Designing Plastic Parts for COMPLEX AUTOMOTIVE APPLICATIONS

KAYSUN

INJECTION MOLDING & ENGINEERING SOLUTIONS

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In an effort to improve safety, increase fuel efficiency, use alternative fuels, and reduce environmental impact, automotive manufacturers are relying more than ever on injection-molded plastic parts and products.

Plastic components, as compared to metal, are an efficient way to reduce weight and cost without jeopardizing quality or safety. For gasoline-powered vehicles, metal-to-plastic conversion means easier compliance with Corporate Average Fuel Economy (CAFE) Standards. For the growing number of electric vehicles on the road, lighter loads translate to increased energy storage for more and longer trips before plugging-in for a recharge.

Therefore, manufacturers depend on the expertise and experience of custom injection molders like Kaysun for plastic component robustness and functionality within complex automotive systems such as braking, cooling, fuel delivery, and powertrains. In addition, molders are entrusted with protecting manufacturers' brands by delivering consistent, quality products that minimize the potential for warranty claims, recalls, and lawsuits.

This guide delves into why a partnership between an automotive manufacturer and a custom injection molder is central to:

- Designing for manufacturability
- Solving common design challenges
- Leveraging mutual expertise to improve product quality and performance, and reduce overall costs

Designing for Manufacturability

Automotive manufacturers place a premium on time. They must balance highly complex, high-volume projects – typically ranging from 50,000 to 1 million pieces – with the demands dictated by the automotive industry's continual evolution.

Design accuracy is vital from the onset of the project. Imprecision in component design, fit, or function leads to time-consuming and costly retooling and product re-runs, not to mention the increased potential for warranty claims, recalls, and lawsuits.

Kaysun conducts Design for Manufacturability (DfM) studies early in every automotive project, with the goal of saving the manufacturer time and costs related to failure or rework. Mold fill assessments verify design and materials performance or, conversely, reveal areas for improvement. For example, the evaluation might identify improper gate locations in the part design. Having a heads-up about needed corrections at a point when adjustments can be made without high time or cost impact is invaluable.

Reviewing the design early is beneficial in determining feasible dimensions and tolerances before an automotive component reaches the molding process. It saves the time and frustration of addressing trapped steel or other moldability issues during production, where resolving problems could delay progress by two or three weeks – a huge detriment to any manufacturer.

DfM studies and design reviews bring molders into the project mix before purchase orders are issued, and before the added pressure of "paying for mistakes" takes hold. It's a smart and efficient use of time that benefits everyone.

IATF 16949 Certification

IATF 16949 is an ISO technical specification developed by the International Automotive Task Force (IATF) to develop a quality management system that:

- Provides for continual improvement
- Emphasizes defect prevention
- Reduces variation and waste in the automotive industry supply chain

IATF 16949 is meaningful to all types and sizes of automotive supply companies anywhere in the world because it is the hallmark of industry confidence and consistency. Its requirements are specifically applicable to manufacturers of production or service parts for the original equipment (OEM) market, like Kaysun. We qualify for and carry IATF 16949 certification.

Common Design Challenges

Here are some common challenges encountered in the design phase of automotive applications:

MATERIALS: Choosing the right materials for a specific application is important. There are tens of thousands of materials options available, and each uniquely impacts a part's form, fit, and function. The breadth of choices alone makes the decision difficult, and the alternatives available to minimize cost without impacting quality must be considered. This is especially true with automotive applications, as they often require the use of specialized resins with high heat- and chemical-resistance to fluids like gas, oil, and transmission or radiator fluids.

TRAPPED STEEL: Trapped steel is the improper ejection of parts from a tool and can result from any number of design feature flaws. In complex tools, the relationship between the ejector pins and other moving parts, such as slides or lifters, must be analyzed to eliminate interference. Designing to include an adequate number of ejector pins is important. Inadequate or misplaced ejector pins will affect the dimensional consistency of the part.

DRAFT: Draft is the degree of sidewall or rib taper needed to allow the molded plastic part to be removed from the metal tool. Plastic parts are difficult to remove from the tool when the degree of taper of a sidewall or rib does not allow removal, and creates the same issues as trapped steel.

WALL THICKNESS: While it might specify a minimal wall thickness, the part design might not account for functional performance requirements and the practicalities involved in plastics processing. This opens up a host of issues that determine whether or not the part is moldable.

GATING: Gating is imperative in molding parts because it facilitates the flow of plastic into the tool cavity. Incorrect gate type, size, and location are issues that cause considerable processing problems that range from functionality to aesthetics.

KNIT LINES: Knit lines create blemishes on the part or product and can weaken the structural integrity of a part. These can be caused by multiple factors, many of which are rooted in design.

CYCLE TIMES: Efficient cycle times translate to lower cost. While integrated with melt temperatures, cooling, and other variables, there is little question that part design impacts cycle times and the ability to hold down costs, speed time to market, and ensure quality.

OVER-SPECIFICATION: There is a tendency among design engineers to over-specify their designs. For example, the specified wall thicknesses may be greater than what is needed for a successful design. This adds cost without improving the fit or function of the part.

LATE START: Many times, design engineers look to the molder and tool maker to develop the tool immediately following the acceptance of a quote, in order to meet a tight production schedule. This gives molding experts little time to present recommendations that can optimize the design and forces any adjustments to be made in the tooling phase, where costs will be higher. Conducting DfM studies help eliminate timing issues.

While these challenges are commonplace, they can be easily solved with the right approach and the appropriate level of design, engineering, and injection molding expertise.

Is Offshoring Economical?

On its surface, offshoring (the practice of basing some of a company's processes or services overseas) appears to be an economical alternative to domestic manufacturing. However, that's not typically the case with complex injection molding projects.

While it's generally true that costs of overseas services for tooling and molding are lower than those in the United States, you pay the price in quality, consistency, and time.

Complex, detailed tooling requires specialized injection molders that can address quality and add value through expertise in the materials ideal for the high heat, harsh chemicals, and other demanding environments found in automotive applications.

Leverage the Knowledge of Experts

Successful automotive design engineers surround themselves with experts in order to improve product quality and performance, and reduce overall costs. This includes reliance on an injection molder that provides insight into the most important aspects of the process.

PLAN AND FOCUS ON ESSENTIALS: Communicating specific expectations to your molder early on regarding automotive component end use, known design challenges, and timeline requirements eliminates unnecessary delays and costs, without sacrificing quality or performance.

EARLY MOLDER INVOLVEMENT: Engaging a molder early in the project gives them the best opportunity to expertly analyze all characteristics of an automotive component. This often results in finding and fixing problems before they happen and identifying ways to cut costs, whether it's in weight, materials, specifications, or processes.

FEASIBILITY: Molders can provide input on the overall feasibility of a design and offer recommendations for increasing tool and part efficiencies.

BROAD PERSPECTIVE: An experienced molder is deeply committed to providing consistent, quality automotive components that positively represent your brand and mitigate the risk of warranty claims, recalls, and lawsuits.

MATERIALS SELECTION: The materials chosen for automotive components, like specialized resins, have a significant impact on performance. To ensure optimum performance, molders can guide materials decisions by sharing information that may not be commonly known to automotive design engineers.

ACCELERATE TIME TO MARKET: Defining measurement techniques and performance expectations early on usually results in a more efficient qualification process and shorter time to market.

PROBLEM-SOLVING: Molders are in a position to identify potential problems and offer practical solutions. Whether it's trapped steel, insufficient draft, gating, heavy wall thickness, internal stresses, or any other challenges that aren't recognized in the design stage, the molder can often design alternatives to avoid these issues.

MANUFACTURING OVERSIGHT: A competent molder applies best practices to all phases of component manufacturing. This level of consistent control eliminates process variations, shortens cycle times, and ensures quality and repeatability from batch to batch.

FEWER PRE-PRODUCTION TOOLING ITERATIONS: During development, a collaborative relationship with your molder reduces the need for multiple, often time-consuming, tooling revisions. This allows more room for adjustments throughout the project, from start to finish.

Metal to Plastic Conversion

When metal automotive parts are replaced with injection-molded plastic automotive components that are engineered to the same tight tolerances and performance levels, costs are reduced anywhere from 25 to 50 percent.

A number of factors account for the measurable savings and substantial competitive advantage. Plastic components are used to replace metal parts in systems ranging from clutch assemblies and transmissions to oil distribution systems, since plastics:

- Lower materials costs
- Eliminate costly machining operations
- Entail fewer secondary operations
- Cost less to ship
- Require no painting
- Increase product life

Lasting Partnerships

The complexities involved in designing parts for automotive applications make choosing the right molder a pivotal decision.

Thoroughly vetting potential injection molding partners prior to entrusting them with your business is essential. Don't be afraid to ask questions about if and how they align with projects you currently have in production. The answers provided have multiple benefits:

- You'll be able to determine their possible fit with your company
- You'll get a feel for their depth of molding knowledge and their willingness to share it in all phases of automotive component design and manufacture
- You'll verify if they offer "one-stop shop" secondary operations like pad printing, heat staking, and sub-assembly

The best and most productive molder relationships are those built over time and on trust. To learn more about how the Kaysun design and engineering teams will work with you to produce automotive components that meet your design, quality, and production goals, call us at **920-686-5800**.

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