# What You Should Know Before Making the EMI Gasketing Decision

**Many hidden costs often go unrecognized until it's too late.**

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Are you aware of *all* your EMI and RFI shielding options? Most engineers recognize the array of choices, but their *usable* choices are often limited by planned production volume. For designs requiring shielding in the form of gasketing, a new option is available: contract gasketing. Contract gasketing offers many cost and quality advantages over alternate methods of shielding. Armed with good information, the best design and production options can be chosen by both the designer and the manager.

We'll answer several questions:

- *What is Form-In-Place Gasketing (FIPG)?*
- *How has FIPG evolved?*
- *What is Contract Gasketing?*
- *What are the advantages of FIPG?*
- *What should I know about shielding with FIPG?*
- *What should the designer and manager consider when deciding between contract gasketing and buying capital equipment?*

**Common shielding choices**
Various forms of traditional shielding are still common. They include die cut gaskets, extruded gaskets, fingerstock, shielding cans, wire mesh, "peel-and-stick", conductive coatings, and others. A newer shielding method used in recent years is automated dispensing. The automated application of viscous one- and two-part materials is known as Form-In-Place Gasketing and is becoming increasingly popular for shielding and many other assembly operations.

**What is Form-In-Place Gasketing?**
FIPG is the liquid application of gasketing material onto a substrate via programmable automation (see example in figure 1). The process is highly accurate (often to 0.001 inch, 0.025 mm), fast, and repeatable. The liquid material, usually a one- or two-part silicone, is typically supplied in one or more parts, and can be precisely metered and mixed. Once applied, the FIPG is cured in ovens or at room temperature, depending on the chosen material and other design factors.

*Figure 1. EMI FIPG on a pager substrate.*

FIPG materials are available for electrically and/or thermally conductive applications. Material manufacturers

market a wide variety of standard materials, and some manufacturers offer custom formulation.

FIPG usage in shielding applications has recently accelerated due to several key benefits:

- Automation can greatly reduce the costs of manual labor
- Total manufacturing costs are lower
- The process of FIPG allows for more precise gasketing
- Reduced costs combined with increased quality yield greater value added
- Automating the gasketing process allows for simplified quality control and data collection procedures
- FIPG can be used with product designs that are not workable with other gasketing methods
- Product size and weight can be reduced using FIPG

**How has FIPG evolved?**

Historically, the most common uses of FIPG were to prevent the passage of dust, moisture, and fluids. Early adopters were primarily in the automotive industry and have since included applications in a wide variety of industries. FIPG was mainly used as a cost-reducing alternative to die cut, extruded, and manually dispensed gaskets.

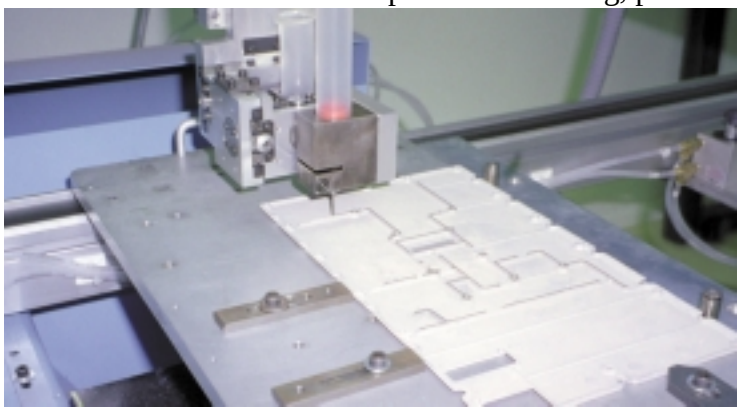

*Figure 2. FIPG is ideal for a variety of applications.*

Applications requiring controlled EMI and RFI emissions are increasingly common. Designers today require the attributes of shock absorption and environmental sealing as well as uniform conductivity. FIPG satisfies all these requirements in the production of high quality electronic products.

Form-In-Place shielding gaskets can be found in many electronic products such as cell phones, pagers, and many other enclosures and housings. New EMI and RFI shielding applications are emerging constantly as the electronics and wireless industries grow. And momentum is building towards the transition to Form-In-Place Gasketing as EMI and RFI regulatory standards become increasingly stringent, and as competitive pressures mount to lower the cost of manufacturing.

**What is Contract Gasketing?**

Contract Gasketing is the application of FIPG without the capital expense of equipment (figure 2). In a high volume production setting, purchasing equipment is often the best choice. However, FIPG is frequently ruled out by some designers and managers due to lower or uncertain production volumes, or because of a long ramp-up time.

Contract gasketing is performed at the contractor's facility with the use of the contractor's dispensing equipment for a specified fee, usually on a per part basis.

So the designer and manager can get all the competitive cost and quality benefits of FIPG without the expense and time associated with the purchase of capital equipment. Gasketing can be done for runs ranging from production-quality rapid prototyping to high-volume continuous production.

**What are the advantages of FIPG?**
Before the choice between equipment and contract gasketing can be made, several advantages and properties of FIPG should be acknowledged.

*Cost savings and quality improvement*
Compared to manual placement of die cut and extruded gaskets, there are significant manufacturing savings in manual labor, inventory for gaskets, production time, and reject rates. Additionally, when a product change necessitates a new gasket design, there are no tooling costs associated with FIPG. It's important to identify the true cost savings of switching to FIPG. Careful assessment of the aforementioned benefits with respect to your particular situation will help identify your true cost savings and resulting productivity gains in other subsequent operations. Ultimately, the automated FIPG process leads to improved and more consistent product quality.

*Advanced and flexible product design*
Product designs can be made smaller and lighter. Accurate manual gasket placement may be very difficult or impossible with small parts and gaskets. Part flange size can be reduced to as little as 0.025 inch (0.64 mm) or smaller when using automated FIPG dispensing, yielding smaller product sizes. Canned shielding can be replaced by FIPG to produce lighter parts and increase board space.

Another point for the designer to consider is that FIPG may be stacked (one bead of gasket material dispensed on top of another) to achieve various profiles. A bead may have a smaller cross section than the one it is stacked upon, thus affording the designer considerable flexibility in gasket profiles.

*All-in-one solution*
FIPG provides environmental sealing properties as well as shock absorption properties. With the added property of EMI or RFI shielding, FIPG provides one of the best solutions for assembling a high quality product at minimized cost.

*Versatility with use on imperfect parts*
Robotic programming permits the adjustment of dispensing heights and widths to compensate for surface imperfections and warpage. This is especially helpful with plastic parts, where dimensional instability can be common.

*Fast change over*
Automated dispensing provides quick change over for new parts or prototypes. FIPG cuts new prototyping time from weeks to hours.

**What should I know about shielding with FIPG?**
Shielding requirements vary based on the application. Below are some questions and answers about FIPG materials for shielding.

*What is the desired shielding effectiveness?*

Shielding effectiveness of FIPG materials on the market typically provide 75 dB or greater attenuation between 20 MHz and 10 GHz depending on the conductive filler. Impressive, considering that these values are

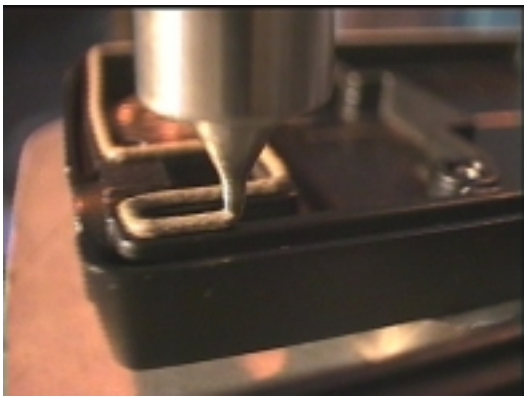

*Figure 3. The gasket texture will appear somewhat coarse compared to a pure silicone gasket, caused by the conductive particulate within the silicone elastomer.*

achieved with very small FIPG cross sections, often less than 0.04 inch wide (1.0 mm). Encapsulated in silicone, the fillers available include silver, silver-plated copper, silver-plated aluminum, silver-plated glass, silver-plated nickel, nickel graphite, carbon and aluminum (figure 3).

Figure 4 shows the range of attenuation values for silver-filled silicones. At lower frequencies, the values are smaller because the conductive particles are separated in the silicone elastomer. Under compression, as shown at the higher frequencies, the imbedded particles make contact and effect higher attenuation values.

The electrical conductivity of FIPG is based on a number of variables:

- Conductivity of the base elastomer.
- Conductivity of the metal filler and plating.
- Percent loading of the filler.
- Particle size of the filler
- Distribution of the filler.

*What is the desired compression/deflection percentage?*
EMI shielded gaskets should be compounded to provide the lowest force necessary to achieve closure while ensuring sealing and conductivity.

The term compression set is the amount, measured in percentage, by which a standard rubber test piece fails to return to its original thickness after subjected to a standard compression load or deflection for a fixed period of time. So look for more resilient materials to have a lower compression set.

It should be noted that due to the loading of precious metals to the silicone elastomer, as much as 60%, the force to compress an EMI shielded gasket will always be higher than a pure elastomeric

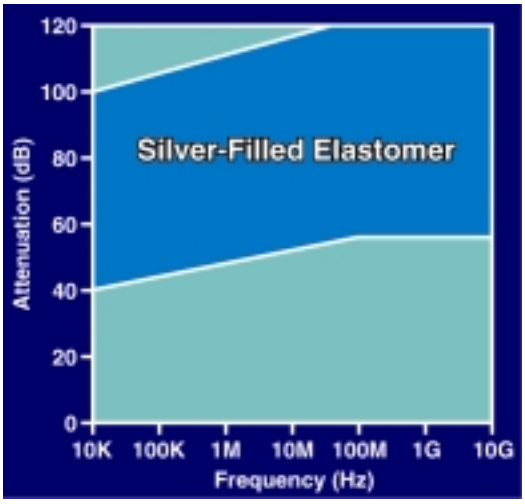


*Figure 4. Qualitative shielding effectiveness of a typical silver-filled silicone gasket after curing.*

gasket. Typical compression/deflection rates range from 3.5% to 40%.

With the recent introduction of sponge FIPG material, lower closure rates are available. Sponge gaskets also compensate for uneveness and warpage of the substrate.

*Does the substrate require preparation for gasketing?*
FIPG is designed to adhere to the surface on which it is dispensed. Excellent adhesions are achieved on a wide variety of substrates, including die-cast aluminum and magnesium, stainless steel, plated plastics, and many others. Many conductive and other coatings also accept EMI shielding gasket materials quite well. The substrate should, however, be wiped clean with a lint free cloth to remove any residual oils from the manufacturing process. The parts should be handled with care to ensure that no skin oils come in contact with the gasketing surface.

*Figure 5. A turnkey system for dispensing and curing FIPG. A high quality flexible automated system will be fully programmable in three axes.*

It is important to remember that the deformation of the mating surfaces must be considered since this will determine the bead height of the gasket. The dispensing robot can be programmed to compensate for consistent deformations in the substrate. If the surfaces are inconsistent in their deformations, sponge FIPG should be considered. Sponge gaskets will fill the voids encountered between uneven mating surfaces.

**Contract Gasketing or Capital Equipment: How Do I Decide?**
Should you buy equipment or contract out the gasketing function? The answer may be obvious for some, but murky for other situations. For the not-so-obvious situations, consider the following.

Not all dispensing equipment can provide the same utility (see figure 5). Small off-the-shelf systems come with limitations of flexibility, performance, and capacity. Some dispensing industry players specialize in pumps, dispensing guns and valves, or "one-size-fits-all" systems with minimal support. Vendors of these types of equipment can provide good solutions, but with certain limitations. Dispensing equipment manufacturers that provide total solutions can help optimize the entire manufacturing process with respect to EMI or RFI shielded gasketing. A "total" solution should address all the costs connected with the gasketing process. Costs can include a spare parts inventory, operator and maintenance personnel costs, utilities, etc.

If your situation doesn't yield an obvious choice between contracting and purchasing, carefully consider all the intangibles and indirect costs. Often in these cases, contract gasketing can be most economical once the hidden costs have been uncovered. Talk with people that have used either or both options. Talk with specialists that understand the issues particular to dispensing because

they can help you identify costs and relative savings.

Whichever choice is made, the dispensing equipment should:

- provide high repeatability for part-to-part consistency
- be modular in design for part or process modifications
- be made by a reputable and knowledgeable manufacturer with expertise in the specialty of gasket dispensing

**Summary**

Shielded FIPG can satisfy several design requirements, often with the optimum results in cost and quality. As compared with other manual gasket placement methods, reject rates can be substantially reduced. Armed with the advanced choices of purchasing capital equipment or contracting the FIPG process, the designer and the manager can cost-effectively produce the highest quality shielded gaskets for the lowest cost. Contract gasketing is a very attractive shielded gasket alternative because of its high quality and many other benefits. Most manufacturers find that contract gasketing is most attractive for situations involving one or more rounds of prototyping with a gradual ramp up to high volume production.

When considering FIPG, whether contract gasketing or buying equipment, it's very important to assess *all the costs* involved in your current process. Evaluate your specific application relative to the many issues identified in this article. Specialists in the dispensing process should be able to provide good insight into the costs and gains associated with your application. Properly calculated, many of the costs that are difficult to ascertain will clearly show FIPG to be the most cost-effective shielded gasketing solution.