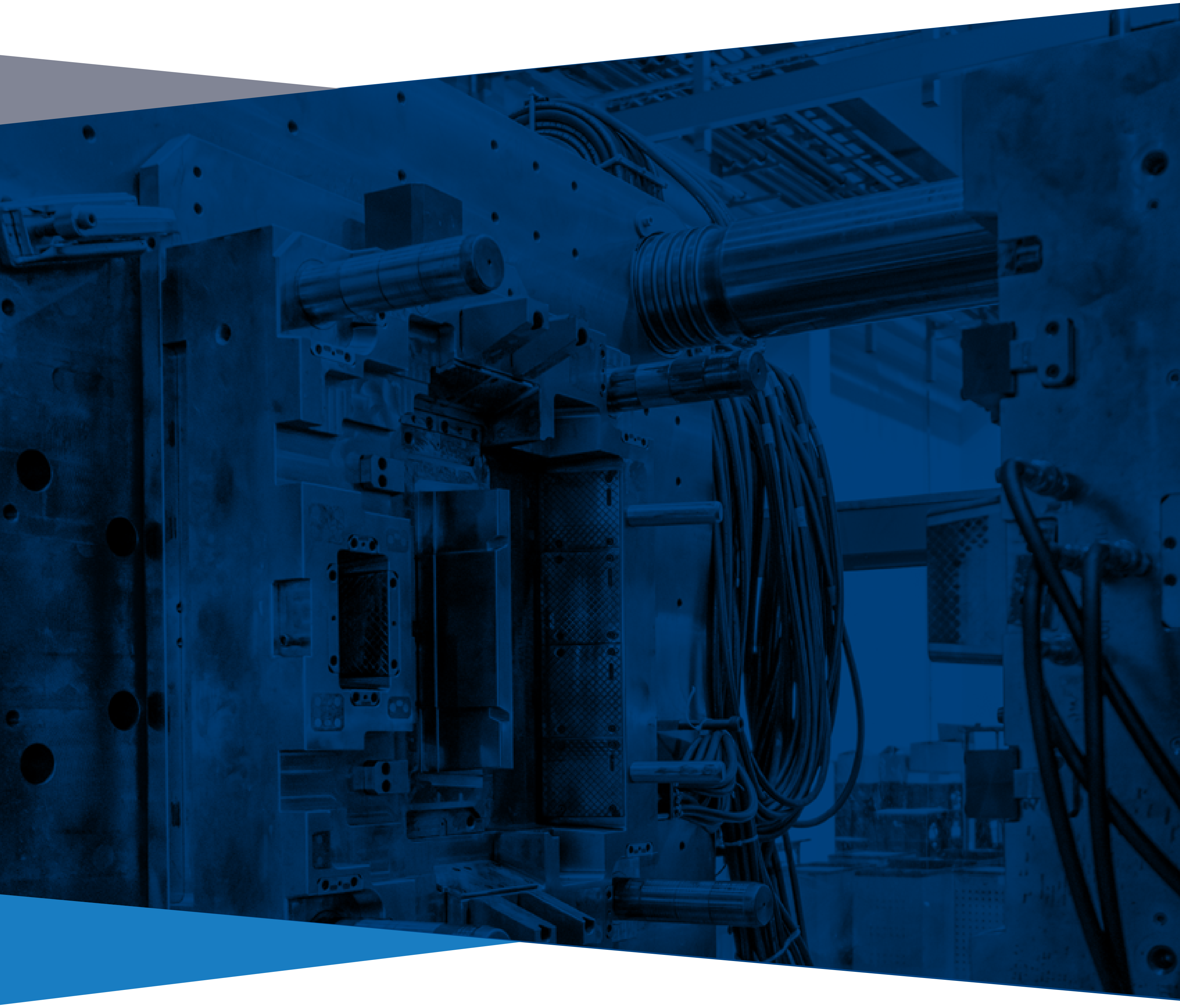
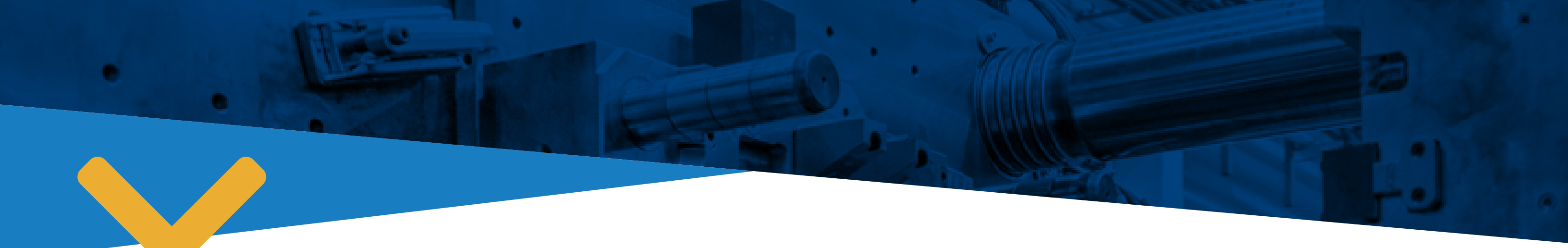
KAYSUN

INJECTION MOLDING & ENGINEERING SOLUTIONS



Custom Injection Molding for a

COMPETITIVE ADVANTAGE



Reduce Costs. Optimize Functionality. Improve Aesthetics.

Custom injection molding is the manufacturer's most direct route to competitive differentiation. It provides the design freedom and process efficiency required to create new features and incorporate new technologies as quickly and cost-effectively as possible.

Today's custom injection molding is defined by part design, tool design, material selection and process control—all simultaneously complex areas that OEMs must address at the beginning of the custom injection molding process with the help of an expert injection molding partner.

WHY USE CUSTOM INJECTION MOLDING?

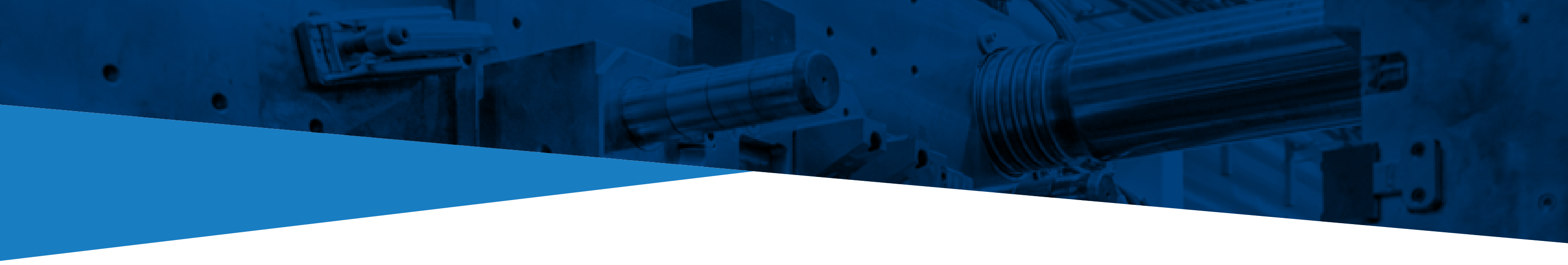
With custom injection molding, additional materials — from dissimilar polymers to lenses, fastener threading, metal components, and other non-plastics — can be integrated during molding to facilitate assembly, optimize functionality and increase durability.

Aesthetic reasons can also drive the decision to use custom injection molding. For example, some OEMs want to use a polymer with an appealing color or integrate decorative elements such as metal flake, gloss, or a proprietary pattern. Such visual uniqueness can be vital to differentiate products within a manufacturing line or to separate them from the competition.

In addition to streamlining production and reducing costs, incorporating the decoration or functional item within the injection process improves quality. Machine-paced production yields higher quality products by eliminating or greatly reducing the inconsistencies brought about through human involvement. It also reduces potential process variances introduced by secondary machining or joining operations. Just as important, custom injection molding yields more predictable product quality because manufacturers are able to consistently maintain production imperatives such as tight tolerances across parts and runs, regardless of the number of units produced.

PART DESIGN CONSIDERATIONS

Many of the crucial decisions involved in custom injection molding should be made as early as possible in the design phase, when project adjustments can be made without significantly impacting the total costs and product timeline. For example, the placement of ejector pins and gating — the point where the plastic enters the mold — is critical aesthetically and stylistically. A visible knit line, where the flow fronts of the molten material meet, may be objectionable to the customer. If such marks cannot be strategically relocated to a place on the part that will not be visible, they can sometimes be disguised by texturing the tool. Either way, the part designer must plan for the change.



If multiple materials are to be used, the polymers must be chosen carefully for compatibility to ensure a permanent bond. Different plastics undergo thermal expansion at different temperatures, and any incompatibility will become a serious issue. For instance, polysulfone will not bond with polypropylene, which in turn bonds weakly with nylon, styrenic, and urethane-based elastomers — overlooking these inherent incompatibilities could be costly.

Further, process complexity is added when a part requires metal inserts. The metal inserts being added to a mold often require preheating to reduce thermal shock and improve retention properties.

A robust part doesn't just meet the original requirements its designer intended. It also stands up to the wear and tear — or even abuse — it is subjected to in daily use. Aesthetically, a device must maintain its appearance. This means no fading, hazing, or yellowing of the plastic after exposure to sunlight, fluorescent lighting, chemicals, or other potentially harsh elements.

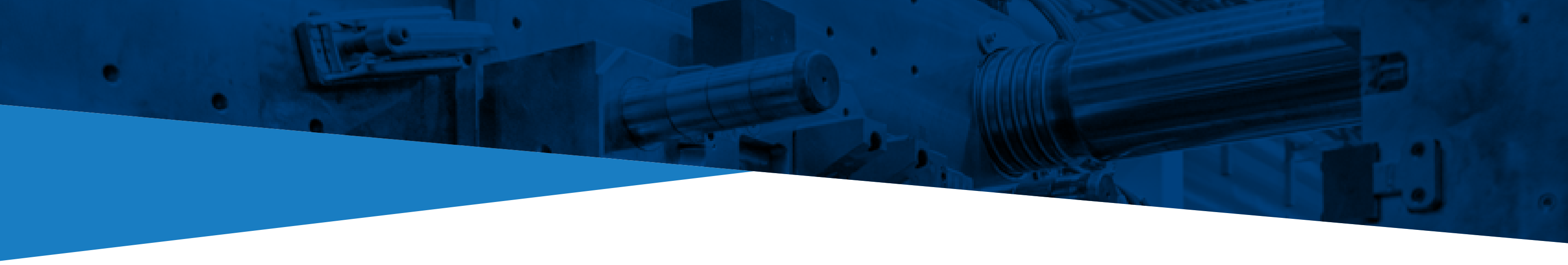
TOOL DESIGN CONSIDERATIONS

The development of the tool is the heart of the injection molding process, the step from which everything else flows. The ultimate success of the part is determined at the point when the engineering team designs, creates, and maintains the tool — accounting for the materials to be used and the quantity of the item to be produced. Poor choices in any aspect of the tool development process will ultimately result in poor products regardless of part design, material choice, or process control.

The tool's durability expectations determine which material is used to make it. For example, aluminum is relatively inexpensive and easily machined but it offers limited longevity. Thus, it should be used only for small and finite production runs.Other materials range from soft steels used for simple, single cavity prototype tools with smaller runs to hardened steels used for complex, multi-cavity tools to satisfy greater production volumes.

Production leaning toward high volume and high complexity underscores the importance of selecting the proper steel for building the tool. The determining factors are based directly on the goals and expectations of the project, ranging from total quantity sought to the finish quality needed (see Table I on page 4 for more information).

Budgets for both time and cost can influence material choice as well. Softer metals, such as P20 steel and aluminum, are easily machined and therefore less costly tool builds. Stainless steel resists corrosion, pitting, and wear while supporting smooth finishes. In general, the harder the steel, the more effort and expenditure is required. Each additional step used to create the tool drives up time and cost. But harder steel tools last considerably longer and return higher-quality parts with greater consistency.



Other steels used for custom injection molding include high-carbon varieties, such as H13. These varieties contain negligible amounts of impurities — an important factor in heat-treating — and are economical to purchase in larger sizes. (see Table II for a breakdown of steel types and characteristics).

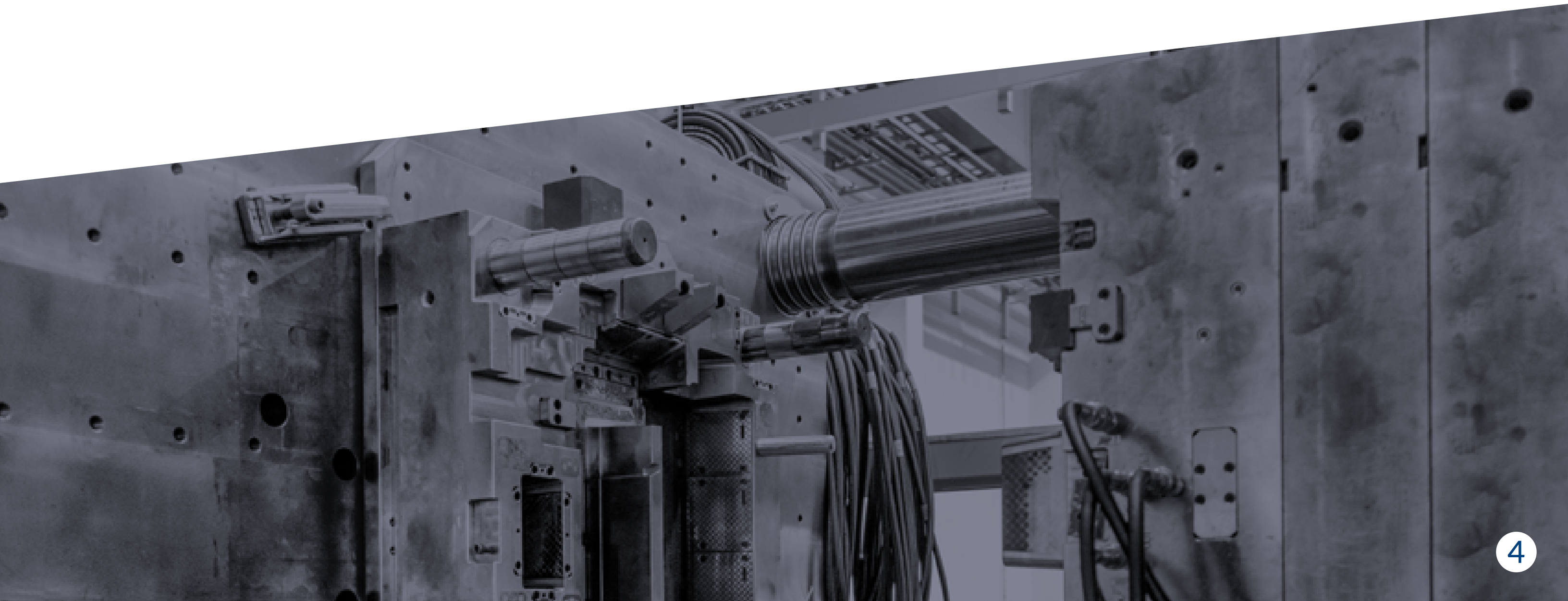
	< 10,000	10,000 – 200,000	200,000 – 1MM
Aluminum	X		
P-20	X	X	X
Tool Steel (various grades)		X	X

Table I. General rules for material choice based on project volume requirements.

Corrosion resistance in a tool is especially important with the use of materials that have a high degree of acidity. These include resins in the PVC family or with certain added agents, such as flame retardants.

S-7	General all-purpose, heat-treatable tough steel. Normal wear resistance.
A-2	General all-purpose, heat-treatable hard steel. Higher wear resistance and less toughness.
D-2	High-wear applications.
420 SS	Medium wear-resistance. High polish. Corrosion resistant. Not as hard.
H-13	Medium wear-resistance. Can be nitrided for surface lubricity with flex strength.

Table II. Different types of steel that can be used to make a mold.



MATERIAL CONSIDERATIONS

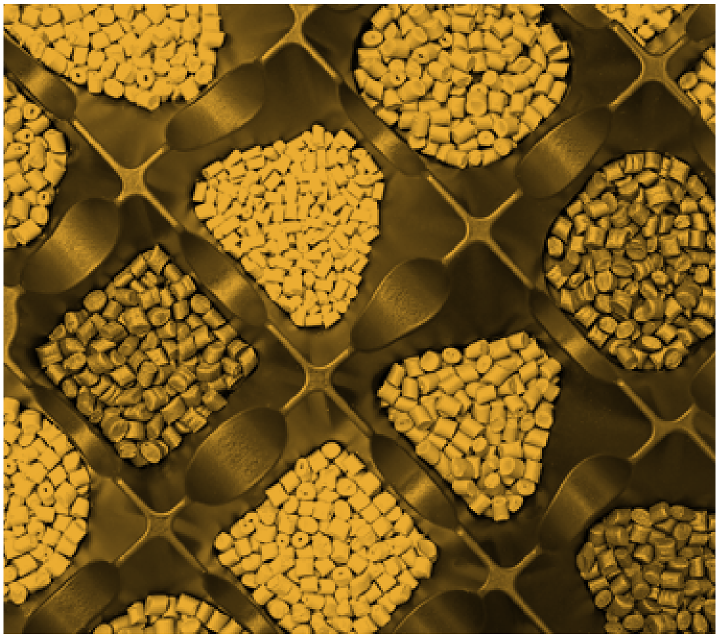
Just as important as selecting the material for the tool is choosing the material for the part, ideally beginning with a plastics engineer interviewing the OEM about its requirements. This information gathering requires a review of any outstanding special needs, like cleaning frequency and sterilization, as well as determining four defining factors:

1. Physical load. The impact expectations of the part must be determined so that it will stand up to the conditions of everyday use without fatigue. Any degradation can lead to part failure.

2. Mechanical function. The particular polymer must be right for its application.

3. Thermal conditions. What exposure will the part have to fluctuating and extreme temperatures? Polymers must be chosen to endure such conditions.

4. Chemical exposure. What types of chemicals will be in the part's environment? What potential vulnerabilities do chemicals present to the part?

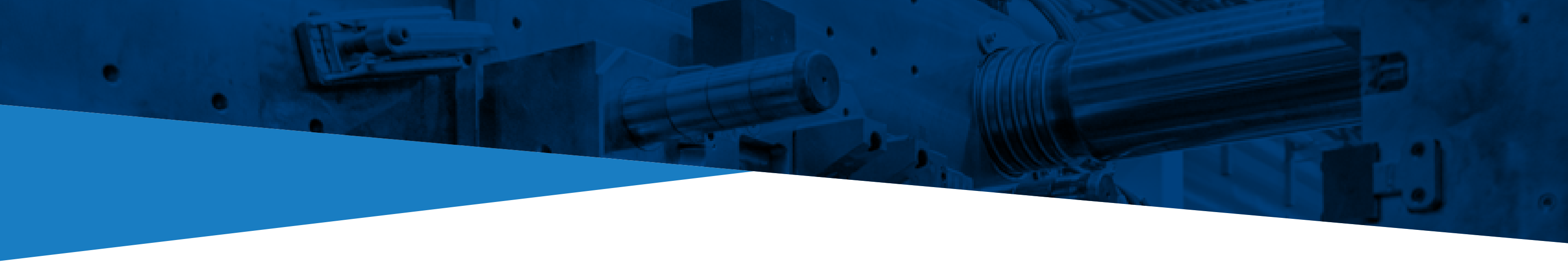


THE NEED TO MOLD DISSIMILAR PLASTICS

One of the most difficult custom injection molding techniques is multi-shot technology, which is required to add softer polymers for ergonomic and waterproofing features (such as keypads, grips, protective bumpers, and seals) over a hard-plastic substrate, as in an impact-resistant device body.

By accomplishing steps like these simultaneously during molding, the manufacturer eliminates costly and inefficient secondary steps from the production process. It can also result in higher quality because the material itself can be monitored during production through cavity pressure feedback — a pressure reading of the resin as it is going into the tool. The feedback provides data on the consistency of the pressure and where correction is needed, such as a change in the viscosity of the molten material.

Thus the tool and the process must be designed to suit the part and materials. No OEM would tolerate a soft-touch keypad separating from one of its handheld devices during use. Nor would they accept a waterproof seal failing because materials were improperly selected or the process to manufacture it was not expertly designed.



HIGH-HEAT RESINS

The high-heat resins required to withstand autoclaving, such as polysulfone, have their own set of process considerations. These materials are more difficult — and therefore more costly — to work with, mainly due to their higher melting points, which complicates everything from safety compliance to the molding process.

For instance, polysulfone has a melting point of 700°F, versus 500–550°F for typical resins. Oil, rather than water, must be used to control tool cooling, requiring a longer molding process and different equipment— with different risks involved. Heating oil also takes longer and metal-braided hosing must be used as opposed to rubber. These higher demands mean higher risks for both safety and deviation. Since the tool itself can reach 325°F (whereas a water-heated tool typically reaches 180°F), it is subject to higher levels of thermal expansion, which adds complexity to the overall tool design process.

SELECTING A MANUFACTURING PARTNER

The importance of selecting the right manufacturing partner increases in direct proportion to the complexity of the task at hand. With all that is at stake, the OEM's evaluation process must be rigorous. It should cover every aspect of a partner's operations, equipment, personnel, track record, culture, and financial health. A site visit should also be part of this process because it provides the best method for assessing the quality of the plant's environment and team.

Custom injection molding can provide a manufacturer with competitive differentiation, but it requires highly specialized equipment, skills, and engineering expertise. OEMs that take advantage of the custom injection molding process will enjoy the benefits of high-quality parts and devices that perform with optimum efficiency and bear lower total production costs.

Contact Kaysun to learn how their experienced engineering and design teams can help you meet your tight tolerance goals and improve the profitability of your next injection molding project.

KAYSUN
INJECTION MOLDING & ENGINEERING SOLUTIONS

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