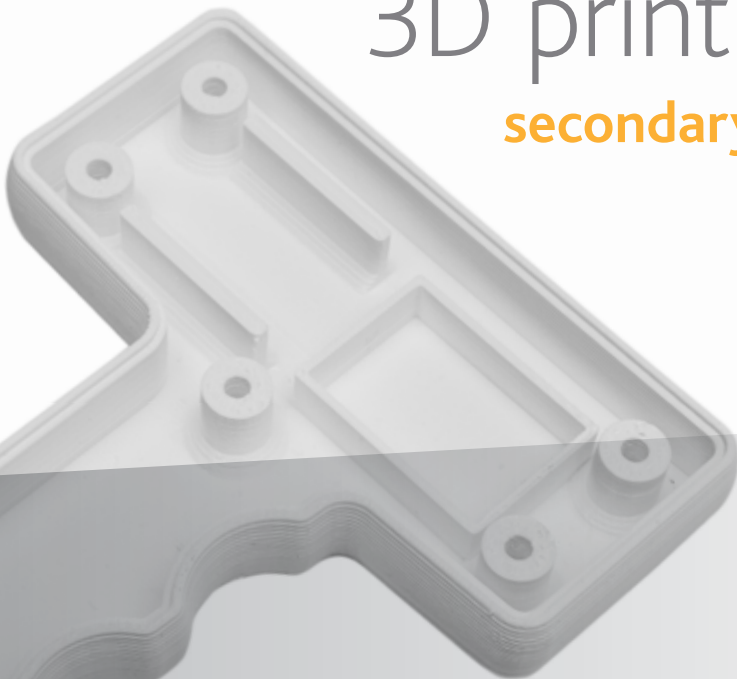




3D printing

secondary operations guide



EASTMAN

3D printing with Amphora

Eastman Amphora™ 3D polymers are low-odor, styrene-free materials that are uniquely suited for 3D printing applications. Filament made with Amphora offers makers the ability to create articles that are more functional, durable, efficient, and attractive. Amphora provides advantages over competitive materials, such as low odor, attractive gloss, dimensional stability, superior toughness, ease of processing, and FDA compliance.



Joining and assembly

3D printed parts created using filament made with Amphora can be assembled by various techniques. For best results, final application and product performance needs should be considered when choosing the most appropriate assembly method.

Adhesives and mechanical fasteners can be used to assemble 3D printed articles produced using filament made with Amphora. In some instances, ultrasonic welding could

also be used to join parts (part design and final application will play a key role in this). Mechanical fastening can be useful for large or heavy parts or when a suitable adhesive system is not available. Always use screws designed specifically for plastics. If bolting parts together, allow for thermal expansion and contraction by drilling oversized holes. Make sure the holes have smooth edges. Do not overtighten screws.



Drilling

Articles printed with filament made from Amphora can typically be drilled using a standard drill press or handheld drill with sharp, clean drill bits. Drill bits designed for use with plastic are recommended. Standard, general-type steel drill bits have also been used but may have to be ground to reduce the depth or angle of cut.

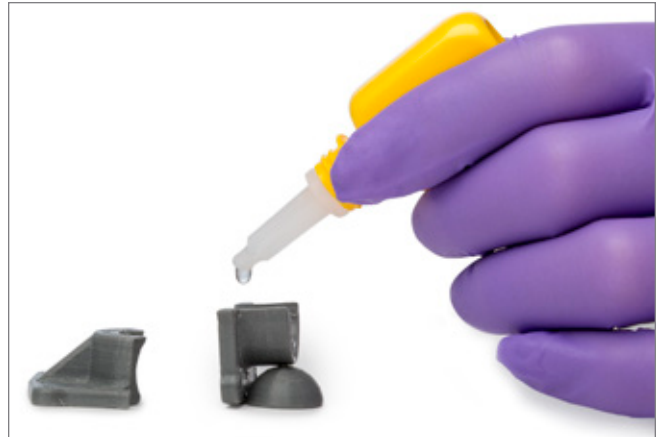
Optimum bit speed, feed rate, and applied pressure will depend on hole size and part thickness. Drill speeds up to 1750 rpm are usually best for smaller holes while speeds as low as 350 rpm can work for larger holes.



Adhesive systems

Many adhesives are available for joining plastic materials. Due to this fact, it is difficult to make general observations. Adhesives do not evaporate and remain a functional part of the finished assembly. The performance and, in some cases, appearance of the finished part can depend heavily on the characteristics of the adhesive layer used. Characteristics to consider when selecting an adhesive follow:

- Chemical compatibility with the part being joined
- Aesthetics
- Expansion/contraction with temperature fluctuations (*mechanical fastening may be a solution to this issue*)
- Brittleness/flexibility
- Service life of the part
- Adhesive strength (*adhesion to the plastic part*)
- Cohesive strength
- Part design
- End-use requirements



Adhesive bonding procedure

The surfaces of 3D printed parts which are to be joined using adhesive systems must fit well without forcing and have no gaps. The bonding surfaces should be smoothed with 120-grit or finer sand paper. The following are a selected number of adhesive systems which have been shown to perform well in bonding Eastman Amphora™ 3D polymers:

- Weld-On® 55™
- Lord® 7542 A/B
- Lord® 406/19
- Loctite® 3105™
- Loctite® 3106™
- Loctite® 3103™

Evaluation of adhesive performance is done according to ASTM D1002.

The adhesives listed do not represent all materials that may work but simply those that have been evaluated and shown to perform well with Amphora. For best performance, follow the guidelines for use provided by the adhesives manufacturers.

Coating/smoothing

There are instances when 3D parts are printed and the parts are rough to the touch due to part design or the way the part was printed. When sanding a printed article, start with 120/180 grit sand paper and work up to 320 grit or higher. The color of the article may change or become slightly dull after sanding, but much of the initial gloss can be recovered with polishing. There are also coating materials on the market that can be used to potentially smooth parts. These coatings are generally applied to parts with a brush or the part can be dipped in the coatings system. There is an associated cure time with these coatings systems. Follow the guidelines provided by the coatings manufacturers when using the systems.

Post-processing is typically unnecessary when printing with filaments made using Amphora. If the user deems post-processing applications are necessary, certain tools and techniques may be applied. In the case of creating a print article with complex designs, support material may be carefully removed using a hobby knife or other sharp blade.

Decorating

The use of decorating techniques allows for aesthetically pleasing parts to be produced. Eastman Amphora™ 3D polymers are typically receptive to a number of decorating techniques.

Painting

Painting can be used to add a decorative element to the part or to possibly improve part surface functionality. Some typical reasons to choose paint may include:



- Improved chemical, abrasion, or weathering resistance
- Color matching with adjacent parts
- Decorative appearance
- High-gloss or matte finish

There are two basic types of commonly used paints: lacquer and curing enamel. The lacquer paints dry by solvent evaporation while the curing-type paints typically require a bake to obtain performance properties. Follow the manufacturer's guidelines for optimum results. Paint suppliers include:

- Norcote
- Sherwin Williams Company
- Nippon Paint Company
- Red Spot Paint & Varnish Company

Before choosing a decoration technique or paint system, the end-use requirements need to be understood and communicated to the paint/ink manufacturer. There are always adhesion concerns with any paint/ink after the coating is applied to the plastic part. It's vitally important to test adhesion on the part being produced.



Spray painting

Conventional spray painting techniques can be used to decorate 3D printed articles. A list of plastic spray paints follows:

- Krylon® Fusion
- Rust® Oleum for Plastic
- Testors® One Coat Lacquer

When selecting paint, carefully consider fitness-for-use requirements such as dry film adhesion and impact strength retention. You may obtain more detailed information about these characteristics from the paint supplier.

Printing/labels

Printing is a common method used for application of markings on parts to add aesthetic options to the finished article. In general, graphics can be easily printed onto parts produced from Eastman Amphora™ 3D polymers. A number of different printing techniques can be used. The use of appropriate ink systems is required to produce parts with the required graphics. Ink suppliers include:

- Nazdar
- Sun Chemical

Self-adhesive labels and decals offer a method for applying graphics or decorations to parts. Labels can be classified as either temporary (designed to be removed at some point during the product life) or permanent (designed to remain in place during the life cycle of the part). Criteria to consider when selecting a label include:

- Is the decoration temporary or permanent?
- Should the label be clear, semitransparent, or opaque?

Some typical types of labels that work well with filament made using Amphora are systems based on PET, polystyrene, or biaxially-oriented polypropylene film backing.



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**Eastman Chemical Company
Corporate Headquarters**

P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

U.S.A. and Canada, 800-EASTMAN (800-327-8626)
Other Locations, +(1) 423-229-2000

www.eastman.com/locations

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