

SPENCER INDUSTRIES INCORPORATED

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Basic Design Guidelines for Thermoformed Parts

It is very important to realize that the key to cost effective production is to stay within the established processing limits specific to a part and to loosen these limits whenever possible. The guidelines listed below are general in nature. Each specific product may have either greater or lesser requirements, so these guidelines are general in nature. Designed applications of the intended part can affect the tolerances of the part. It is our recommendation that each part be discussed prior to and after the quoting process. We stand ready to assist in these discussions.

Materials chosen for a product play a large role in the tolerances of a part. These guidelines are based on experience with dimensionally stable resins such as HIPS, ABS and TPO. These same guidelines would not be recommended for dimensionally sensitive materials such as HDPE, HMWPE, PP, etc..

All trimming is done at ambient plant conditions. Dimensions are based on these temperatures. If parts are measured subsequently in varied temperature conditions, dimensions will change. All materials have differing thermal expansion rates. If wide temperature swings will affect the part it should be noted up front so adequate steps can be taken to insure that the part will function as designed.

General Tolerances and Guidelines

Draft: The degree of taper of a vertical sidewall. This facilitates the removal of the part from the mold. If these guidelines do not meet your design criteria please contact us before making final decisions on the design.

Male Tooling: 2 degrees minimum up to 6 inches depth; 5 degrees above 6 inches depth

Female Tooling: 0 degrees if less than 2 inches depth; part specific if more than 6 inches

Note: some scratching may occur at 0 degrees draft on female tool

Radii: The greater the radii the better for material distribution and cost. Radii should be discussed in detail. Desired part appearance plays a key role in determining the radii that should be used.

Male Tooling: Outside radii should be one material thickness + .03 minimum to + .06,

which is ideal. Height, depth and draft will determine what is needed.

Female Tooling: Inside radii can be as small as .03 which will appear as 0, or sharp.

Draw Ratio: The ratio of the horizontal dimension versus the vertical dimension. The ideal situation is a 2 to 1 minimum (2 horizontal, 1 vertical). This allows the material to flow into or over the feature without substantial thinning that might weaken the feature. It is best to discuss these issues prior again to finalizing the design since draw ratio is very part specific.

Ribs and Bosses: In general, ribs and bosses have been secondary machined parts that were glued into the formed part. This approach is generally relatively expensive. Another approach is to form a second part with these features and glue or sonic weld it to the first part. The least expensive approach is to twin sheet the two parts eliminating the gluing or sonic welding operation. This approach requires design consultation with us to insure the final outcome is what you are looking for in the product appearance and function.

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Texture: Texture should be incorporated into the part to hide such things as vacuum holes and minor blemishes in either the tooling or the sheet. The texture can be put on the sheet or on the mold, or both. In the case of female pressure forming, areas may be left untextured for such applications as assembly of nameplates or decals. Consult us for the recommended textures to give your product the best final appearance.

Part Dimensioning and Reference Points: All dimensions should be relative to the tool side of the part. Reference points should be designed so that all measurements are relative to a controlled surface, i.e., a molded feature or a critical feature. Machined features should be relative to a controlled feature, not each other.

Undercuts: Undercuts can be accomplished through the use of movable or retractable components in the mold. If your product requires undercut areas, please consult with us so that we can assist in designing them correctly.

Tolerances: Most parts are trimmed with cnc trimming machines. While very accurate, there are tolerances involved that must be considered in designing the part. The tolerances listed below are for cnc trimming. Tolerances for die cutting, hand routing, saw cutting and in-mold trimming need to be discussed separately.

Trim to trim tolerance: +/-0.020 up to 12 inches; +/-0.030 12 inches to 60 inches; +/-0.001 per inch above 60 inches.

Form to trim tolerance: +/-0.030 up to 12 inches; +/-0.060 12 inches to 60 inches; +/-0.001 per inch above 60 inches.

Drilled hole center to center: +/-0.015 up to 12 inches; +/-0.001 per inch above 12 inches.

Drilled hole diameters (plunge cut, not routed): +/-0.007 checked with pin gauge.

Drilled hole diameters (non-plunged cut holes): +/-0.015 checked with pin gauge.

Twin Sheet Forming: This process yields the best of all worlds when it comes to both aesthetic qualities and structural integrity in thermoforming. The exterior, or show surface, of a product can be smooth and not show structural components, while the rear of the product can have ribs, bosses and other structural features. Spencer has led the industry in twin sheet forming development for years. We can assist in the design of the product from its very inception.

Assembly and Decorating: Painting, nameplates, decals, hot stamping and hardware are all components that can finalize the product for immediate end use. Spencer specializes in all types of decorating and assembly in house.