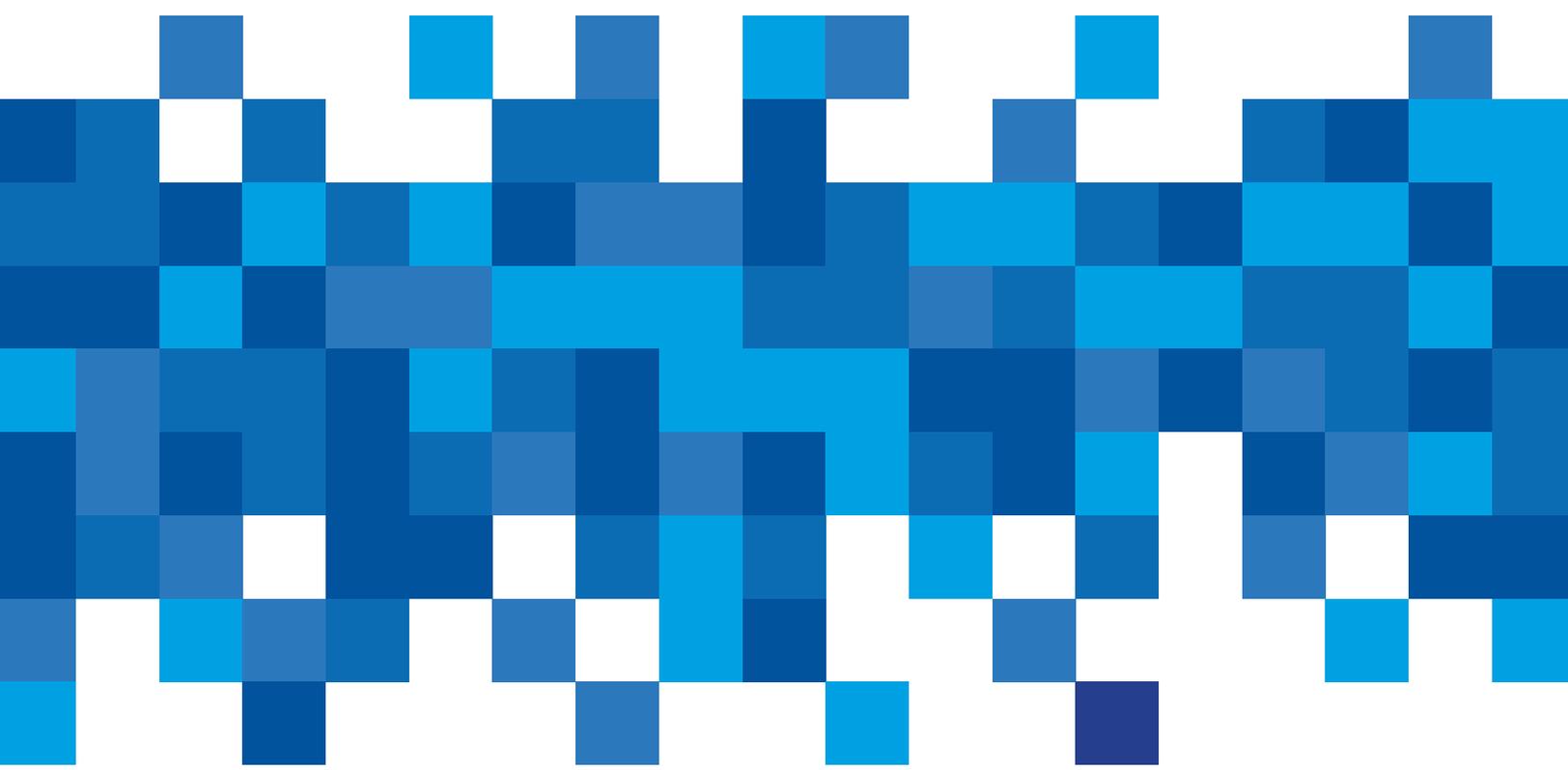


# Leveraging Multiple Materials in Your Product Design



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Every company has its own set of issues to overcome. Parts are failing. Manufacturing labor costs are too high, cutting into profits. Product development is at a standstill. Time to market is slow because the production process is overly complicated. Design innovation can create solutions to these issues while keeping your business on the forefront of technology. What tools can product designers, engineers and innovators leverage to take their product designs to the next level?

Incorporating multi-material components into a product design can lead to innovative results. Multi-material components can offer a host of product benefits over one-material designs, including:

- Product improvements from leveraging physical or chemical property benefits of multiple materials
- Superior fit and product performance from integrating dissimilar materials
- High-quality seals, gaskets and ergonomic features can be produced from functional soft/rigid material combinations
- Enhanced product integrity, reliability and safety

Manufacturers can help you create a cutting-edge product by leveraging multiple materials that offer unique benefits over a one-material design. Choosing the right combination of materials and manufacturing methods is a complicated endeavor. Finding the right balance of quality, cost and capability in materials and suppliers is essential to success.

Reviewing existing designs and well-known methodologies is a good starting point when developing a product utilizing multiple materials. When brainstorming solutions for your product, expand the process by considering design ideas from entirely different industries; talking through the solutions that were created for different products with diverse uses can help generate new ideas. Reviewing what has been done before can help you get started, but true innovation will come from considering each material and assembly method and their unique benefits. Through this process, you might come up with a unique combination of materials that has never been used before that offers the necessary features to meet your design specifications.

How can you leverage multiple materials to take full advantage of their benefits? When selecting the ideal material combination for a new component, there are many important things to consider.

- **Material compatibility.** First and foremost, the materials chosen for an assembly must be compatible with each other. If the assembly is an over-molded application, the materials must be able to bond together. Another consideration is stability — if the materials are pressed together in an assembly for years, will chemical reactions lead to a degradation of properties?
- **General performance.** The selected materials must hold up to the demands of your application and the stresses of everyday use. Tension, compression, tear and creep are just some of the forces that could impact your component's performance.
- **Chemical resistance.** Components are used in different environments and are exposed to a multitude of elements. Whether the product is designed for medical, automotive, aerospace or general consumer use, the environment must be thoroughly considered in order to select the appropriate material.
- **Product life cycle.** Implantable devices that are designed to stay in the human body for the life of the patient are exposed to various fluids, acids and lipids and cannot break down from this contact. Similarly, the average car life expectancy is around 8 years or 150,000 miles, and during this time the car's parts will be exposed to weather, salts, dirt, solvents and a multitude of stresses and strains. In both cases, a material must be chosen that can withstand these stresses.
- **Cost.** It is important to create the correct balance of performance, quality and cost. For example, creating a complex overmolded device that provides greater performance than the product requires – at a higher cost – can limit the success of an otherwise great design. By determining an appropriate sale price while analyzing quality and performance requirements, you can set a target budget per piece that will help you choose the most cost-effective materials and assembly method.

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## Designing Products with Multiple Materials

When developing a product design, it is important to leverage the experience of a knowledgeable manufacturer like MRPC, who will always consider the component's use and other design requirements to ensure a successful outcome. A supplier with a thorough understanding of the application's rigors and a broad knowledge of materials will guide you to proper choices in material, design and manufacturing method.

MRPC's experienced engineering team will leverage years of technical knowledge as we review your product design and guide you to the right choices. They will review your plan and recommend when to combine parts through multi-material molding or other assembly methods to create a higher-performance component at a lower cost.

A manufacturer with niche capabilities can leverage their experience to combine materials that don't traditionally work together. It is critical to select a manufacturer with a willingness to experiment to find the ideal combination of materials to meet product design requirements. MRPC will consider every possible angle to come up with the best solution for our customers. We take on technically challenging applications and try new production methods for components that push the edge of design. We have built our knowledge through innovation and have experienced great success on behalf of our clients.

## Multi-Material Assembly Methods

Once you've discovered which materials have the features that match your design specifications, it's time to determine which assembly method will be most effective in meeting your project goals. MRPC has broad experience with various multi-material production methods, and can combine different materials to meet the demands of new product designs and specifications.

### Mechanical Assembly

Mechanical assembly uses screws, fasteners, built-in snap features, post-and-sockets and other similar connections to assemble disparate materials. There are few limitations in the types of materials that can be combined this way.

Key advantages of mechanical assembly include:

- Wide range of possible material combinations
- Components can often be disassembled for service and repair
- Requires a small capital investment

For example, MRPC worked with a client to modify an existing product design for a polycarbonate dental packaging cap and vial. The existing cap was screwed into place onto the vial using a threaded design. This prevented the client from automating their packaging process, as the equipment would either over-torque and crack the cap, or under-torque, causing the cap to fall off during shipment. MRPC resolved this issue by creating a threaded design that snapped into place, but could still be unscrewed normally. The end customer experienced no change in the function of the vial, while the client saved tens of thousands of dollars in labor costs.

### Chemical Assembly

Chemical assembly leverages adhesives to bond two materials. The adhesive must be chemically compatible with both substrates while creating a sufficient bond. The adhesive must also be able to withstand all of the environmental rigors of the end application. Successful chemical assembly production requires a manufacturer with intimate knowledge of adhesive and material compatibility, as well as rigorous testing and experimentation to confirm a successful bond. MRPC has decades of experience with materials, adhesives and priming methods that have created strong, successful chemical bonds in product assemblies.

Chemical assembly offers these benefits:

- Improved stress distribution across mating surfaces
- Excellent shock and vibration resistance
- Creates smooth, uninterrupted surfaces
- Reduced weight compared to mechanically assembled components

MRPC used chemical assembly to help a client create a disposable Y-body connector that is used to mix and apply a two-component surgical adhesive. This complex assembly consists of seven separate components, including two molded plastic luer fittings, two check valves, a plastic molded Y-body connector, a co-extruded silicone tube (composed of silicone co-extruded over a metal wire) and a molded silicone tip. MRPC molds each of the silicone and plastic components, extrudes the tube, chemically adheres each part together and packages the complete assembly into a sterilizable Tyvek pouch. The customer works only with MRPC for this device, which has simplified the process of creating a truly innovative design at an extremely low cost.

## Thermal Assembly

Multiple methods of thermal assembly can be used to bond thermoplastic materials. MRPC uses spin, ultrasonic and vibrational welding and heat staking to complete product assemblies. These methods create strong chemical bonds by melting the plastic material together.

Thermal assembly can provide these benefits:

- Hermetic seals can be created
- Bond strength approaches the physical limits of the raw material
- Excellent stress distribution across the joining surface
- Smooth mating surfaces

MRPC leveraged ultrasonic welding to develop a three-piece check valve consisting of a two-component plastic housing and an internal rubber valve. The completed assembly creates a hermetic seal with a chemical bond between the two housing components, removing the risk of leakage or failure of the check valve.

## Overmolding

Overmolding, or multi-material molding, involves molding a material over a previously formed part.

The substrate can be nearly any rigid material, such as plastic or metal. However, the temperature requirements for the overmolding process and the chemical compatibility of the materials can create certain limitations.

When molding a thermosetting silicone over a thermoplastic material, the thermoplastic must have a high enough melting temperature to remain solid while overmolding with the thermoset material. This greatly limits the pool of thermoplastic substrates that can be used in this type of design.

By leveraging overmolding, you can take advantage of these inherent benefits:

- **Improved physical and mechanical performance.** By utilizing multi-material molding processes instead of other methods to create assemblies, the final product is often stronger thanks to a robust material bond.
- **Cost reduction.** Multi-material molding eliminates complex manual processes by allowing assembly automation. This reduces labor expenditures, which in turn lowers product costs.
- **Improved quality, consistency and longevity.** Multi-material molding is a highly repeatable process that generates higher-quality products, which often have a longer usable life than hand-assembled components.
- **Ergonomic benefits.** Multi-material molding allows product designs to be easily modified to incorporate ergonomic benefits such as contoured rubber grips.

MRPC helped a client develop an innovative micro-molded neurostimulation lead that involves two layers of overmolding. The first overmolding is a tiny Nitinol metal ring that is overmolded with an implantable PEEK material. This overmolding is then primed and overmolded again with an implantable grade silicone seal on one end. This component measures only 0.080" in diameter and weighs less than a gram, adding to the project's complexity.

## Conclusion

When developing a new product design or enhancement, consider all available material options to maximize the functionality of the component. MRPC can help your team work through your essential questions and determine the best material and manufacturing method for your product design. We can help you decide which assembly method is the correct path to take in manufacturing your multi-material device to achieve the performance benefits, cost reductions or other project goals you may have. Regardless of the production method, our design and manufacturing expertise will help you achieve the results you desire.

## About MRPC

MRPC is a single-source provider of innovative medical device components and assemblies, specializing in clean room molding with a focus on silicone molding, two-material molding and micromolding. As an FDA-registered manufacturer, MRPC is committed to providing our customers with the highest level of expertise through extensive staff training, industry certifications and a long history of success.