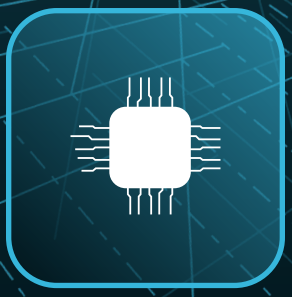
MODUS

NOLATO EMI SHIELDING AND THERMAL INTERFACE



How to Choose the Right Solution

With so many materials and material applications available, how do you choose the right EMI sealing and thermal interface materials and processes?

This article will provide information on the many EMI and thermal management solutions and products available. The solution you choose should meet your exact design requirements for interference, heat and environmental elements. Optimize equipment function and longevity by making an informed choice.

EMI/RF Interference

There are countless causes of electromagnetic interference (EMI/RF), originating from both man-made and natural sources. Understanding the source of the interference is fundamental to determining the appropriate EMI shielding. The right shielding will keep unwanted energy from entering or leaving electronic equipment.

Nolato Trishield® and Compashield® electrically conductive silicone rubber materials can be dispensed, extruded or cut for well-designed, cost-effective EMI seals.

Heat

Each product release of a new electronic device features increased power and reduced size. The latter by itself generates excess heat, which eventually results in damage. Thermal interface material (TIM) solutions dissipate heat by filling air gaps and voids between a heat sink and heat spreader improving reliability and extending the life of electronic devices.

Nolato's Compatherm® gap filler is offered in a range of thermal conductivities and harnesses. It is a cost-efficient thermal management solution for increased heat dispersion.

Form-in-Place (FIP) Gaskets - Trishield®

While traditional gaskets are die-cut from a separate piece of material to form a seal between two surfaces, the Datron XYZ robotic form-in-place gasket dispenser places a precise string of conductive gasket silicone directly onto one of the surfaces. The Nolato form-in-place gasket design guide contains a form-in-place gasket definition and includes technical specifications, tolerances and product design requirements.

Among Nolato's state-of-the-art offerings is its Trishield® technology, a unique dispensing process widely used by leading companies in high-tech industries that require electromagnetic interference (EMI) shielding.

Trishield's® solution combines excellent shielding effectiveness with superior mechanical performance by dispensing EMC gaskets formed into a triangular shape, therefore reducing material usage and required compression force to create an effective shield.

This product is ideal for complicated designs, including small or tight spaces where real estate is especially scarce yet dependable shielding is imperative. When highly-skilled and time-intensive assembly is needed, the benefit of a robotic form-in-place gasket machine's placement—versus the expense of trained manpower—is a major benefit.

Within today's complex electronics designs are small and intricate chambers. The precision placement of EMI/RF shielding is crucial to the final product.

Electronic and DataComm devices are particularly susceptible to electromagnetic and radio-frequency interference and FIP dispensed gasketry is a smart choice over traditional cut or molded gaskets.

FIP is not just for sealing joints within electronics. It also joins dissimilar materials, such as metal and plastic; provides shock absorption for extreme movement; insulates electrical components; and can meet MIL-A-46106A and FDA 177-2600 specifications.

MODUS

Additional Benefits:

- Allows for compartmentalized shielding
- No adhesive required
- Wide variety of versatile material combinations
- Adaptable to a multiple surface design
- Small gasket dimensions
- No grove required
- Excellent positioning tolerances
- Automated and quality controlled process
- Reduced total landed cost
- Electrical conductivity
- Electromagnetic or radio-frequency shielding
- Shock absorption
- Exposure to the extremes of the environment or chemicals

MODUS

FIP Material Selection

There is now a vast range of form-in-place materials available for gaskets. These can provide excellent shielding effectiveness, superior adhesion, heat and humidity resistance and reliability in low compression sets.

Conductive and non-conductive silicone and fluorosilicone compounds are resistant to heat, cold, moisture, UV, ozone, galvanic corrosion and pressure. Add electrically conductive filler—such as silver, copper, nickel, aluminum, ferrite and graphite particles—and you now have an excellent seal for EMI/RFI shielding.

NON-CONDUCTIVE SILICONE FIP GASKETS

- **Low closure force requirements**
- **Provides environmental sealing**
- **Resists corrosion and tolerates extremes of moisture, UV, and ozone**

CONDUCTIVE SILICONE EMI GASKETS

- **Include silicone compounds with conductive fillers such as silver, copper, and nickel-graphite**
- **Combine limited environmental protection with EMI shielding properties.**

INGRESS PROTECTION (IP) GASKETS

- **Secure sealing against harsh environmental elements such as water, dust, and gas**

MODUS

The Importance of Tolerances

Tolerances are critical to any good design. With FIP, height is probably the most important physical tolerance specification as it determines the gasket width. A valuable benefit of form-in-place gaskets comes down to manufacturing. FIP gaskets can be made with the thinnest possible bead within the very smallest cross-sections.

Unlike traditional compression gaskets and O-rings, which are pre-formed to design specifications, the Trishield® dispensed EMC technology is actually formed into a triangular shape. The bead height is normally between 0,5 to 2,0 mm and the point-to-point contact provides exceptional shielding effectiveness with reduced compression force.

The triangle shape of Trishield®, combined with the smaller form factor, means designers can pack more features into the same size package. Using an EMI FIP shielding gasket requires less closure force and can provide more than 5% space on the printed circuit board (PCB).

Why Choose Form-In-Place For Your Project?

Form-in-place gasket manufacturing lends itself to quick-turn prototyping, high volume production of complex parts, and vertical integration. FIP is ideal for both intricate and small compartmentalized shielding. Automation provides short lead times, fast adjustments, and the ability to quickly and continually verify quality. Automation also reduces labor and material costs.

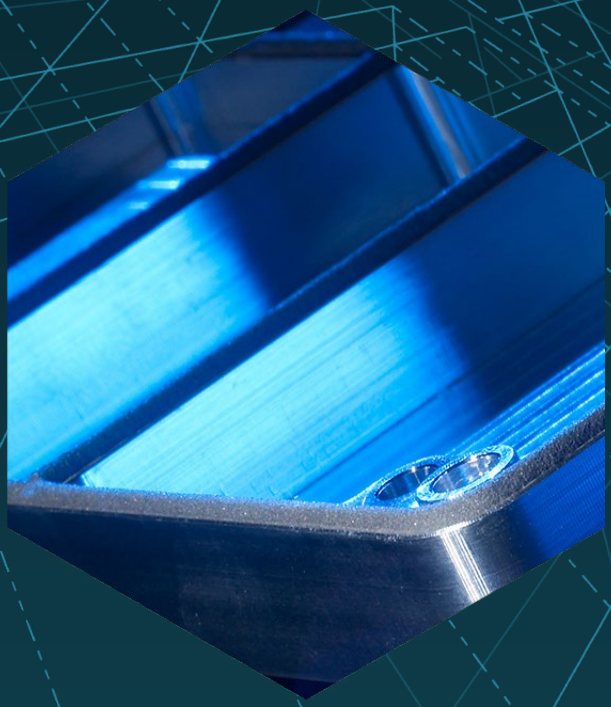
Mold-free robotic dispensing increases precision and provides extensive design versatility. Combined with the vast variety of available FIP materials, form-in-place is a smart and solid choice for effective environmental, EMI or RF shielding.

MODUS

FIP v. Traditional Gaskets: Cost

- Dispensed FIP gaskets offer a low total cost of ownership.
- Half of the material usage of traditional gaskets
- Shorter production time 40% fewer fasteners needed
- 80% lower compression force
- Possibility to increase tolerances
- Shortened supply chain
- No gasket inventory to maintain
- No assembly required
- No repackaging or reshipment needed
- No damage due to excess handling

Nolato: Custom and precision dispensed gaskets: **https://www.nolato.com/en/new-emis-tart/form-in-place**



MODUS

Extruded gaskets - Compashield®

Compashield® Extrusion is Nolato's brand for extruded EMI shielding gaskets. The extrusion process string injects electrically-conductive silicone rubber into the desired shape along with the cross-section to meet your design specifications. The cross-section can be rectangular, solid or hollow and made in various shapes, dimensions and lengths.

Thanks to Nolato, designers no longer need to choose between an environmental seal or an EMI shielding gasket. Nolato merged both gasket types into a single product.

Compashield® Extrusion features a thin, electrically conductive shield co-extruded on a high-performance silicone rubber base. These string-injected gaskets can be formed from Ni/C, Ag/Al, Ag/Cu or Ag/Glass material, which exhibits excellent electrical conductivity combined with ideal mechanical properties.

There are a range of standard or semi-standard profiles available; solid O, hollow O, D, P, E, U, solid square, and hollow square which are ideal for flange and groove applications.

In some cases, custom or unique shapes can be created, which could also include innovative anti-stretch and press-fit features. After extrusion and curing, the gaskets may be cut and spliced to your exact specifications creating full EMI shielding enclosure seals. The bonds are spliced using a Nolato press, but the extrusions can also be cold bonded or glued if needed.

The biggest benefit of using an extrusion is the efficient use of expensive shielding materials. EMI shielding extrusions can be made with a thin outer layer of conductive silicone, thereby significantly reducing the volume of silver or nickel graphite.

Compashield® 2.0 Compashield 2.0 is designed for 5G frequencies and will meet future shielding demands. Natural changes (aging), impair shielding effectiveness on many gaskets.

Compashield 2.0 provides continued low resistance both new as well as after aging.

- **Lower compression force >20%**
- **Better compression set >30%**
- **Twice the tensile strength**
- **Electrical resistance improved by 50%**

Nolato: New Compashield® 2.0 - Lower compression and better recovery: **https://www.nolato.com/en/new-emi-start/new-refined-compashield-with-lower-compression-force**

MODUS

Compashield® Extrusion EE

Compashield® EE gaskets provide both excellent EMI shielding performance and environmental sealing function in flange-and-groove mounting applications. These gaskets have become a standard for customers who are concerned about saving space.

Compashield® Press-Fit

Compashield® Press-fit is the latest addition to the Nolato Compashield® brand. The Pressfit solution eliminates the extra cost for adhesive and makes mounting and dismounting much easier if needed.

- **Combination of excellent shielding effect and environmental sealing**
- **Space-saving**
- **Optimized conductive/non-conductive material combination**
- **Low compression set**
- **Low compression force**
- **30 dB better shielding effectiveness than the standard EE profile**
- **10 - 20% cost savings on backside tape**
- **30% quicker assembly**

MODUS

Compashield® Ultra-Soft

Nolato offers a modified version of its standard Ni/C hollow-O gasket: Compashield® Soft. It is co-extruded with a conductive material as the outer layer and non-conductive material as the inner layer. It has less compression set and less compression force than standard Ni/C gaskets.

- **Minimized compression force**
- **Durable in sharp corners**
- **Excellent EMI shielding performance**

Compashield® Anti-Stretch

The anti-stretch design with embedded thread reinforcement, in metal, prevents both stretching and shrinking. In this way, the length of the gasket is fixed, which makes high precision assembly easy for the operators, and therefore secures an unsurpassed sealing effect. It is available for both EMI or environmental shielding, or both.

- **Fast assembly with 100% precision in length**
- **100% secured sealing**
- **Higher output due to lower risk for assembly mistakes**
- **Possible to form a gasket with the metal thread**

MODUS

Compashield® Materials

These EMI shielding or electrically conductive silicone rubber extruded materials are an effective and reliable environmental seal, which will show minimal to no deterioration of conductivity and shielding over time. Silicone rubber can easily withstand heat, cold, moisture, UV, ozone and pressure over an extended period.

COMPOUNDS INCLUDE:

- **Silicone • Silver / Copper • Nickel / Carbon**
- **Nickel / Graphite • Silver / Aluminum**
- **Pad interface materials - Compatherm®**

MODUS

What is Thermal Management?

All electronic devices and circuitry encounter resistance and mechanical friction, which generates excess heat. This heat must somehow be controlled with thermal management systems. These are designed to provide electronic cooling solutions.

The greater the electrical power running through these devices and circuits, the greater the heat generated. Thermal Interface Materials (TIMs) are designed to sufficiently, efficiently and effectively dissipate this heat to improve reliability and prevent premature failure.

A thermally conductive gap filler or compound, Compatherm® is specially designed for cooling electronics through thermal dissipation to transfer heat from hot components on a printed circuit board (PCB) to a heat sink. These materials are specifically designed to effectively fill small air gaps and microscopic irregularities to lower thermal resistance and provide crucially important cooling.

The idea of using a TIM is to displace the air in the gaps and irregularities with two or three orders of magnitude higher thermal conductivity. There are two different TIM gap-filling applications:

- **Thin bondline: when surfaces are pressed directly against one another.**
- **Thick bondline: where a mechanical hard stop keeps the surfaces in place.**

The typical thin bondline ranges around 10-200µm and thick bondline ranges around .02-5mm.

MODUS

Benefits of Compatherm®

- Certified thermal conductivity
- Ultra softness for low compression forces
- High conformability, fits well on protruded and recessed areas
- Easy handling due to excellent mechanical properties
- Customized materials available

Benefits of Compatherm® Pad

- Excellent thermal properties
- Ultra softness for low compression forces
- High conformability, fits well on protruded and recessed areas
- Wide range of standard materials
  Customized materials available

The Benefits of Compatherm® FIP

- Excellent thermal properties
- Available as both one and two-component compounds
- Ultra Conforming
- Excellent wetting
- Ideal for filling variable gaps between multiple components and a common heat sink
- Machine-Material integrated solution for dispensing available
- Customized materials available

MODUS

Selecting a Thermal Interface Material

Dispensed thermal paste; dispensed thermal pad; liquid gap filler; cut pads, etc.

With so many variables, picking a thermal interface material can be complex. When you add specific performance requirements, selecting the right thermal material can be even more challenging.

Material options provide a thermally conductive solution; effective shore hardness; and are often composed of a polymer as well as a coupling agent, function filler, and pigment that provides the TIM color.

- **Polymer - offers basic material and mechanical performance**
- **Coupling agent - offers better wetting**
- **Function filler - offers a specific function**
- **Filler - offers thermal conductivity**
- **Pigment - provides color to differentiate the product line**

Thermal Paste

Thin bondline materials may achieve their performance by wetting out the surfaces or allowing the surfaces to get very close to one another. The basic thin bondline TIM is the thermal paste or liquid gasket material which is wet and viscous in nature and can achieve a very thin bondline under pressure.

MODUS

Phase Change Material (PCM)

This thin bondline material typically comes as a dry, pre-cut pad that is placed on either the component or the heat sink and then placed under pressure when the surfaces are assembled together. During initial burn-in, when the heat source reaches its operating temperature for the first time, the TIM pad will be heated above its phase-change temperature and soften to a more viscous state - basically changing from a solid to a liquid phase.

Graphite Film

This thin bondline material accepts a higher contact resistance and slightly thicker bondline.

Gap Filling Pads

Thick bondline materials are designed to conduct the heat over a longer distance while still offering thermal resistance and withstand a significant degree of deflection. By being soft and compliant, gap-filling thermal pads deflect, flow and conform to surfaces very well. Pads come in a vast variety of material types with different conductivities, pressure/deflection responses, harnesses, tackinesses, electrical insulations, thicknesses, etc.

Dispensed Filler

This type of filler comes in a two-part cure-in-place filler and a one-part non-curing filler (known as gels). The two-part cure-in-place filler is dispensed in a liquid state but subsequently freezes upon curing to a precise fit. The one-part thermal gel fillers do not cure after dispensing but remain in a viscous state indefinitely.

Both are entirely viscous during assembly and can be deflected to their minimum thickness. This makes it possible to optimize the design for a much thinner bondline than with pads, even when tolerance spans are large.

Rubber Film

This material is a carrier membrane coated with a thermally conductive rubber compound. It is applied under direct pressure between the heat sink and heat source, just like the thin bond like materials but are thicker and do not wet surfaces. Rubber film flows slightly under pressure.

MODUS

Choose the Right Heat Transfer

Effective heat transfer is vital to creating efficient and reliable products. Although great gains are being made to reduce the amount of heat that is produced, there is still a need to transfer heat in order to increase longevity.

By choosing the correct Thermal Interface Material (TIM), reliability increases while failures decrease.

As you now know, choosing an effective EMI shielding or thermal interface solution is a daunting proposition. The vital factors for EMI/RF shielding and thermally conductive TIMs have been introduced and explained in this document, so you can begin selecting a solution that best fits your interference and heat transfer needs.

It is always a smart decision to reach out to the shielding/thermal experts to guide you through your design options. You can count on our many years of successfully solving EMI and thermal problems in our fast-changing manufacturing space.

Our engineers offer experience and expertise to help you through the labyrinth of materials and manufacturing combinations with the flexibility you need to succeed. You can count on us so your customers can count on you. Contact MODUS Advanced to learn more.

Engineering Problems Solved on the Spot.

REQUEST A QUOTE TODAY.

MODUS