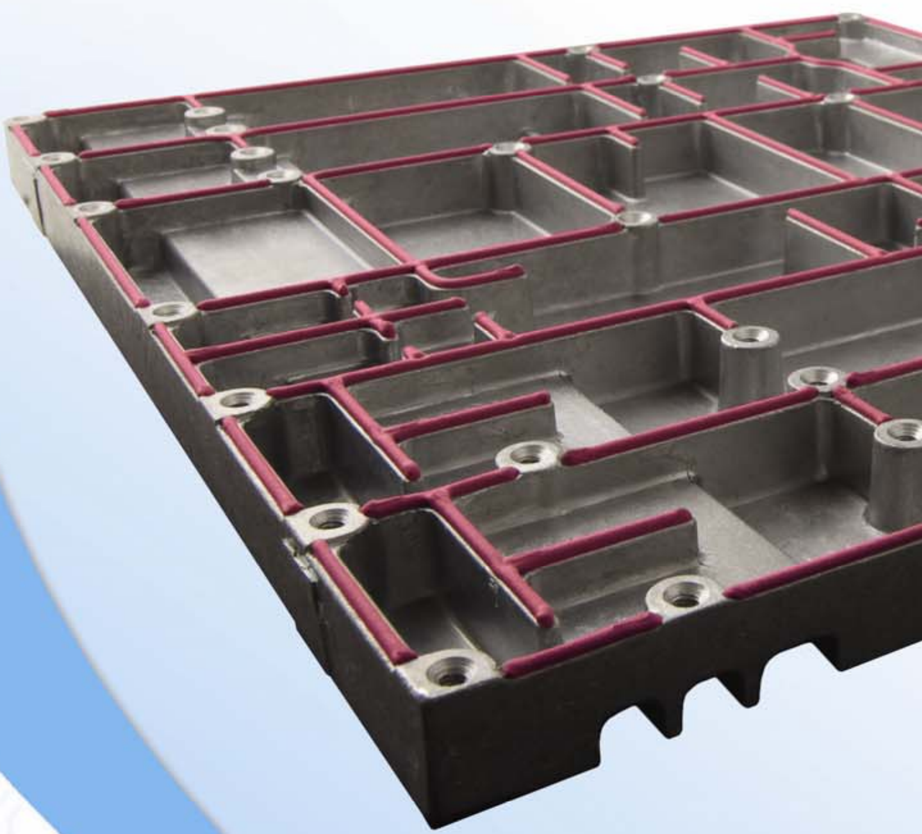
Form-in-Place EMI Gasket

APPLICATION GUIDE



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Overview

Form-in-place gaskets for EMC applications are among the highest performance EMI shielding materials. Typical applications consist of dispensing FIP beads onto conductive injection molded plastic parts, or a machined or cast metal part (Figure 1). The performance and reliability of the gasket is impacted by several material and process dependent variables. The purpose of this guide is to help electromechanical design, manufacturing process, and reliability engineers understand and control these variables for optimal performance from receipt of FIP material through the device's lifetime.

Figure 1: A typical machined aluminum chassis prior to FIP dispense

Form-in-Place Gasket Material Selection

There are two major decisions for selecting the type of FIP paste:

1. The type of conductive filler used in the FIP paste.

2. The cure mechanism for the polymer resin used in the FIP paste.

Conductive Fillers

The conductive filler contributes to the overall initial performance and the overall reliability of the device. Laird Technologies uses metal coated powder fillers. Table 1 indicates the electrical performance characteristics of different fillers. (Table) is a relative guide for galvanic compatibility with the chassis or enclosure.

Conductive filler	Filler type	Shielding requirement	Comments
SNL	Silver-Aluminum	>90 dB	High shielding performance, good EMP resistance, Aluminum offers improved corrosion resistance over Copper
SNK	Silver-Copper	>100 dB	Highest EMI performance in most application. Filler size allows for the smallest bead cross section dimensions.
SNC	Nickel-Graphite	>100 dB	Good performance , corrosion resistance
SNN	Silver-Nickel	>95 dB	High performance

Table 1: Electrical Performance of Conductive Fillers

Polymer Resin

Laird Technologies has two basic types of one-part silicone polymer resins used in FIP pastes.

1. **HXP-type** polymers are thermal cure silicone resins.
   They require an oven to cure the paste into a finished gasket.

2. **RXP-type** polymers are moisture cure silicone resins.
   They require controlled room-temperature and humidity for proper cure and optimal performance.

Paste Manufacture, Shelf Life, Shipping and Handling Recommendations

FIP paste is manufactured from single part reactive Silicone resins, conductive particle fillers, and additives to promote adhesion, dispense performance, reliability, and other properties. Laird Technologies guarantees the shelf life of the paste from the date of manufacture, and guarantees the product is shipped with 50% of the shelf life remaining. Laird Technologies recommends the material is purchased for current use and shipment by priority air freight. Users should consult the Material Safety Data Sheet for up-to-date information on safety and handling. FIP paste should be stored in a constant temperature freezer (this type of freezer does not go through a de-frost cycle) after it is received and prior to use. FIP paste is supplied in 300cc and 55cc cartridges. The cartridges and syringes come individually packaged in a moisture barrier sealed bag. FIP paste should be stored in this bag until use. We recommend using all of a single cartridge within a single shift.

Prepare FIP Paste for Dispense

Remove the FIP paste from the constant temperature freezer and bring the FIP paste to room temperature (about 70°F, 20°C) before opening the packaging. Attach the barrel end adaptor and proper dispense tips (table) to the FIP cartridge. Load the cartridge into the dispense robot. Minimum recommended time for a 55cc syringe is 30 minutes. Minimum recommended time for a 300cc cartridge is one hour.

Prepare Chassis for Dispense

Ensure the chassis is clean and free of residue and oils often left from previous processing steps. A solvent such as isopropanol or propyl-propanol, ethyl acetate, acetone or water wash can be used depending on your chassis material, or coating material, and expected type of residue. Dry the chassis completely. Load the chassis onto the robot stage or table. A fixture should be used to hold the dispensing surface of the chassis level to the stage or table top.

Bead Dimensions and Recommended Dispense Parameters

The aspect ratio of the FIP bead varies with the desired height and the FIP paste material selected. 0.80 is the maximum recommended bead height for a typical 1.0mm bead. As the bead height increases, the recommended maximum aspect ratio will decrease. Higher aspect ratio beads and triangle shaped beads are possible when a 4 axis dispense machine is used with a triangle shaped dispense tip. Specific parameters that affect bead dimensions and FIP materials performance are discussed below.

Operating Pressure

The amount of pressure used to dispense a bead out of a syringe or cartridge is one of the main factors that determine the dimension of the bead. A more viscous material requires more pressure to eject a bead from a syringe or cartridge, and to yield a bead with the same dimensions as a less viscous paste. Different batches of paste often possess slightly varying viscosities, and so require varying ejection pressure. Initial recommended operating pressure if 5 bar (74 psi). It is therefore important to adjust the pressure accordingly to produce FIP gaskets with the desired dimensions. Excessively high pressure makes it difficult to maintain a uniform geometry bead.

Dispense Speed

The speed at which a paste is dispensed is another parameter that greatly affects the dimensions of an FIP bead. A decrease in speed results in an increase in bead dimensions, as the material is given more time to deposit on the fixture. A typical Laird FIP paste is run at speed of 15 to 25 mm per second but can be adjusted to higher speeds when running a less viscous material. A typical Laird Technologies' FIP paste dispensed at a speed of 15 to 25mm per second, however, higher speeds may be obtained using other dispensing tips.

Diameter of the needle

Although the diameter of a needle has less bearing on bead dimensions than operating speed or pressure (as you can produce a wide range of bead dimensions with a single needle), it is still important to choose a needle of the right size in order to better control the aspect ratio. Most needle manufactures specify the dimension of bead achievable with a particular needle size. Choose the size closest to your desired bead dimension.

Distance of the tip of needle from the fixture

If the tip is too close to the fixture, it flattens the top of the bead resulting a larger width and smaller height. If the tip is too high, the bead becomes wavy and fails to follow the path along sharp corners and edges. The best position for the tip is just above (around 0.1 to 0.2 mm higher than) the height of the bead being dispensed.

Length of the needle tip

The length of the needle affects the amount of pressure required to dispense a bead of certain dimensions. Shorter tips (usually 0.25 to 0.50 inch) are more commonly used since longer tips require higher running pressures for the same quality of bead produced by shorter ones. Nevertheless, it is sometimes necessary to use longer needles for certain applications, such as when the gasket needs to be dispensed in a groove or when the path is close to a lip on the fixture.

Needle geometry and design

The choice of needle design or geometry depends on the customers' application. The most commonly used needle type is a straight, stainless steel tip which is difficult to bend, and therefore has lesser chance of producing misaligned gasket beads. For pastes with medium to high viscosity, a tapered needle can be used as it allows the bead to be dispensed at a much lower pressure. Other designs are angled stainless steel and flexible polypropylene that are best suited for hard-to-reach areas and corners of the chassis.

Volume of paste in the syringe

When dispensing large volume of paste, it is common to experience a change in volume flow of the material during the dispense cycle. As product is dispensed from the cartridge or syringe the volume of air behind the plunger increases. This results in a declining FIP material flow rate through the needle. This leads to a smaller material pressure at the needle resulting to smaller beads. It is therefore necessary to adjust the pressure accordingly. Mechanical dispense systems overcome the short coming of pressurized systems, but are much more expensive.

Recommended Cure Parameters

There are two types of FIP cure materials RXP and HXP types. RXP paste is cured from the moisture in the air. RXP paste requires a climate controlled facility. HXP paste requires an oven to apply heat. Improper cure of the materials will impact FIP bead shape, electrical and mechanical performance, and in-application reliability. Specific cure recommendations are given in table 3. A fan should not be used to 'air dry' the paste or cracking during cure will occur. Temperature and Humidity are important parameters that impact the performance of the final FIP component. Temperature and humidity during dispense and cure should be recorded as part of QA procedures to ensure repeatable and reliable FIP performance.

Paste type	Suggested temperature	Recommended Humidity	Time	Comments
RXP - Moisture cure	15-40°C	50% RH	1hr handling, 24 hr complete cure	higher humidity or higher temperature may accelerate cure. Lower temperature and lower humidity may prevent cure.
HXP Heat Cure	120°C minimum	Various	1.5 hr	Cure temperature should be kept below 160°C. Need to ensure the entire chassis reaches the minimum temperature for 1.5 hr. Oven capability, chassis dimensions and loading impact the heat capacity of the system and the temperature profile during cure.

Table 3: Recommended cure conditions for RXP and HXP type paste