THE SMART GUIDE TO

Designing for Manufacturability

A designing for plastic injection molding resource

Injection Molding Basics

The Basics of Molds and the Plastic Injection Molding Process

Plastic Injection Molding

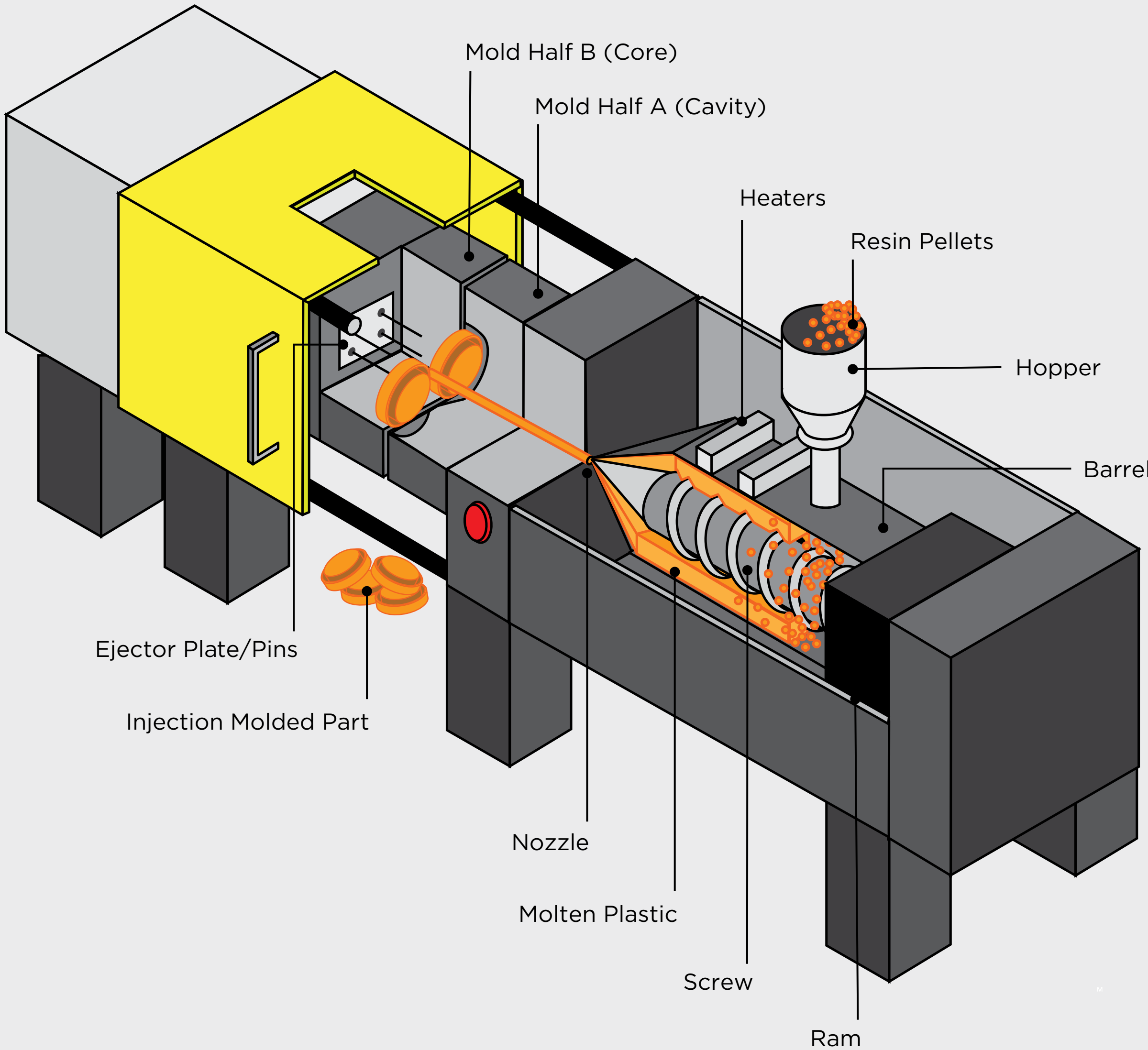
To understand part design, learning the injection molding process is essential. The illustration depicts a typical injection molding machine.

THE PROCESS:

Plastic *resin pellets* are loaded into the *hopper. The pellets then* travel into the *barrel* of the injection molding machine. Through both heat and pressure, the plastic pellets are melted into a *molten material* that is ready to be injected. Pressure, temperature and time cycle are optimized to create quality custom parts.

Once the right environment inside the barrel is met, the *ram* moves forward driving the screw. As the *screw* turns, it creates pressure which pushes the molten plastic through the *nozzle* and into the mold.

Once cooled, the mold opens and the ejector plate engages, releasing the final part from the mold.



Mold Basics

Injection molds consist of two main components: the mold cavity and the mold core.

CAVITY (MOLD HALF A): forms the major external features.

CORE (MOLD HALF B): forms the main internal surfaces of the part.

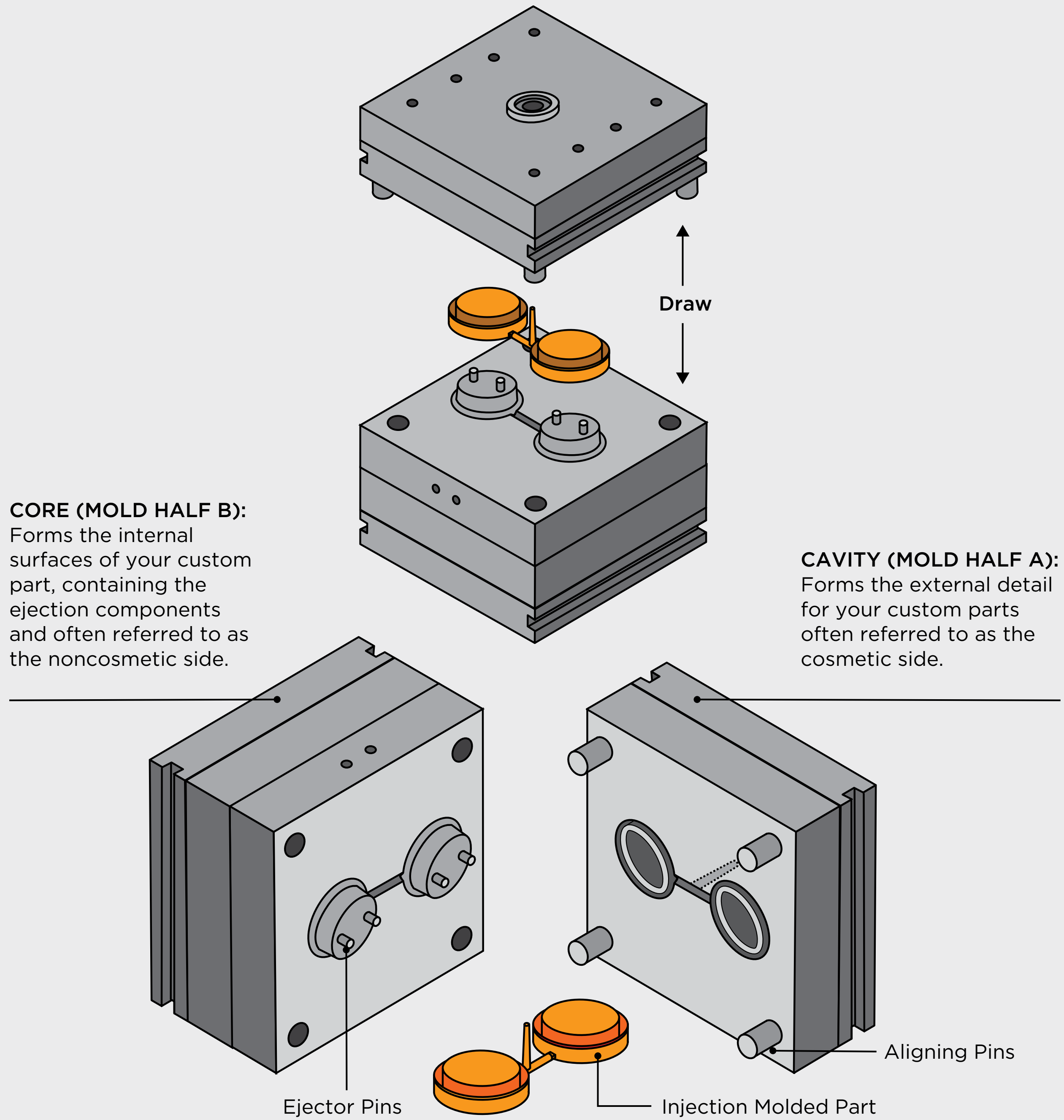
The cavity and core separate (Draw) along the parting line and, with the aid of ejector pins, release the finished plastic part. The process is then repeated.

Depending on your part design, the parting line can either fall on the top, bottom, stepped or angled in order to accommodate all part features.

High quality, efficient tooling relies heavily on good part design as well as advanced skills in mold design and the manufacturing of the tool.

An injection mold is a high precision tool that must be rugged enough to withstand hundreds of thousands of high pressure molding cycles.

By optimizing your part design and focusing on consolidating many key features, you can reduce your overall investment.



Types of Molds

PROTOTYPE MOLDS

Prototype molds are usually built from aluminum, enabling shorter build times than production molds and facilitating quick modifications should the injection molding process or the part require them.

Producing prototype parts quickly will help you to get your products to market faster than your competition. By using engineering grade resins, your injection molded prototype parts can be tested under the same conditions as your final parts and can be made of similar, if not the exact, finish materials. This approach enables you to test in real mechanical, chemical and environmental circumstances and help you create the best possible part design for your product.

BRIDGE MOLDS

When designed and built correctly, prototype tools can be used to bridge the gap between prototype and production. Using prototype tools for bridge production enables companies to release production parts into the marketplace quicker than if they waited for production tooling to be built, thereby accelerating revenue attainment and giving them an advantage over their competition. For low volume production, prototype molds are often all that is required.

PRODUCTION MOLDS

Typically, traditional molds are made of steel. Costs are higher than prototype molds because production molds must be made of a durable material to endure high-volume part production. Production molds usually take more time to build than prototype molds and are not easily modified. Lessons learned through the prototyping process are incorporated into the design of the production tools.

Materials / Resins

Material selection will be one of the first and most important steps of designing your part.

Before you begin, consider your part's end function. Ensure the properties required for performance and cost of material are optimal.

Producing high quality, consistent plastic injection molded parts relies heavily on your chosen material. Visit us at: **www.xcentricmold.com/plastics/** to view detailed information on some of the most common resins to help with your selection. Or, give us a call at (586) 598-4636 and speak to one of our knowledgeable technical specialists.

There are currently 62,000+ thermoplastic resins to choose from and these resins are available in a wide assortment of grades with different properties. For that reason, we recommend you visit **www.matweb.com** where you can browse by name, type or performance characteristics to find the resin you need.

Keep in mind, resins can be combined or added to ensure your finished parts meet your products requirements.

- **Off-the-shelf colors are generally less expensive than custom colors**
- **Your injection molding partner should be able to source the material you need**

EXAMPLES OF ADDITIVES TO CONSIDER:

- **GLASS FIBER** — Strengthen/Stiffen resin but can become brittle
- **CARBON FIBER** — Strengthen/Stiffen and static dissipation
- **MINERALS** — Increase Hardness
- **PTFE** — Lubrication
- **KEVLAR** — Strengthen/Stiffen with less abrasion than glass
- **GLASS BEADS** — Stiffen and reduce warp
- **STAINLESS STEEL FIBERS** — Conductive for electronics
- **UV INHIBITOR** — Protection from sun

HIGH PERFORMANCE 300°F +

- Polyetheretherketone (PEEK)
- Polyamidimide (PAI)
- Polyimide
- Polyphenylene Sulfide (PPS)
- Polytherimide
- Polyphenylene Sulfone (PPSU)
- Polysulfone (PSU)

ENGINEERING GRADE 185° – 300°F

- Acetal
- Nylon
- Polyesters
- Polycarbonate
- Polyurethane
- Polyphenylene (PPE)
- Polyvinylidene (PVDF)

STANDARD RESINS 185°F

- Polypropylene
- Polyethylene
- ABS Plastics

Materials / Resins

Use this chart to help optimize performance and cost for your chosen material.

Mechanical Properties: Low, Average, High

Moldability Properties: Poor, Average, Good, Great

Material	Strength	Hi Temp Strength	Impact Resistance	Dimensional Accuracy	Finite Details	Thick Section Voids	Resistance to Sink	Resistance To Flash	Relative Cost
Acrylic	Average	Low	Low	Good	Good	Great	Good	Good	$$
ABS Plastic	Average	Low	High	Good	Good	Good	Good	Good	$
Acetal	Average	Low	Average	Good	Good	Poor	Good	Good	$$
Thermo-Elastomer	Low	Low	High	Poor	Great	Great	Good	Poor	$$
High Density Polyethylene (HDPE)	Low	Low	High	Good	Great	—	Poor	Poor	$
Nylon 6/6	Average	Low	High	Good	Great	Good	Good	Poor	$$
Nylon 6/6 (Glass-filled)	High	High	Average	Poor	Good	Great	Good	Good	$$
Polybutylene (PB)	Average	Low	High	Good	Good	Average	Good	Good	$$$
Polycarbonate (PC)	Average	High	High	Good	Good	Average	Good	Good	$$$
Polybutylene and Polyethylene	High	Average	Average	Poor	Good	Good	Good	Good	$$$
Polypropylene	Low	Low	High	Good	Great	Poor	Poor	Poor	$
Polystyrene	Average	Low	Low	Good	Good	—	Good	Good	$