

Use Case: Design

***MAXIMIZE THE POTENTIAL
OF ENGINEERING
MATERIALS WITH
THE PROPER DESIGN***

Envalior
Imagine the Future

SUMMARY

Envalior offers many thermoplastics, ranging from high volume polymers to performance and specialty materials. These materials have widely varying properties in the fields of mechanics, chemical resistance, flame retardance and more. They are suitable for production processes such as injection molding, blow molding and extrusion.

Besides these materials that are sold as granules, Envalior also offers the base materials for Advanced Thermoplastic Composites (ATC): uni-directional tape and woven fabrics consisting of continuous glass or carbon fibers embedded in a thermoplastic matrix material. These tapes or fabrics can be wound or thermoformed, resulting in parts that have good mechanical properties.



INTRODUCTION

Given the broad material portfolio that Envalior has to offer, there's a suitable material for almost every design challenge. Depending on the application and the appropriate material and production process, one can benefit from our below offerings.

- Specific properties: using various additives and fillers, thermoplastic materials can be made conductive, flame retardant, resistant to heat, impact, chemicals etc.
- Design freedom: injection molding lends itself to both very small intricate parts and large, yet highly detailed geometries. This enables part/function integration, reducing production and assembly costs.

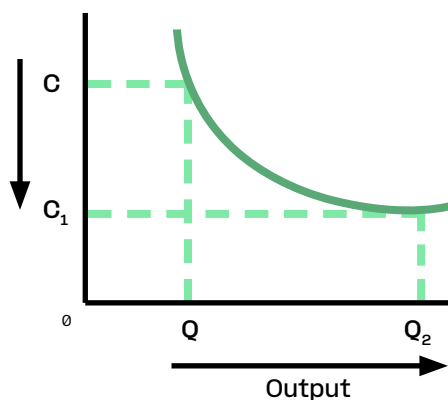


- One-step production process: an injection molded part typically doesn't require secondary operations like deburring, milling or coating.



- Aesthetics and decoration: thermoplastic materials offer intrinsic color and a broad variety of surface textures, eliminating the need for post-processing. Even printing the part can be integrated in the molding process by applying In-Mold Decoration (IMD) or In-Mold Labelling (IML). If desired, parts can be over-molded, painted, metal plated, etc., in a secondary processing step.
- Various fixation options: depending on where/how you want to attach the part, a plastic part can be fixed using snap features, screws, glue, welding, heat staking or over-molding.
- Weight reduction: compared to most metals, thermoplastic materials have a low density, so a plastic part is lighter than its metal counterpart, even if its volume is bigger.
- Cost reduction: production processes such as injection molding, blow molding, and extrusion, are ideally suited for cost-effective mass production.

Average Cost

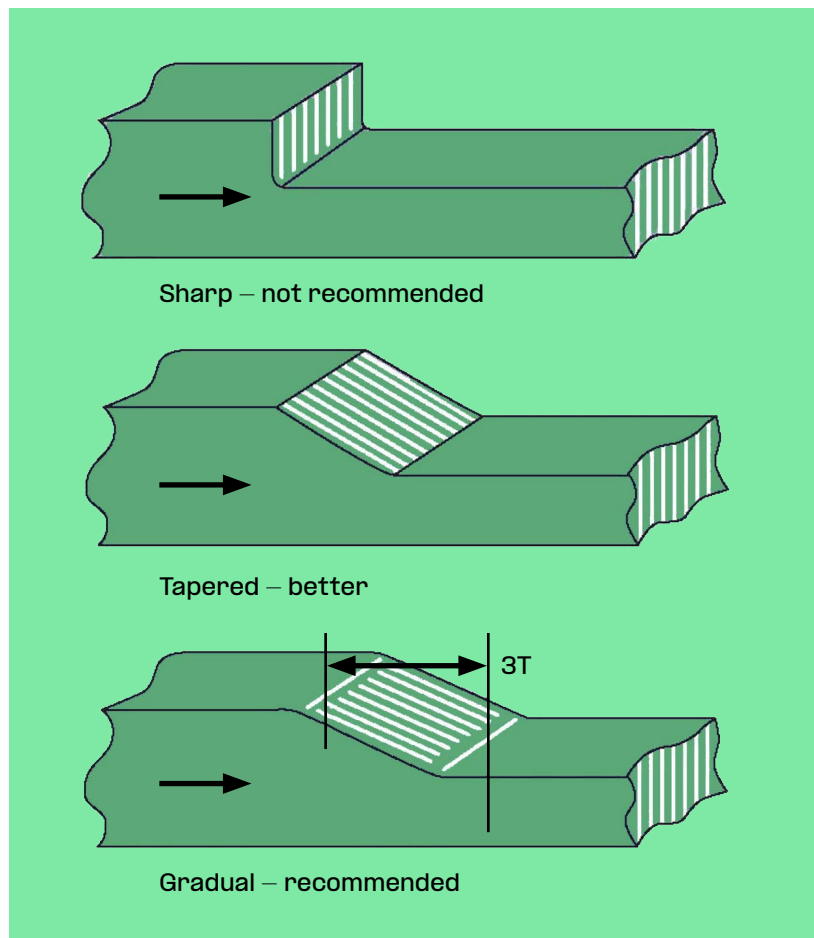


- Sustainable materials: Envalior continuously works on making its materials more sustainable and, as a result, the number of bio-based and recycle-based grades in our portfolio is growing. Our Sustainability Team uses Life Cycle Assessments (LCA) to help you make informed decisions and compare objectively between available solutions.

BEST PRACTICES FOR *DESIGNING ADVANCED MATERIALS COMPONENTS*

To ensure advanced material components are correctly designed follow these guidelines:

- Choose wall thickness wisely, depending on material of choice and application requirements. Apply a uniform wall thickness and/or gradual transitions.

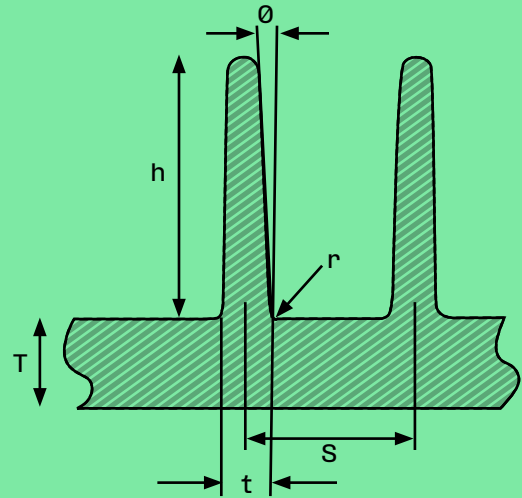


Direction of flow during injection
molding of compact resins

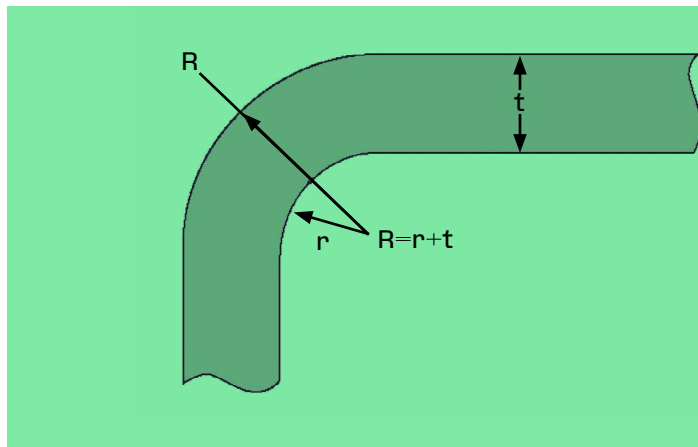
- To locally reinforce a part, add a pattern of ribs—their thickness should be approximately two-thirds of the general wall thickness.

Guidelines for Proportional Ribs

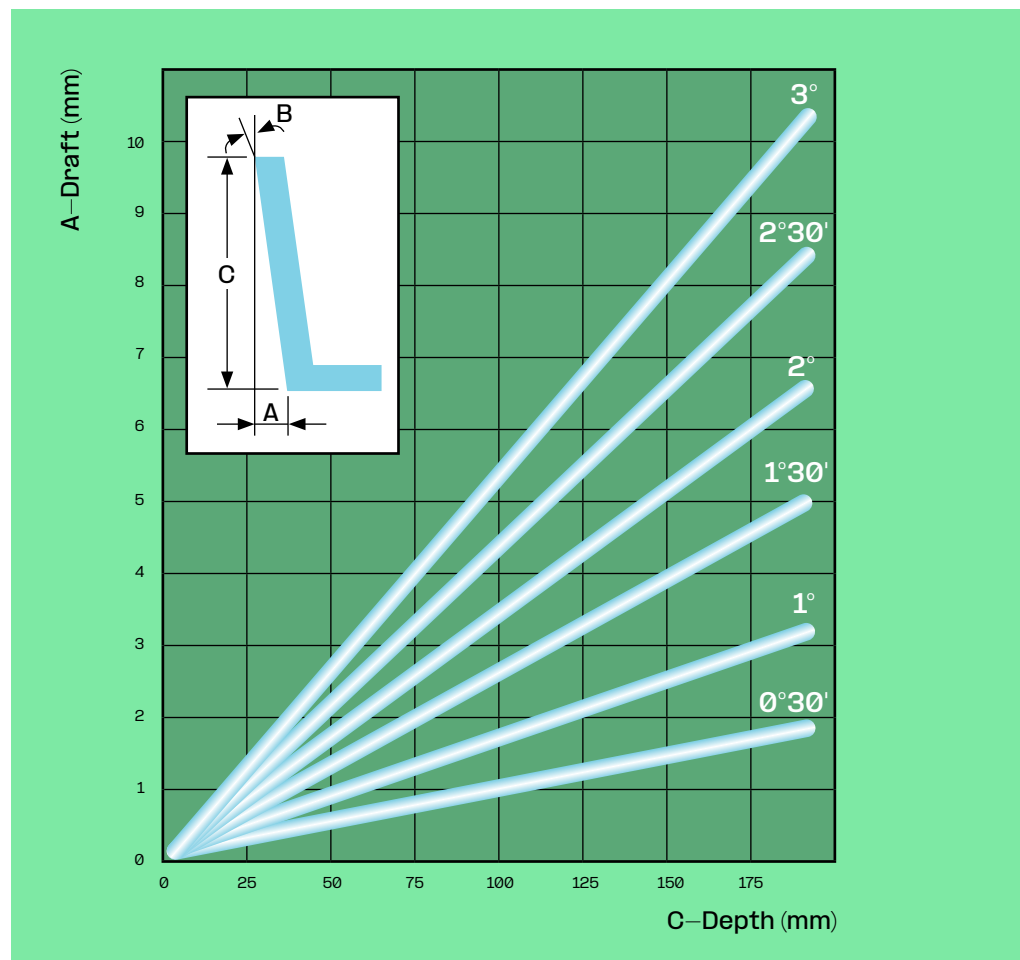
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|-------------------|-------------------------|
| 1. Base thickness | $t \leq 0.5T$ |
| 2. Height | $h \leq 3T$ |
| 3. Corner radius | $r \geq 0.25 - 0.5T$ |
| 4. Draft angle | $\theta \geq 0.5^\circ$ |
| 5. Spacing | $S \geq 2T$ |



- In corners, apply fillet radii as sharp corners are sensitive for stress concentration and are also suboptimal for material flow in the mold and mold durability.



- Metal inserts can be considered in highly stressed areas, for example where the part is connected to other parts.
- Avoid narrow, deep pockets in the part. These require thin, long tooling cores that are weak and difficult or impossible to cool properly.
- Tooling modifications are relatively easy when they are metal safe, meaning material is removed from the mold (and subsequently material is added to the part).
- Apply a release/draft angle on surfaces perpendicular to the pull direction of the mold; this will facilitate ejection of the part and prevent scratch marks on the part's surface.



CONCLUSION

Envalior, a global leader in thermoplastic material science, offers a full portfolio of best-in-class thermoplastic material solutions and global application development support. Through innovation and market-leading sustainable products, we make ideas come to life. We drive progress for a better and more environmentally friendly world. This can only be achieved through deep collaboration with our customers and stakeholders who share the vision for a better future.

Our products and innovative pipeline of new materials are sustainable, purposeful and circular and are designed to make the world a better place. Many challenges lie ahead to be tackled in an evolving environment, but we are confident our high performance, safe and lightweight solutions will shape the future in new mobility, advanced electrical and electronics, and many other industries.



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