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BONDING & SEALING

SOLUTIONS FOR EV BATTERY ASSEMBLY

*D*omo3

A STRONG BOND WITH E-MOBILITY



The world of transportation is changing rapidly. Electrification represents the largest change in transportation since the invention of the internal combustion engine.

At the heart of electrification is the Lithium-Ion Battery. Ongoing advancements in energy density, safety, and cost to produce are driving mass electrification of transportation. Adhesives, sealants, and Thermal Interface Materials (TIM) are all important components of electrification and are enabling exciting design breakthroughs. These applications require robust dispensing solutions.

As you scale from prototype to mass manufacturing you need a partner you can count on. Graco is a leader in automotive and battery dispensing equipment. Our experts have vast experience in some of the most challenging applications. Count on us to get it right the first time.

Bonding, sealing & thermal applications

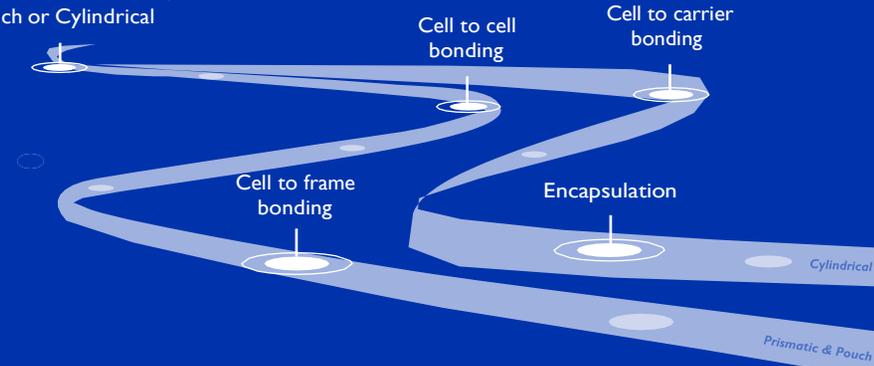
MODULE ASSEMBLY



Processes

- Preparation
- Stacking
- Electric contacting
- Electronics assembly
- Housing assembly
- End of line testing

Cell selection: Prismatic, Pouch or Cylindrical



PACK ASSEMBLY



Processes

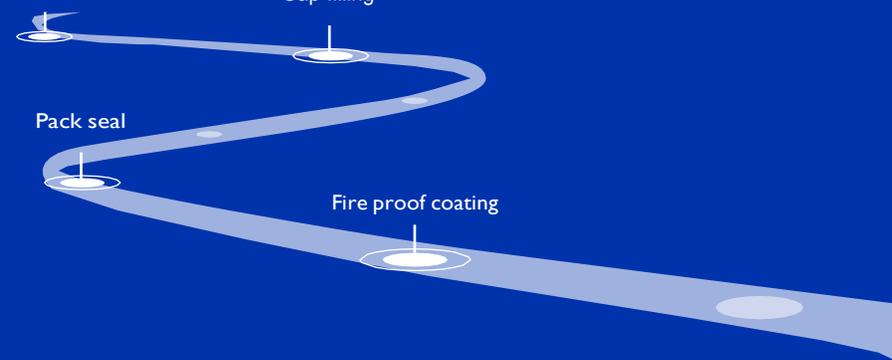
- Pre-assembly
- Module insertion
- Electric integration
- Cover assembly
- End of line testing

Structural bonding

Gap filling

Pack seal

Fire proof coating



MODULE ASSEMBLY APPLICATIONS



The module assembly process depends on the cell format and the individual manufacturer designs. While pouch, prismatic, and cylindrical cell modules all have their unique design challenges, different sealing, bonding or TIM applications are used to provide strength, protection and efficient heat dissipation.

Preparation > **Stacking** > Electric contacting > Electronics assembly > Housing assembly > End of line testing

Cell to cell bonding

Inside prismatic or pouch module designs, cells are firmly bonded to each other to create cells stacks and to provide insulation and protection against vibration or movement.

Pouch cell lamination

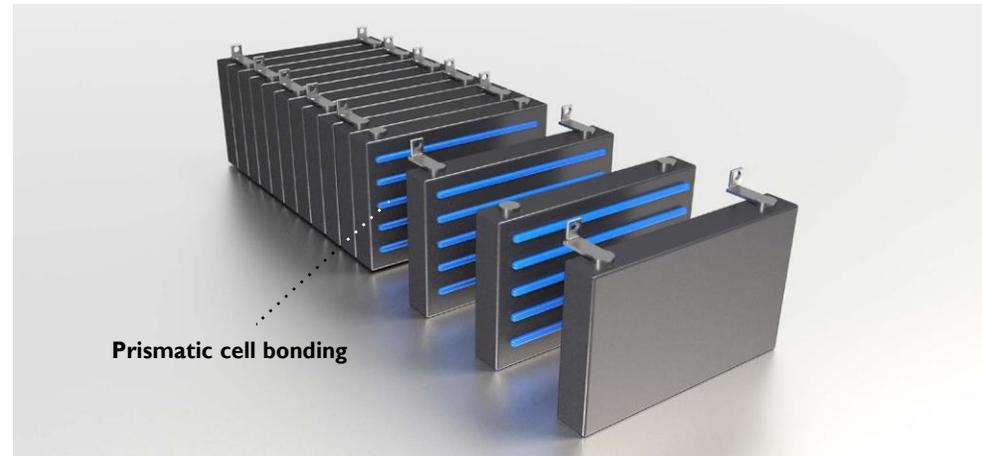
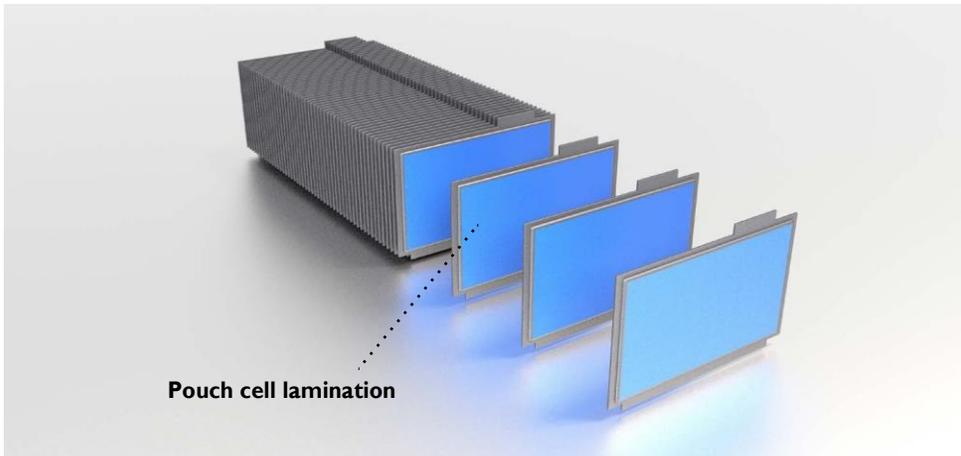
Hot melt pressure sensitive adhesives are commonly used in pouch cell lamination to bond layers together. In cases where thermal conductivity is required, a silicone or polyurethane material may be used. These applications often require a precise spray or swirl pattern.

> **Graco solutions:** [PR70](#), [EFR](#), [HFR](#), [PCF with Precision Swirl](#), [Therm-O-Flow](#), [Abrasive resistant pumps](#)

Prismatic cell bonding

Prismatic cells are bonded with 2-component urethanes or silicones which need to be light and flexible to allow the cells to expand during charging and discharging. To provide complete insulation and avoid short circuits, the application needs to be precise to avoid air gaps during the dispense.

> **Graco solutions:** [PD44](#), [PR-X](#), [PR70](#), [MD2-valve](#), [Abrasive resistant pumps](#)



Cell to frame bonding

In many cases, modules are enclosed in a lightweight polycarbonate or ABS enclosure that is sealed closed.

Cold plate bonding

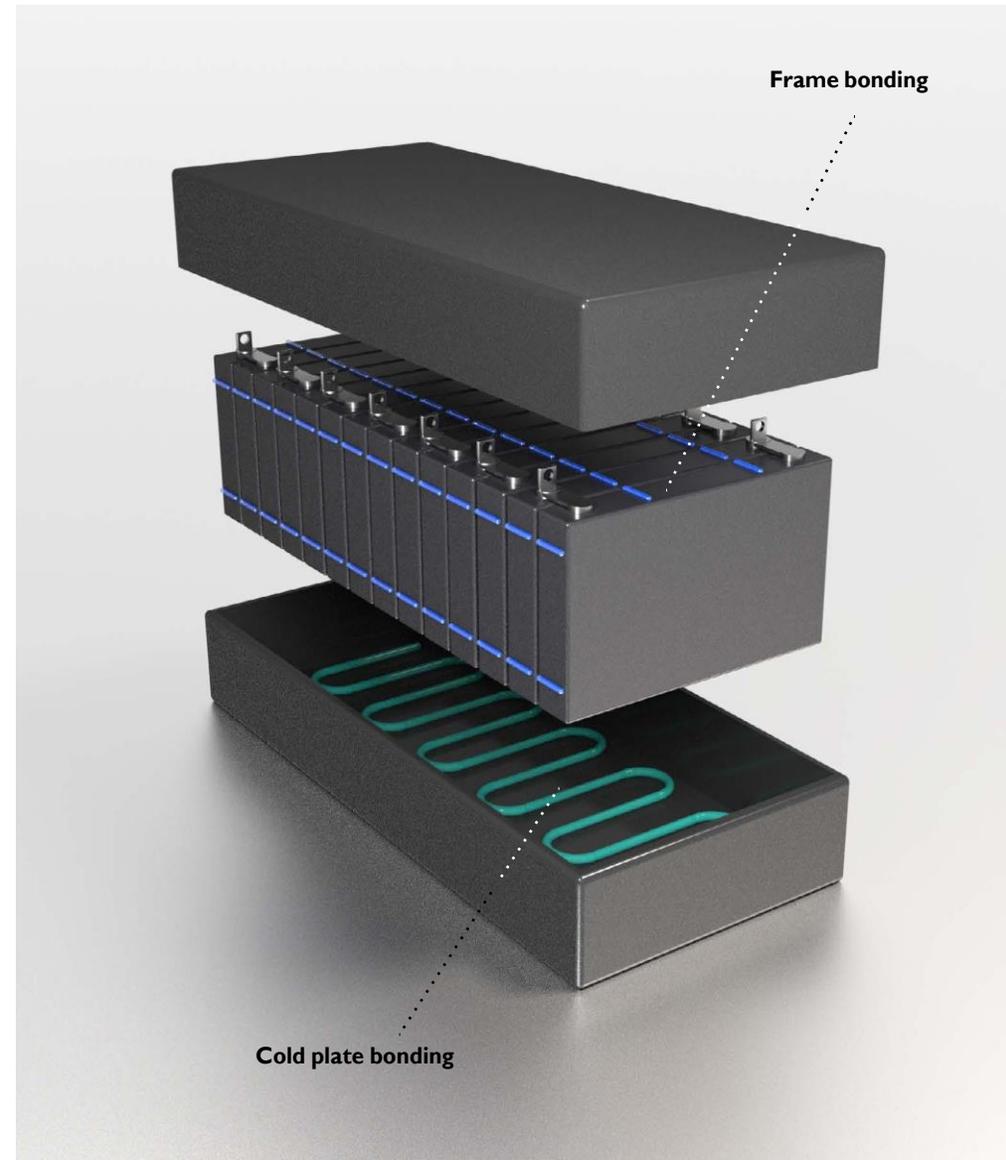
Cold plate bonding involves bonding cells or other electronic devices to a cooling plate. This generally involves a structural bond that provides good thermal conductivity and dielectric strength. These materials are often abrasive and require the right dispensing solution. Two component meter mix with precision control is of critical importance in these applications.

> **Graco solutions:** [PR70](#), [EFR](#), [Abrasive resistant pumps](#)

Frame bonding

Cells are bonded with the frames around them to protect against outside contaminants. The sealing surfaces are generally very small and require precise bead dispensing.

> **Graco solutions:** [PD44](#), [PR-X](#), [PR70](#), [MD-2 Valve](#), [Advanjet Valves](#), [PCF](#), [Dispensit](#), [Abrasive resistant pumps](#)



Cell to carrier bonding

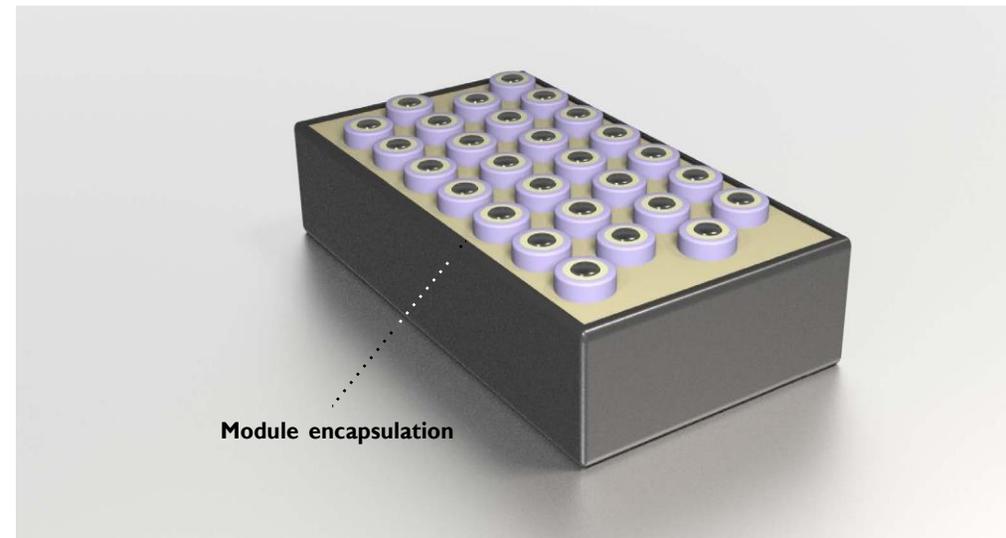
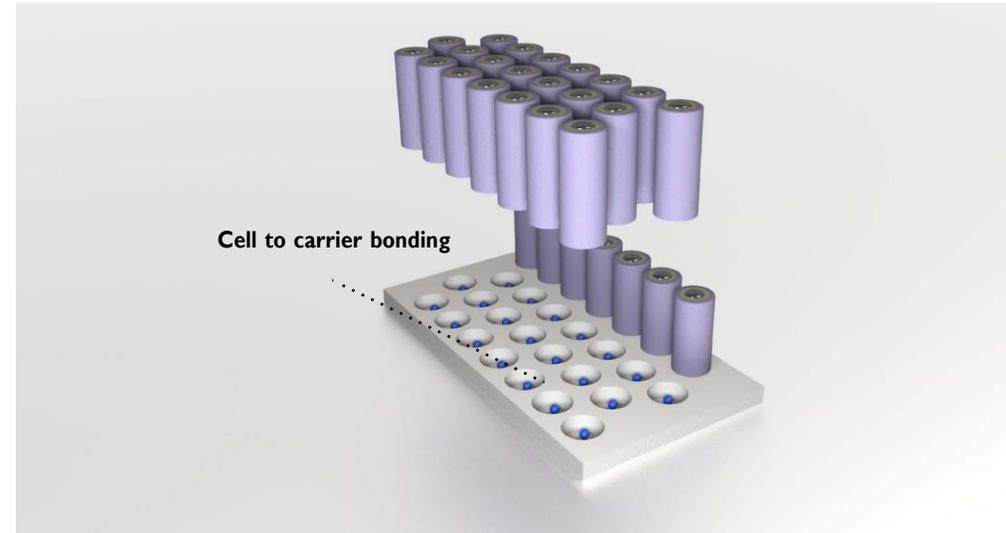
Cylindrical cells are often bonded to a polycarbonate carrier during module assembly. This holds the cells stationary through the tab welding process and provides structural integrity to the module. A variety of adhesive chemistries can be used in this application including UV and 2-component acrylics.

> **Graco solutions:** PD44, PR70, Dispensit, Advanjet Valves

Module encapsulation

Module encapsulation, often used in cylindrical cell modules, provides for increased shock and vibration performance and is used to help prevent thermal runaway / propagation events within the modules. These materials are generally 2-component polyurethanes, silicones or epoxies that have a foaming reaction to create a lightweight buffer between the cells. This challenging application requires the right equipment and expertise as ratio, flow and mixing energy are all critical variables.

> **Graco solutions:** PD44, PR70, PR-X, EFR, HFR, Progressive Cavity Pump, Voltex Dynamic Mix Valve, High-wear MD-2 Valve, Abrasive resistant supply pumps, UniXact



PACK ASSEMBLY APPLICATIONS



The assembly of battery packs includes applications to bond, fill, seal and coat. All of these applications contribute to guarantee strength, lightweight, proper heat management and protection against vibrations, shocks, water intrusion and outside contaminants.

Structural bonding

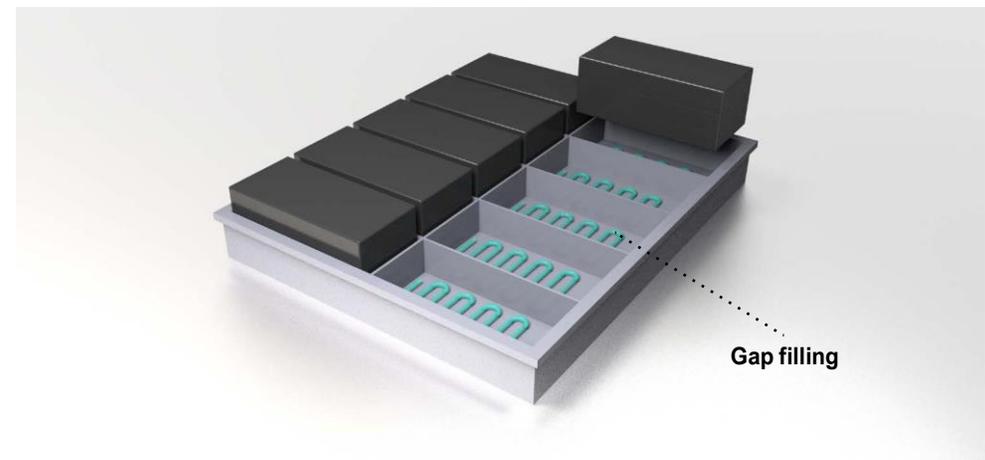
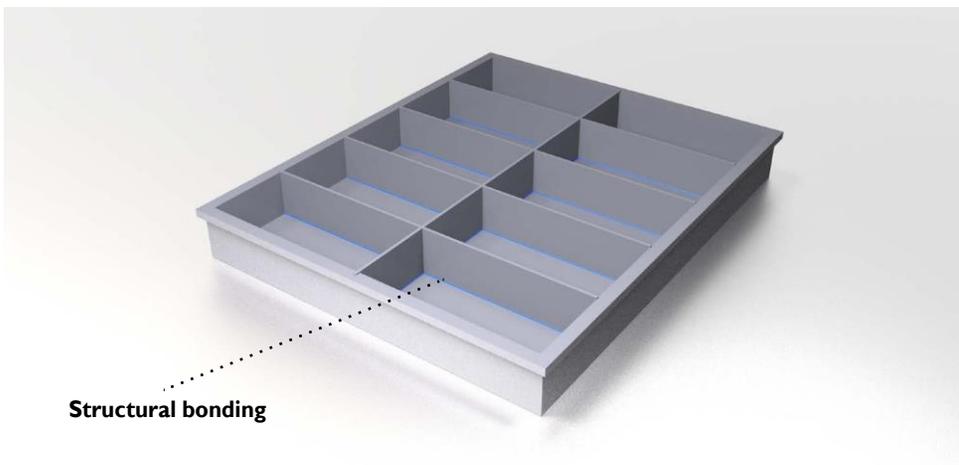
Structural bonding with 1K or 2K epoxies is done to bond aluminum or other materials within a battery pack. This not only contributes to the lightweight design but also offers extra strength and rigidity to the battery pack, which helps its crash-durability over the lifetime of the battery. Given the important nature of this application, the right equipment is a must.

> **Graco solutions:** PR70, EFR, HFR, PCF, High-wear MD-2 Valve, Abrasive resistant pumps

Gap filling

The performance of the battery is highly dependent on good thermal management. Thermal interface materials or gap fillers provide perfect thermal dissipation from the heated modules to the cooling circuits on the battery pack. These 1 and 2 component gap fillers are generally non-structural but are very viscous with highly abrasive fillers which contain ideal heat conducting characteristics. The application often requires high flow dispensing with robust pumping, precise metering and dispensing, where air gaps must be avoided for an optimal heat transfer. This application has many challenges and requires the right equipment that is made of abrasive resistant components to correctly handle these gap filler materials.

> **Graco solutions:** EFR, HFR, High-wear/high-flow MD-2 Valve, Abrasive resistant pumps



Pack seal

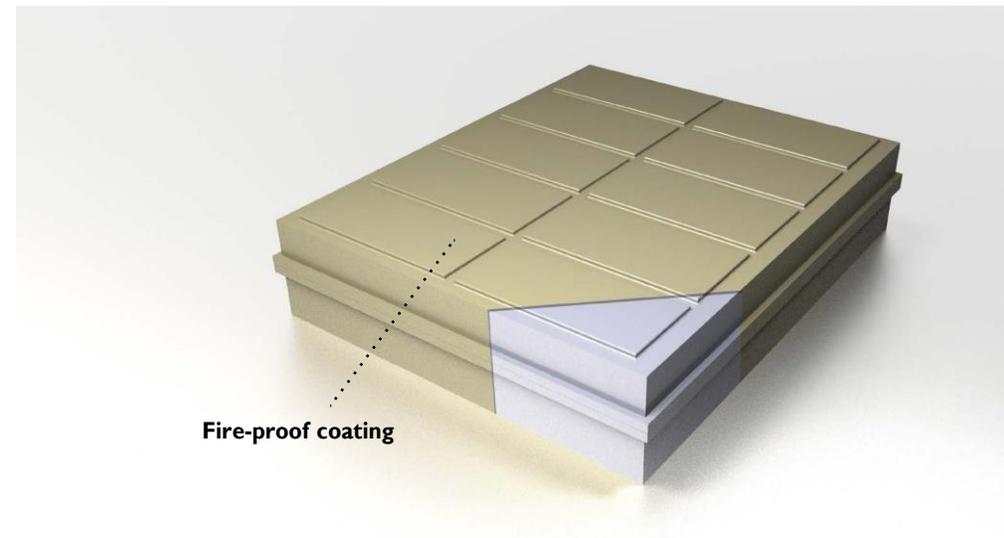
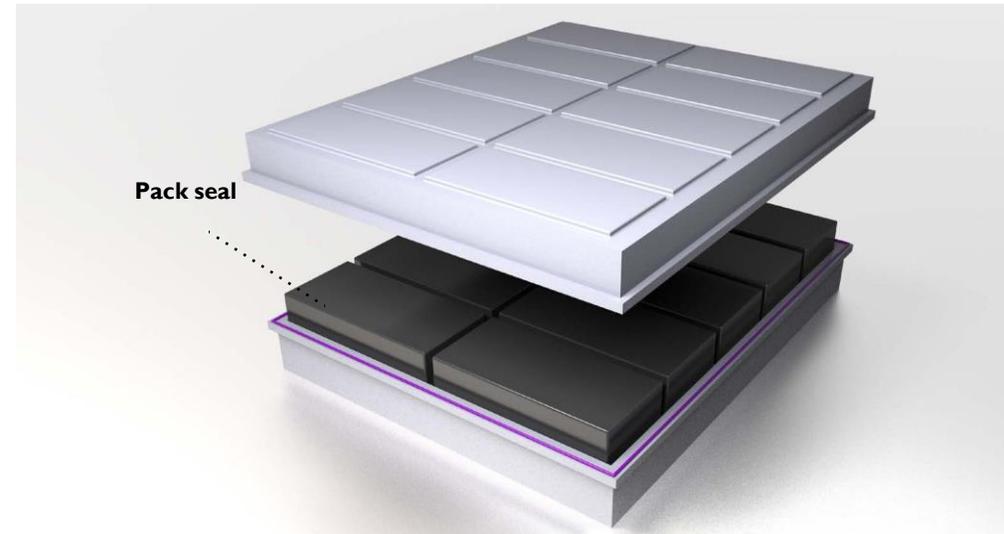
The pack seal is critical to the longevity and safety of a battery pack. The seals are often designed to an IP68 standard, which means that the seal will protect against water intrusions as well as outside contaminants. A variety of sealants can be used and fall into two categories- cure in place gaskets (CIPG) and form in place gaskets (FIPG). CIPG gaskets are dispensed and allowed to cure before assembly, creating a compression gasket in the pack seal joint. Alternatively, an FIPG gasket is dispensed, assembled immediately, and allowed to cure over time. In either case, precise and repeatable dispensing equipment is required for this critical seal.

> **Graco solutions:** [EFR](#), [HFR](#), [PCF](#), [Voltex Dynamic Mix Valve](#), [Progressive Cavity Pump](#)

Fire-proof coating

The cover of the battery pack can be sprayed with a fire-proof coating that not only protects against fire but also protects against corrosion. When applying the coating the thickness needs to be consistent over the complete cover with as little overspray as possible. It is therefore important to use equipment that can keep a constant and accurate spray pattern without overspray.

> **Graco solutions:** [XM](#), [HFR](#), [PCF](#), [Abrasive resistant pumps](#)



OUR EQUIPMENT AND EXPERTISE



Graco is a leader in fluid handling equipment, providing high quality solutions to a wide range of industries such as Automotive and Battery. With years of experience we are able to provide you with tailor made solutions that help you pump, meter, mix or dispense a wide range of adhesives, including high abrasive materials such as TIM.

Whether your process requires miniscule drop dispensing or large volume continuous flows, Graco has got you covered.

2-COMPONENT METERING MIX & DISPENSE SYSTEMS



PD44

Shot sizes from
0.005 cc to 5 cc



PR-X

For beads or dots from
0.03 cc to 50 cc



PR70

Shot sizes from
2 cc to 70 cc



EFR (electric driven)

Shots from 0.3 cc to any
size or continuous flow up to
3200 cc/min at 207 bar



HFR

Shot sizes above 30 cc
or continuous flow up
to 19000 cc/min



XM

Spray coating
from 1 liter to 11 liters
per minute



I-COMPONENT METERING SYSTEMS



Dispensit

Shot sizes from
0.001 cc to 52 cc



Progressive Cavity Pump

Continuous flow
up to 87 cc/min



PCF

Shot sizes down to 1 cc
or continuous flow from
6 cc to 22500 cc/min

I-COMPONENT SUPPLY PUMPS

Pneumatic Driven

Ambient



Dynamite

For 300 cc cartridges
– 1 gallon pails



Check Mate

For 20 liter to
200 liter pails

Heated up to 400°F



Therm-O-Flow

For 20 liter to 200
liter pails

Electric Driven

E-Flo SP

For 20 liter to
200 liter pails



GRACO HAS GOT YOU COVERED



Unmatched quality

Our focus on continued innovation keeps Graco on the forefront of fluid handling technology. We typically reinvest three times the industry average into research and development. Our mission is to provide customers with products that result in the lowest total cost of ownership while maximizing product quality and business success.

Global presence

With facilities located in Europe, Asia Pacific and the United States, Graco provides a personalized, end-to-end partnership experience. Our engineers will lead the solution planning, testing and refining of your solution in our regional labs to ultimately over-seeing the product installation process.

Personal support

After installation, in-person support will be available from our worldwide distribution network of trained and certified distributors who offer relevant experience, product knowledge and responsive service. There is no better reassurance than Graco technology, product innovation and the people committed to helping you succeed all day, every day.



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