KADDAS ENTERPRISES INC.®
INNOVATIONS IN THERMOFORMING SINCE 1966

Manufacturer of Thermoformed Plastic Products

We are a second generation, women-owned business, founded in 1966

Thermoforming Basics

Thermoforming of plastics is one of the oldest methods of processing plastic materials. It is an adaptable process used in the manufacturing of many different products used in all forms of transportation and everyday products. It is also used for prototyping of products produced by other forming processes. Thermoformed parts are all around us and play a big part in our lives.

It all begins with the material. Thermoplastic sheets are manufactured from blended raw materials. This will include polymer resins, colorants, etc. This blending of raw materials is done to an exacting process to ensure uniformity and consistency among batches. The material is then drawn through extrusion rollers to create a finished sheet.

The forming process is fairly simple at its base. You heat up a plastic sheet to a specific temperature, drape it over a mold then a vacuum is applied. The piece is cooled before it is removed from the mold. Thermoforming covers all processes which involve heat to shape polymers.

Benefits of Thermoplastics

Thermoplastics are available in different compounds from acrylic and ABS to PVC and polycarbonate. Each has different and specific thermal and mechanical properties. A unique characteristic is that all of these can be formed into complex geometries without changing the properties of the base materials. Thermoplastics are lighter in weight than FRP (fiberglass) or sheet metal and it does not involve any time or labor for finishing steps. An almost infinite range of colors are available but with a limited amount of textures.

- Durability
  - They are impact resistant and malleable. In many applications they have a longer service lifethan comparable materials as they do not dent, ding, crack, chip, splinter or fray. Thermoplastic's durability will reduce replacements and service calls.
- Chemical/Stain Resistant (Graffiti Resistant)
  - Will not yellow or stain because of contact with any chemicals including cleaners and solvents. There is also material available that is graffiti resistant so a perfect solution for any outdoor or customer facing applications.
- Codes and Requirements
  - Thermoplastics can be produced with certain additives to meet even the restrictive FAA requirements. Sheets are available that meet FAR 25.83 that calls out for strict conformity to smoke, flammability and toxic gas release requirements for aircraft and other transportation interior products. Most all thermoplastics are inherently biocompatible which means theyare perfect for medical device applications.
- Environmental
  - Thermoplastics are recyclable. They contain no VOC's and do not outgas. Thermoformed plastics are an environmentally sound solution. They support end-of-life recyclability and life-cycle design.

KADDAS ENTERPRISES INC.®
INNOVATIONS IN THERMOFORMING SINCE 1966

Manufacturer of Thermoformed Plastic Products

We are a second generation, women-owned business, founded in 1966

Thermoplastic Applications

Like mentioned above, thermoplastics touch almost every aspect of your daily life. Below is a non-comprehensive list of industries using vacuum forming for a multitude of applications. Please note this list is just touching the surface of places and applications where thermoformed plastics can be found.

Thermoformed plastics are the preferred medium for durable customer facing products!

Aerospace-most interior parts including seat parts, covers, tray tables, lav and galley parts as well as cockpit items like life vest pockets, trim pieces and sunshades for commercial, VIP and cargo planes as well as structural parts

Rail-all interior parts as well as cockpit and electrical enclosures

Bus- most interior parts

Marine-all interior parts, mostly custom pieces as well as some cockpit items and electrical enclosures

Energy-line protectors, bushing terminal covers, pole cap & top covers, cut-out switch covers, dead end covers, perch deterrents, arrestor covers and bolt covers

Food-containers, trays, chocolate molds

Office/Furnishings-chairs and chair backs, cubical parts and custom aesthetic pieces for lobby's, etc.

Medical-Spica cast boards, wheelchair parts, instrument housings, pedestals, seat backs and arm rests, masks and many other parts

Vacuum and Pressure Forming

Thermoforming uses two different processes: vacuum forming and pressure forming.

Vacuum forming heats a sheet to a pliable state and then pressed against a 3D mold by vacuuming out the air between the sheet and the mold.

Pressure forming heats a sheet to a pliable state and then pressed against a 3D mold by vacuuming out the air between the sheet and the mold as well as applying air pressure to the outside of the sheet.

Both processes are cost effective with quick tooling turnover. Both work well on small and larger items.

Vacuum forming has sharper details and allow for undercuts. It also has tighter tolerances and molded in textures.

Pressure forming is good for complex shapes and products with vents or louvers.

KADDAS ENTERPRISES INC.®
INNOVATIONS IN THERMOFORMING SINCE 1966

Manufacturer of Thermoformed Plastic Products

We are a second generation, women-owned business, founded in 1966

Thermoforming vs. Injection Molding

The Costs

THERMOFORMING		INJECTION MOLDING
$$	Tooling Cost	**$$$$$**
$$	Per Piece Prod Cost	**$**

Lead Time

THERMOFORMING	INJECTION MOLDING
12 Weeks	24 Weeks

Process

THERMOFORMING	INJECTION MOLDING
Tooling-Single 3D mold is made from MDF	**Tooling**-Double sided 3D mold is created from aluminum, steel or a copper alloy
Materials-Flat sheets available in infinite colors, thicknesses and textures	**Materials**-Pellets available in many colors and textures
Production-Sheet is heated and vacuumed over a 3D mold	**Production**-Pellets are heated to a liquid state then injected into a mold
Finishing-Trimmed either by robot or by hand, can be used without coating or can be painted, image imbedded, silk screened or have a specialty coating applied	**Finishing**-Can be painted when removed from the mold for aesthetics, silk screened or have specialty coatings applied

Considerations

THERMOFORMING		INJECTION MOLDING
Limited	Variable thicknesses within a single part?	**Yes**
Excellent	Unpainted Look	**Good**
9ft x 4ft	Size part can be produced (nominal)	**4ft x 4ft**

Best Uses

THERMOFORMING	INJECTION MOLDING
Part Size-Large parts and multiple parts in a single sheet	**Tooling**-Double sided 3D mold is created from aluminum, steel or a copper alloy
Run Size-Small to medium runs, 100-3,000	**Run Size**-Large runs, 3,000+ (small to medium size parts)
Aesthetics-Very pleasing, perfect for customer facing products	**Variation**-Able to create parts with variable thicknesses per part

KADDAS ENTERPRISES INC.®
INNOVATIONS IN THERMOFORMING SINCE 1966

Manufacturer of Thermoformed Plastic Products

We are a second generation, women-owned business, founded in 1966

Thermoforming vs. Fiberglass

The Details

THERMOFORMING		FIBERGLASS
Thermoforming is a highly automated process; most tooling is made from MDF and aluminum which decreases lead times and provides lower labor costs. Thermoforming is faster and less expensive in volumes of hundreds to mid thousands.	Labor Cost/Lead Times	Fiberglass molding is a very labor-intensive process and often requires multiple tools for the production of a single part which results in slow output, higher costs and longer lead times compared to thermoforming
A process that heats a sheet and uses vacuum and/or pressure to form that sheet against a 3D mold	Process	Fiberglass reinforced resin is formed into 3D shapes, the resin is applied in multiple layers to build up strength and achieve the desired thickness
From 100-3000	Volume	Proto-types and small runs
TPO, (Thermoplastic Poly Olefin) is a popular material choice for replacing fiberglass, it is more durable, crack and UV resistant and significantly lighter, infinite options in colors, textures, thickness and specialty features like chemical resistance, flammability ratings and graffiti proof	Material	A choice of fiber materials, fiber weave and either polyester or epoxy composite materials, limited to color gels available
Can support tight tolerances and complex geometries necessary to create mating parts	Tolerances/Geometry	Difficult to support complex geometries and tight tolerances necessary to create mating parts with fiberglass molding
Up to 35% lighter	Finished Weight	Up to 35% heavier
Can be molded in color & texture. Offers a high-quality unpainted finish. Can be image impregnated or silkscreened. High-gloss scratch-resistant finishes and metallic options available.	Finish Options	Must be painted. Limited options for high-gloss scratch-resistant finishes.
Both final thermoformed parts and excess material are fully recyclable.	Recyclability	The final parts are non-recyclable and the process uses a significant amount of hazardous materials.