



EVERYTHING YOU NEED TO KNOW ABOUT **OVERMOLDED CABLES**

iconn an R2M co.
SYSTEMS, LLC

A N O V E R M O L D I N G G U I D E

THE PROCESS OF OVERMOLDING

In the most basic sense, overmolding is a performance enhancer for products and electrical components.

The process of overmolding involves bonding a layer of durable material over an already existing part to create a single unit—for example, the adjoining of a cable and a connector. The goal of overmolding is to create the best possible adhesion between the cable, connector and overmolding material.



THIS RESULTS IN NUMEROUS BENEFITS:

- Creates a junction that is impervious to liquid, can survive harsh environments and boosts a product's IP rating to IP-67 or more.
- Forms an ultra-rugged, tamper-proof, 360-degree strain relief barrier around critical electrical connections to shield against vibration, shock and continual flexing without damage to the termination point.
- Improves the aesthetic appeal of cabling by allowing customized design, such as color, texture and branding.
- Provides greater product design freedom, whereas other cable assembly methods (like mechanical back-shells and enclosures) are bulky and create constraints.
- Decreases human error and simplifies installation by producing a one-piece assembly with visual indications to assist in the mating of each pair.
- Offsets upfront costs and delivers ROI by simplifying installation and increasing product durability and lifespan.



DOES OVERMOLDING MAKE SENSE FOR YOUR PROJECT?

Overmolding is used in a variety of industries and applications, including medical, pharmaceutical, automotive, electronics, manufacturing and packaging. Not sure if overmolding makes sense for your application? Below is a checklist of requirements that might apply to your project.

Checkmark all that pertain to you.

✓ OVERMOLDING CHECKLIST

| | |
|---|--|
| <input type="checkbox"/> | I need a cable assembly with a long lifespan. |
| <input type="checkbox"/> | My cable assembly will be plugged/unplugged from an electrical source repeatedly and frequently. |
| <input type="checkbox"/> | My cable assembly will need to withstand a high amount of physical abuse and abrasion. |
| <input type="checkbox"/> | I need a cable assembly that will survive specific chemicals, acids and bases. |
| <input type="checkbox"/> | My cabling needs to be branded, color coded and aesthetically pleasing. |
| <input type="checkbox"/> | My cable assembly needs to make installation faster and easier for technicians. |
| <p>If you checked more than one of the above requirements, overmolding should be among your project considerations.</p> <p>However, achieving these requirements will depend on selecting the right overmolding material for the application in which your cable assembly will be used.</p> | |

OVERMOLDING MATERIAL SELECTION

Thermal Bonding is a mechanical interlock design that physically holds the overmolding material to the cable and connector. Thermal bonding can be achieved independently or in conjunction with other types of bonds. Below is a chart of the materials most commonly used and how they perform in the field.

The most important factor when making your selection is the compatibility between the cable jacket and the molding material.

Choosing the right material for overmolding is “make or break” for the success of your cable assembly and, ultimately, your product. The most important factor when making your selection is the compatibility between the cable jacket and the molding material. If materials aren’t correctly matched, then the best possible thermal bond won’t occur, which may result in overmolding issues. The most common issues related to poor thermal bonding include separation between overmold material and cable.

| NAME | ADVANTAGES | DISADVANTAGES |
|---------------------------------------|--|--|
| Polyvinyl Chloride (PVC) | Durable, with excellent resistance to weather, flame, chemical, tension and abrasion. Can be hard and rigid or soft and flexible. | Poor regulatory reputation. Very stiff in cold weather. |
| Polypropylene (PP) | Inexpensive and versatile. High impact and wear resistance. Flexible, with a high threshold for elongation. Resistant to acids and bases. Can become brittle in cold temperatures. | Not ideal for UV exposure or high heat applications. |
| Acrylonitrile Butadiene Styrene (ABS) | Tough. Impact and chemical resistant. Widely used across different industries. Low shrink. High dimensional stability. Affordable. | Poor weather- and solvent-resistance. High smoke generation when burned. |
| Thermoplastic Polyurethane (TPU) | High resistance to abrasion. High elasticity, making it a great performer in low temperatures. Resistance to oil, grease and solvents. | Not as cost-effective as other materials. |
| Thermoplastic Rubber (TPR) | Performs like rubber but processes like plastic. Slip resistant. Excellent weather resistance. High shock absorption and flexibility. Soft texture. | Prone to warping. |
| Polybutylene terephthalate (PBT) | Moderate to high strength. Can be tough and flexible. High resistance to fuels, oils, fats and many solvents. Does not absorb flavors. Resistance to high temperatures. | Not ideal for thin parts. |

** Note: material properties may vary. This chart is for general reference purpose only.*

MOLDING DESIGN



When designing an overmold, the key is to customize the design according to the exact specifications of the molding process. This is an extremely important step in development and should not be treated as an afterthought. Think of your molding design like it's a house. The quality of the blueprint will determine how well a house structurally holds up and protects all the things that will dwell inside its walls. The initial design of mold tooling for your cable assembly is no different. If the design isn't compatible with the molding process and materials, it could result in deformities and other product issues that affect how the mold holds and shapes material. Overmolds can be designed to include synergistic features like mounting or hanging geometry, etc.

Moldmaking starts using advanced computer software. This software allows designers to map out every detail of the mold and feed the data to a 3D printing machine for prototyping (more on this later). Molds can be designed to have single or multiple cavities to address either high- or low-volume production. The number of cavities will depend on your volume requirements with consideration for cost and cycle time.

MULTI-CAVITY VS. SINGLE CAVITY M O L D D E S I G N S

Multi-Cavity Mold Designs are best for high-volume production involving tens of thousands of parts per month or more. The cost will be greater up front, but the price per overmolded part will be lower because they require less machine time to fulfill the order. A multi-cavity mold can have as few as two cavities or as many as 200 (depending on the part). For cable assemblies, the maximum number of cavities is generally eight.

Single cavity mold designs are best for low-volume production involving less than 5,000 pieces per month.

TECHNOLOGIES USED FOR OVERMOLDING

Tooling is the physical part or “mold” used to manufacture overmolded products. Tooling can be expensive to design and create, but advanced technologies are helping to lower the cost. The more intricate the design, the more costly the tooling. To help control costs, manufacturers also offer different metals and materials that can be used to build tooling. Which technologies and materials you choose will depend on the volume of product and the details of the design.

Aluminum Tooling

- Best for low-volume production
- Supports production quantities of 10,000 parts or more
- Ideal for simpler mold designs to decrease manufacturing time and costs
- Supports single and multi-cavity tooling designs
- Offers better heat dissipation and eliminates the need for cooling lines
- Relatively inexpensive

3D Printed Tooling (Rapid Prototyping)

- Used to test tooling designs before mass production/final tooling
- Tooling can also be created for small quantity production runs
- The most cost-effective way to manufacture tooling
- Fast turnaround time for finished tool
- Can only survive the production of 50 to 100 mold cycles
- Can make functional prototypes
- Specific part complexities may limit the application of this option

Steel Tooling

- Best for high-volume production
- Ideal for multi-cavity tooling designs
- As quantities increase, part costs decrease
- Able to support intricate designs
- Offers more finishing options than other tooling materials

MoldFlow Software

A specialized software used by engineers to create a simulation of how tooling designs will function. New part designs can immediately be analyzed to identify potential flaws that might otherwise not be discovered until the part is in production. The software helps detect existing and potential quality issues, like weld lines, deep undercuts, flow lines or inadequate draft angles. It can also predict molding machine requirements, which tremendously helps with cost estimation (larger machines cost more to operate).

OVERMOLDING PROTOTYPES

As you can see, the process of designing overmold tooling is a project all on its own! Design errors can have a dramatic impact on production costs, cycle times, time-to-market and the overall quality and performance of the product—especially when designing multi-cavity molds and dealing with high volumes. Thanks to the growing sophistication and accessibility of prototyping technology, engineering teams can now 3D print a tool and test its functionality and manufacturability before production steel is cut. The ability to prototype significantly reduces cost, time and material waste.

PROTOTYPING FOR MULTI-CAVITY MOLDS

Overmold prototyping is most valuable when designing for multi-cavity tooling. Creating a multi-cavity mold isn't as simple as copying a CAD file multiple times. There are complex physics surrounding the thermal variations in a multi-cavity mold and how molten material flows through a mold's gates, runners and sprues. The more complex the mold, the more complex the physics. For this reason, it is imperative key adjustments be made—for example, adjusting the mold gate (including knock-outs) or using side actions. Using 3D printing, multi-cavity molds can be produced and tested fast and risk-free. Once the design and performance are approved, that cavity can be replicated using a stronger material to support high production volumes.

THE ABILITY TO PROTOTYPE
SIGNIFICANTLY REDUCES COST,
TIME AND MATERIAL WASTE.

OVERMOLDING, INJECTION MOLDING, INSERT MOLDING. WHAT'S THE DIFFERENCE?



INJECTION MOLDING

Injection molding involves shooting molten plastic into a mold to create a solid piece. It is extremely versatile and used in a broad spectrum of applications and industries.

The Process: Injection molding is a term used interchangeably with “overmolding”. Both terms represent the process of heating thermoplastic material and using high pressure to force the material through a nozzle and into a mold. Once the mold is full, pressure (usually hydraulic) is applied to keep the materials tightly in place. As the materials cool, adhesion takes place. Once complete, the mold opens up, and the product drops out.



INSERT MOLDING

Insert molding is the act of permanently adhering two parts together. It's commonly used when placing threaded “inserts” into molded parts or encasing electrical connections.

The Process: This process will produce one part that is specifically manufactured to fit inside a larger injection molding design. Like injection molding, insert molding involves a thermoplastic material being forced into a molding cavity. But this time, the material fills in around the insert. The finished product is a single part comprised of both the insert and overmolding material.

TWO-SHOT MOLDING & MULTI-SHOT MOLDING

Two-shot or multi-shot molding is cost-efficient for large production volume (more than 10,000 parts). This process is ideal for parts made of multiple colors, materials or components.

The Process: Two-shot molding is similar to injection molding but requires a specific molding machine equipped with two or more nozzles. As the name suggests, this process involves injecting a single mold with multiple materials during a single molding cycle. After the first material is injected, a steel part creates space for the next material to be injected.

Ultimately, customizing and overmolding your cable assembly is about reducing part costs and enhancing the performance of your product. This is the goal whether you're making 2,000 parts or 2 million. When looking for a cable assembly manufacturer, find a partner who understands this goal and offers the support your team needs to achieve it.

iCONN Systems is a design engineering firm with the expertise and manufacturing capabilities to help your development team customize the optimal cable assembly for any type of application. We offer numerous advantages to ensure your customized overmolded cable assembly fits into the scope of your project, including a cellular manufacturing process that decreases cycle time, minimizes resource waste and results in a higher quality product. We also add value to our services at every opportunity.

For example, offering rapid prototyping, verification and validation testing, and Advanced Product Quality Planning (APQP). From rugged outdoor environments that expose electrical connections to harsh weather elements, to medical equipment that must be as aesthetically appealing as it is compliant and resistant to chemical cleaning or strain—iCONN will help make you successful in the market by eliminating concern regarding electrical failures in the field.

READY TO GET
STARTED?

SPEAK TO AN EXPERT

VIEW OUR
STANDARD AND MODIFIED CONNECTORS
AND OVERMOLDED CABLE ASSEMBLIES.

VISIT OUR WEBSITE