

# Mushroom<sup>®</sup> Packaging

By Ecovative



Our Treaty's Mushroom<sup>®</sup> Packaging



**Custom Packaging Design  
Process + Overview**

© 2023 Mushroom<sup>®</sup> Packaging - Technology pioneered by Ecovative Design

Confidential - not for distribution

# Welcome to Mushroom<sup>®</sup> Packaging

**Originally created in 2007,**

Our packaging is grown, not manufactured.

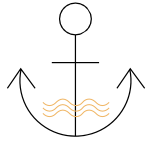
We offer a high-performing, cost competitive packaging solution which is naturally thermally insulating and water resistant. Mushroom<sup>®</sup> Packaging grows in 7 days using mycelium, the roots of mushrooms, as the biological binder, and is fully home-compostable in 45 days.

Once we've identified the opportunity fit, we'll look to connect you with the appropriate Mushroom<sup>®</sup> Packaging licensee for your region.



# Mushroom<sup>®</sup> Packaging **is**

Made with only two simple ingredients — hemp hurd and mycelium — our packaging protects whatever you're shipping.



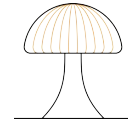
Ocean Safe



Plastic Free



Chemical Free



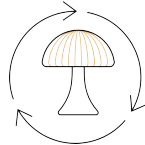
Natural



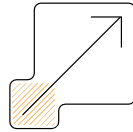
Flame Resistant



Grown



Home Compostable



Scalable



Water Resistant



Custom Design

# Custom Design Timeline

Phases and lead times for the Mushroom®  
Packaging custom design process

## Design

### Dimension Drawing + Render

This stage includes a price estimate per-piece.  
Design & Prototyping fee quoted based on project scope.

**1-2 business days** per iteration

## Prototype

### Custom Grown Prototype

Price includes 2 rounds of prototyping, if required.  
Additional iterations and prototypes available for an extra fee.

**3-4 Weeks** per iteration

## Quote

### Quote + PO

**Includes production tooling costs which typically range from \$1,500-\$8,900**  
depending on timelines, commitment size, and annual volume needs.

**1 Week** per iteration

## Production

### Tooling

Lead time required to  
produce production  
tooling.

**3-4 Weeks**

### Production

Lead time varies based on annual volume needs and  
tooling investment. Lead time decreases with future  
reorder or blanket POs.

**6-12 Weeks**

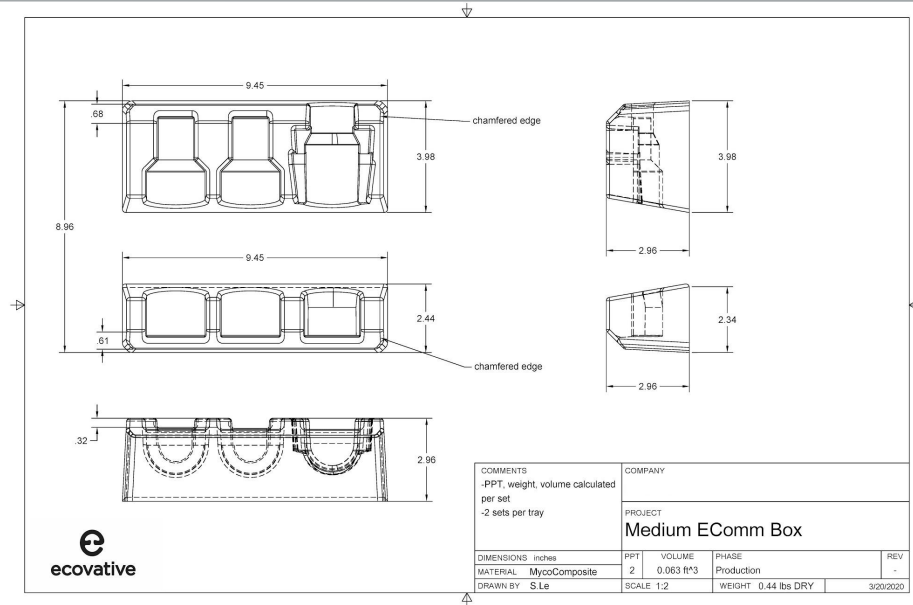
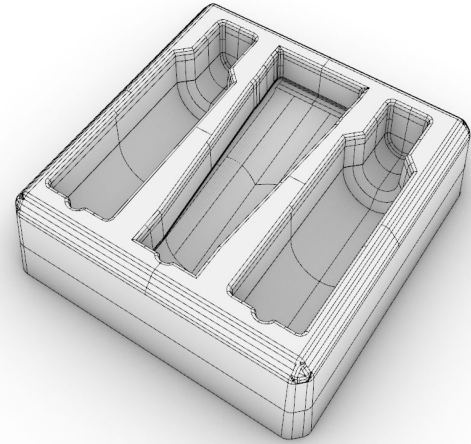


# Design + Prototyping Process

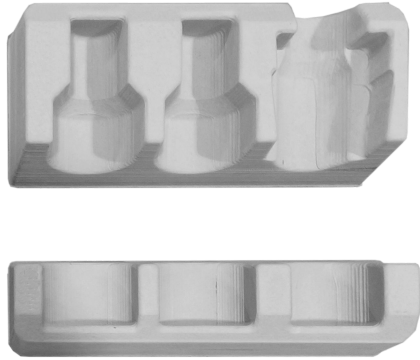


# Design Process

Design is created in-house using CAD. After receiving feedback, iterations are made to create a final render and dimension drawing.



# Prototyping Process Overview



## Step 1: Hard tool

CNC the positive form design out of MDF (medium density fiberboard), which is used for forming grow trays.



## Step 2: Growth tray

Recyclable PETG plastic thermoformed tray for growing Mushroom® Packaging, which is reused many times.

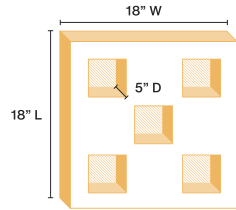


## Step 3: Grow + Ship Parts

Fill grow trays with substrate and let them grow for a 1 week cycle before shipping to client for approval.

# Design Constraints

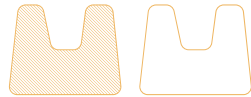
Guidelines and Considerations for  
Mushroom® Packaging



## Maximum Part Dimensions:

18 x 18 x 5"

Smaller parts fit multiple per tray.



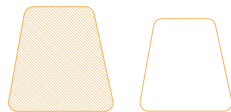
## Contraction

Parts must be scaled up since they shrink when drying:

4% in the x axis

4% in the y axis

7% in the z axis



Wet/Living

Dry

## Velvety Overgrowth

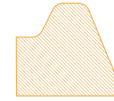
4 days in tray (internal growth)

2 days no tray (external growth/overgrowth)

1 day to dry, preventing further growth and fruit mushrooms.

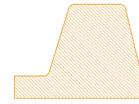
Incorrect

Correct



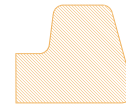
## Draft Angles

At least a 3 degree draft angle on all vertical walls, with no undercuts.



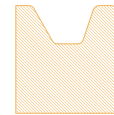
## Wall Thickness

Minimum of  $\frac{3}{8}$ " to avoid voids. Avoid large, thin walls which can warp and are structurally weak.



## Edges

Fillet all edges with a minimum radius of 0.125"



## Draw Ratio

The draw ratio should be at least 1 unit wide by 1 unit tall. Avoid deep cavities.



## Orientation

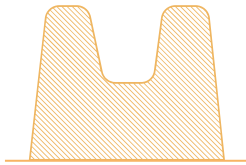
Standing upright on shelves is not recommended due to draft angles. Product will tilt downward and could fall.

# Design Tolerances

Standard Tolerances for Mushroom® Packaging

## Why Tolerances?

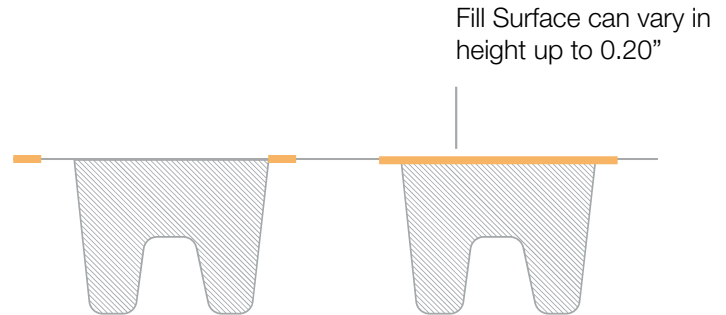
Flash extends out when mycelium grows, flash is mostly trimmed off but can have some extra material width, up to 0.20"



### Standard Tolerances for Grown Parts

+/- .125 Molded Surface in cavities  
+/-0.20 XYZ overall dimensions

\*Sleeves are not recommended due to these large tolerances.



### Fill Surface

Every tray is filled in one direction, typically on the bottom because it is flat. The fill surface texture is rougher than the molded surface.

Molded Surface in cavities can have slight variations due to overgrowth, up to .125" which can influence how tight a product fits.

# Orientations for Custom Parts

Some options to choose from depending on your product needs



1 Piece  
**Laydown**

*\*Most popular & cost effective!*



1 Piece  
**Upright**

*For shorter products*



2 Piece  
**Laydown**

*For larger products*



2 Piece  
**Upright**

*For added protection*



Logo  
**With Lid\***

*For insulation needs.*

*We do not recommend designing with a lid unless required for thermal purposes*



3 Piece  
**Bottom + Sides**

*For largest products*

# Material Specifications, Certification + Testing



# Material Specifications Sheet

Mushroom® Packaging Hemp Blend

ATTRIBUTE	STANDARD	HEMP BLEND
Density (lbs/ft3)	ASTM C303	7.6
Internal Bond (psi)	ASTM D1623-09	—
Compressive Strength (psi)	ASTM C165	18
Compressive Elastic Modulus (psi)	ASTM C165	165
Screw Hold - Face (lbf)	ASTM D1037-12	—
Flexure Strength (psi)	ASTM C203	34
Compostability (days)	ASTM D6400	30
Flame Spread	ASTM E84	20
Peak Heat Release Rate (kW/ m2)	ASTM E84	—
Smoke Emission (m2/m2)	ASTM E84	50
Thermal Conductivity, at 10°C (w/mK)	ASTM C518	0.039
Water Vapor Permeation (dry cup)	ASTM E96	30
Moisture Storage at 53.5% RH (%)	ASTM CI498	8
Moisture Storage at 75% RH (%)	ASTM C1498	12
24 Hour Water Swell (%)	ASTM D1037-12	—



# Drop Testing and Ship Testing

Requirements and Recommendations

## **Drop Testing: ISTA 1A Standard Testing Procedure**

- Performed in house at no extra cost
- Drop 10 times at height dependent on weight of product
- We require final outer shipping boxes (provided by client) to properly conduct this test. If parts are required to go into production before final outer boxes are available due to time constraints, we will not be able to complete this test for design validation purposes.

## **Ship Testing**

- Once a prototype design is confirmed, we encourage clients to complete a simple ship test with prototype packaging using the box, Mushroom® Packaging prototype, product, and any marketing collateral.
- Client is encouraged to conduct further ship testing as desired before prototypes are fully approved for production.

## **Additional Testing**

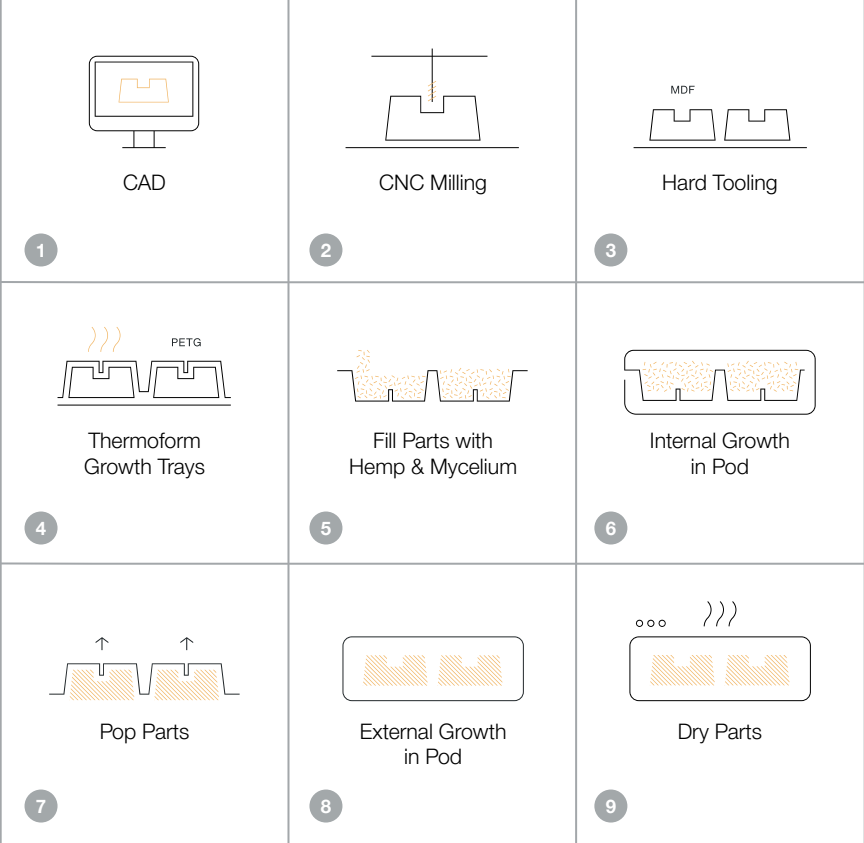
- Vibration testing and other shipping tests can be done at a third party testing facility at an extra cost if required.
- Many customers conduct further testing on their own and additional prototypes can be provided as needed for a small fee.

# Production Process



# Mushroom<sup>®</sup> Packaging Overview

Design packaging, Fabricate tooling, Grow parts



# Step 1: Fill Parts

Mushroom® Packaging Production Process



After filling the grow trays with our hemp & mycelium raw material blend, the parts are podded and grow for 4 days as the mycelium starts to bind the loose substrate together.

## Step 2: Pop Parts

Mushroom® Packaging Production Process



After popping parts from the grow trays, the parts are placed on racks to grow for 2 more days. This step creates a soft layer of mycelial overgrowth.



# Step 3: Dry Parts

Mushroom® Packaging Production Process



Finally, parts are dried to inactivate the mycelium from further growth. No spores are produced in this process.

# Examples of Custom Molded Parts

A sample of companies that use Mushroom® Packaging



# Examples of Standard Parts



Breakaway Corners



Breakaway Corners  
in Box



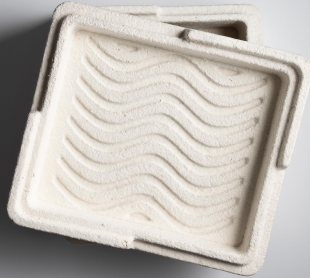
Small Gift Box



MushLove Gift Box



Small Cooler  
both pieces



Large Cooler  
both pieces



Brick



Sample Part



Bear



Tincture Packaging





# Thank You

Visit us at: [MushroomPackaging.com](https://MushroomPackaging.com)

Visit our Licensees too!

