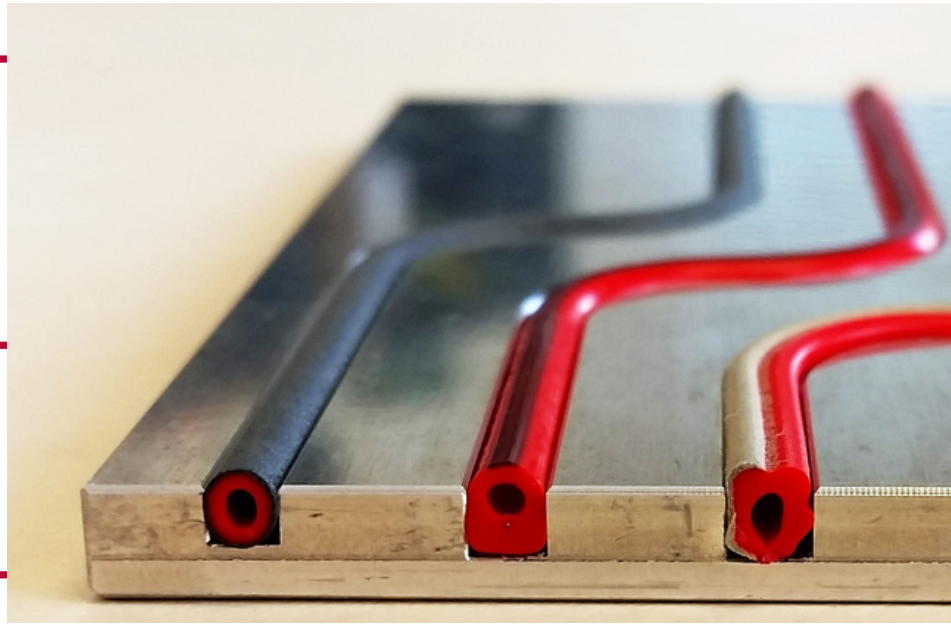
Bi-material silicone EMC (EMI) shielding gaskets can be made by extruding two types of silicone simultaneously: a **loaded silicone** (Al/Ag or Ni/C) and a **neutral silicone** (fluorosilicone or not).

The advantage is the flexibility of the EMC shielding gasket compared to a pure loaded silicone gasket (harder).

The arrangement of the two types of silicone on the gasket profile is **variable** depending on the specifications to be achieved.

- Ni/C or Ag/Al
- Fluorosilicone is also available
- Neutral & loaded silicone
- **IP 68** & **UL 94-V0**

- Manufacturing : Extrusion, molding, splicing.
- Conductivity : <0.12 ohm-cm
- **45-60 Shore A**



2 A few examples of EMI shielding gaskets

EMI shielding metallic gaskets

Metallic EMC shielding gaskets are manufactured by chemical cutting and mechanical forming from 0.15mm thick steel plate (Sandvik Chromflex). These shielding gaskets have a series of small spring teeth around the periphery. This allows them to compensate for gaps due to tolerances between two metal castings for example.

Material of the EMC gasket

Sandvik Chromflex metal foil, 0.15mm thick.

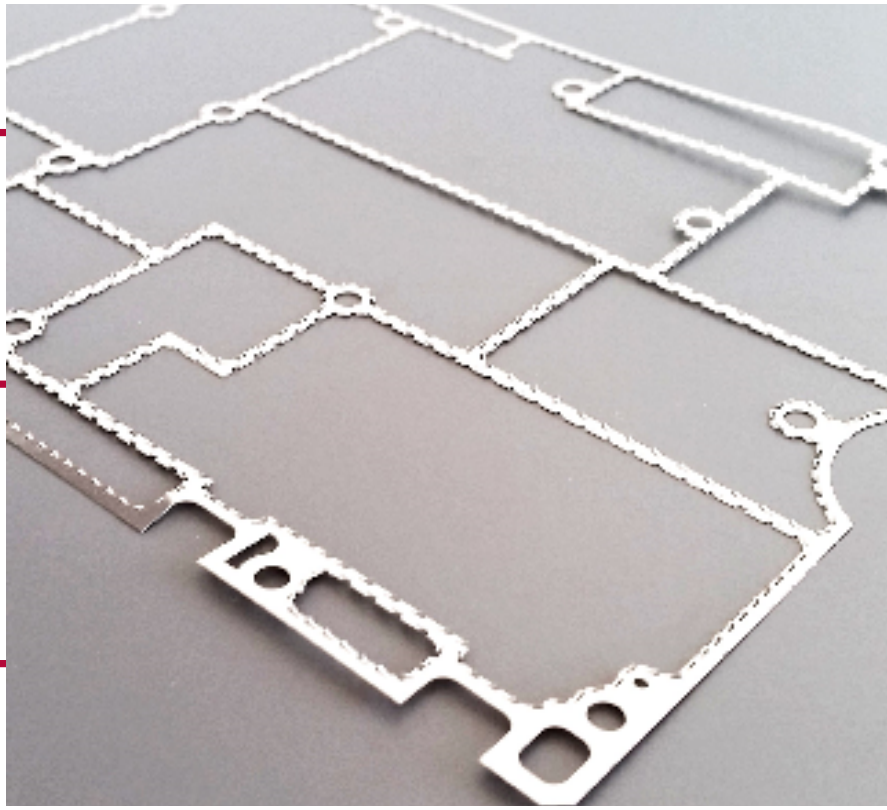
Sealing level of the EMI gasket :

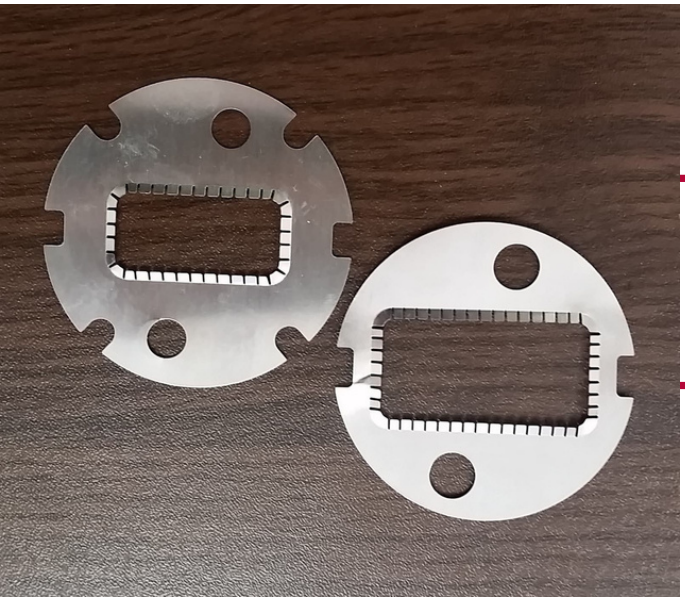
These types of EMC shielding gaskets are, by definition, only designed for EMC shielding by providing **grounding** between two foundries. There is almost no sealing against particles (IP).

Stainless steel
0.15mm thickness
or copper

Photo etching

Spring strength
to ensure the contact





Low **compression force**

Max. dimensions **400** x **500mm**.

3 How to choose the right material

How to choose a shielding gasket for your EMC?

The choice of materials must be taken into account when selecting the type of shielding gasket. Not only for electrical conductivity and **EMC** shielding performance, but also for compatibility with its environment. Galvanic couples are important to ensure the **longevity** of an equipment. Some metals, in a salty environment, will react with each other and **oxidize** rapidly.

For example, Ni/C (Nickel Graphite) loaded **EMC** gaskets are recommended when mounted on a nickel surface (plated or painted) enclosure. On the other hand, a silver or copper loaded gasket in contact with an aluminium housing in a salty environment will corrode quickly. This will result in mechanical degradation of the seal, with a loss of EMC and/or **IP** sealing. In addition to corrosion on the worst case.

	Enclosure Material										
Filler Type	Aluminium Alloys	Magnesium Alloys	Stainless Steel	Copper Alloys	Cadmium Plating	Tin Plating	Nickel Plating	Chromium Plating	Silver Plating	Zinc Plated Galvanised Steel	Titanium
Silver/Nickel	X	X	√	√	X		√	√	√	X	√
Silver/Copper	X	X	√	√	X	X		√	√	X	√
Silver/Aluminium			√	√				√	√		√
Inert Aluminium (A1 compatible)	√		√	√		√	√	√	√		√
Silver/Glass	X	X	√	√	X		√	√	√	X	√
Silver	X	X	√	√	X		√	√	√	X	√
Nickel/Graphite			√	√		√	√	√	√		√

4 Mesuring the effectivness of an EMC gasket

Grounding with the EMC shielding gasket

To be functional, the EMC gasket must be grounded. This **grounding** must be done directly against the metal. Some coatings or paints are electrically insulating. In this case, it is important to ensure that the grounding is made by partially removing the paint or the surface coating, which allows a contact of conductive surface against conductive surface.

Some surface coatings are **conductive**. For example for aluminium surface coatings (on a heat sink for example), Surtec 650 is electrically conductive, as opposed to anodizing which is insulating.

Lifetime of an EMC shielding gasket and maintenance

The shielding effectiveness of an EMC gasket in place varies very little over time (except in the case of oxidation or non-compliance with galvanic couples). However, if maintenance is carried out on the equipment and the EMC gasket is removed, you must be careful.

During a disassembly operation, the gasket may **come out of its groove** or move. In this case, depending on its level of resilience (its ability to return to its original shape), the electromagnetic shielding and **IP** sealing may be impacted.

We recommend changing EMC gaskets (especially loaded silicone or foam and conductive fabric versions) at **each maintenance** operation to avoid a second maintenance operation after reassembly of the equipment and the detection of an EMC or fluid leak due to the gasket

Friction resistance is also a consideration in some applications. EMC foam gaskets with conductive fabric are particularly **resistant to friction and wear.** These conductive gaskets are therefore suitable for electromagnetic (EMC) and radio frequency (**RF**) sealing of cabinet doors or between two metallic parts

In all cases, and for all types of gaskets, we recommend a regular inspection of the equipment and gaskets and a **replacement** if necessary. It is better to replace a gasket than to have to carry out maintenance following a system failure.

What does the shielding effectiveness of an EMC shielding gasket depend on?

The level of shielding does not only depend on the chosen materials. Performance is all about finding the best balance between integration, **price**, maintenance and **material compatibility**.

Let us **help you choose** your EMC gaskets to ensure a high level of electromagnetic shielding (EMC) and/or IP sealing performance.

5 Conclusion

Each EMC gasket application is too **specific** to provide a generic solution. The type of application, the integration stage, the environment, the sector, the technical requirements. These are all parameters that a professional can help you to understand.

Supporting you at the **earliest** stage of your conception also allows you to approach the tests and certifications with confidence. By having confidence in the materials you have chosen and their level of performance.

For example, avoiding silicon-based materials in space or medical applications (because of the risk of out-gassing) or mixing **galvanic couples** in a saline environment.

You want to discuss about how to put these gaskets within your projects ?

I send a mail

I go on the chat

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