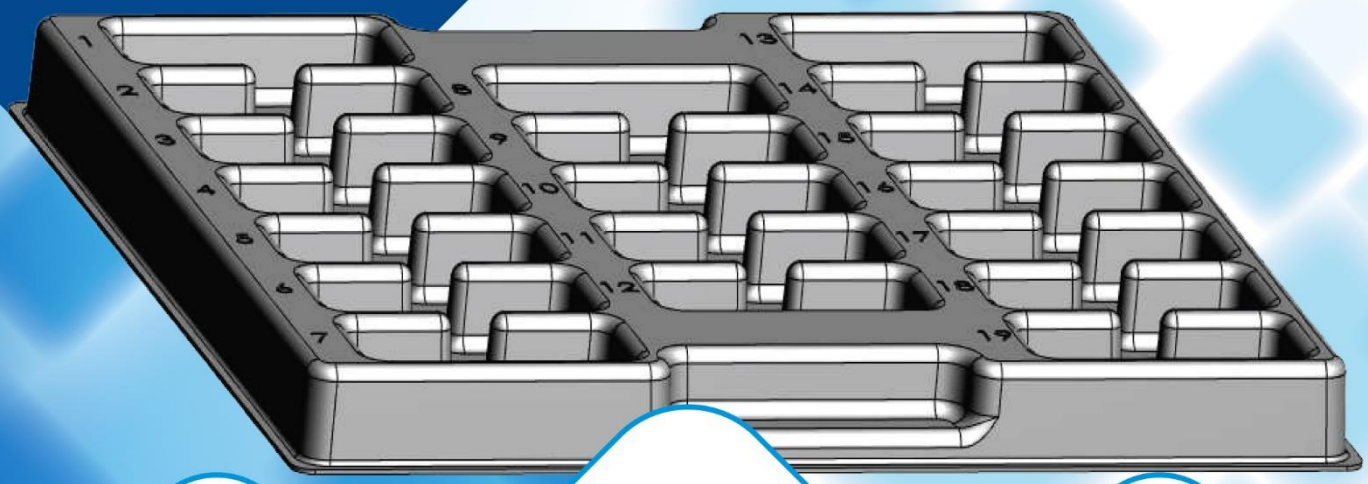
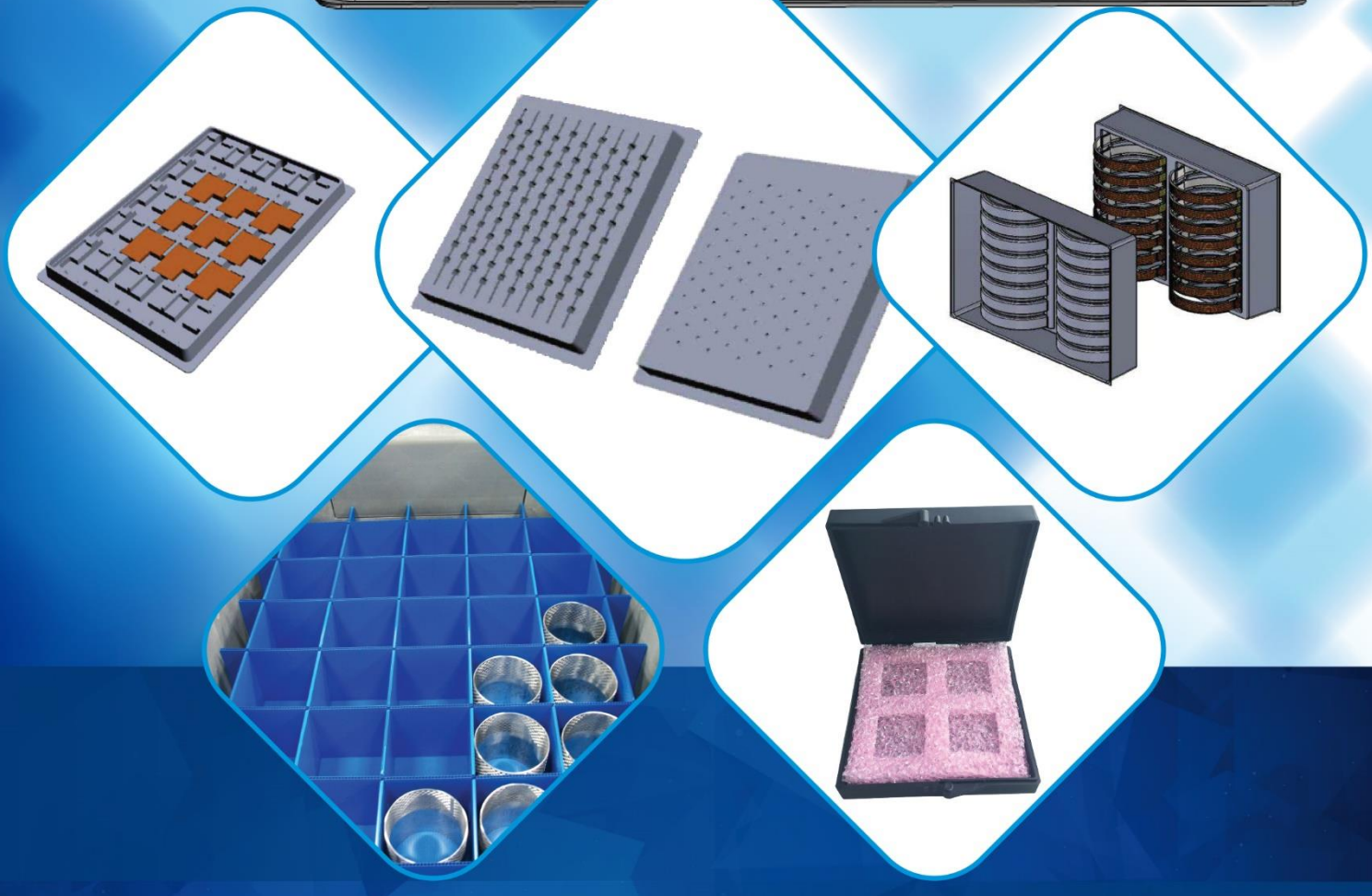
Custom Trays
Design Guide

ENGINEERED COMPONENTS & PACKAGING, LLC





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Custom Plastic Trays Design Guide

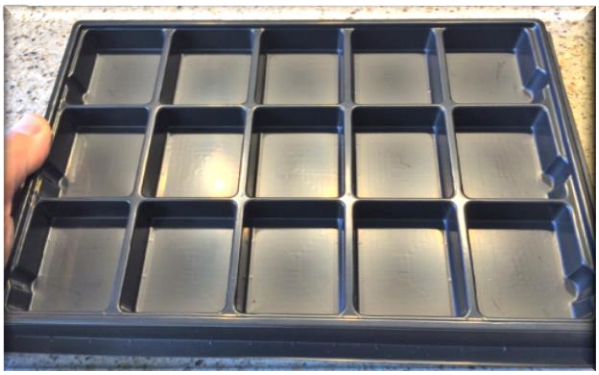
This white paper is intended as a guide noting common Tray Design Features, Material Options, and Typical Tray Applications along with the Advantages of Custom Tray Packaging. This guide is designed to assist packaging engineers and others tasked with tray design and sourcing. For additional information on custom plastic trays contact Engineered Components & Packaging.

Outline

Advantages of Custom Trays

- **Low Tooling Cost**
  Starting at $ 600 for basic designs in low volume applications.

- **Labor Savings**
  Eliminating bags or special packaging materials can streamline the packaging process saving significant time while properly protecting parts.



Conductive, Reusable, Stackable

- **Economical Packaging Cost**
  Low part cost and cost per component. Trays are also low in weight reducing shipping costs.

- **Part Counts & Inspection**
  Trays can be made to a specific even number like 50 or 100 cavities per tray facilitating counting. Cavities can be numbered if needed for inspection.

- **Cleaner than Corrugated**
  No corrugated dust with plastic trays. The plastic can be used in cleanrooms or for medical applications depending on material choice. See material information below.

- **Reusable Packaging**
  Trays can be made for internal plant handling and for shipping applications. Reusability reduces packaging cost per component vs. disposable custom trays.

Advantages of Custom Trays

➢ Custom Tray Cavities

Custom tray cavities formed to exactly match part or made to contact part only in certain areas building in clearance (areas of no contact) for fragile or areas requiring optical clarity. More information below.

➢ Material Options

Material options depending on part and application. For instance several ESD materials are available for electronic components. PETG is often used for optics and lenses sensitive to outgassing. More information in Material section below.

➢ Used With Automation

Able to be used in Automation Processes. See custom design features below.

➢ Overall Tray Size

Overall tray size to fit current box configuration, or standard off the shelf boxes.

➢ Recyclable

Plastics used for trays are 100% recyclable, and trays are often reusable.

Tray Applications

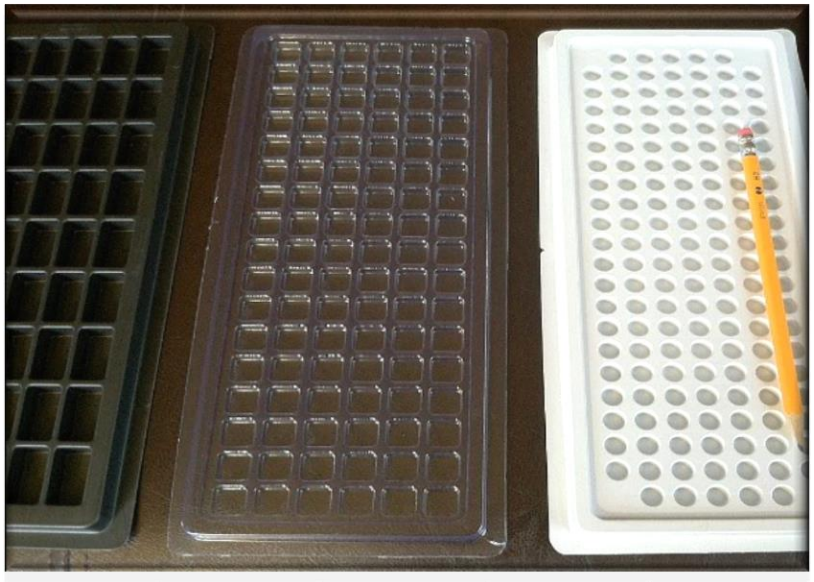
- Shipping Trays
- Material Handling Trays
- ESD protection Trays
- Medical Trays
- Drip Trays
- Automation Trays
- Packaging Trays
- Automotive Style Dunnage Trays
- Food & Bakery Trays
- Retail Trays

Materials for Custom Trays

Custom Trays Material

Material selection is a key decision when specifying a tray. Key variables when choosing a material include, ESD requirements, impact resistance, budgetary constraints, operating temperature, chemical resistance, cleanliness with regard to applied coatings, clarity (clear vs. opaque), color, and sealing technique if applicable.

- **Material Thickness**
- **Material Considerations**
- **Common Materials**
- **ESD Materials for Shipping Trays**
- **ESD Materials for Reusable Trays**



Materials for Custom Trays

Material Thickness

Plastic

- .020” starting thickness is common for disposable shipping trays for small parts.
- .030” - .060” starting thickness for use for a number of cycles but not long term.
- .060 to .375” starting thickness for long term reusable trays.

(Notes intended as a guide dependent on depth of tray and many other factors.)

Molded Pulp (2 Options)

- .⅛” standard gauge molded pulp. This is typically used for shipping and lighter items.
- .250” heavy gauge molded pulp is very durable used for skids, trays, and heavier parts.

Material Considerations

- Cost
- Chemical Resistance
- ESD Requirements
- UV Resistance
- Wash-ability
- Durability
- Heat Deflection
- Coatings applied to materials for ESD protection or de-nesting *(medical)*

Materials for Custom Trays

Common Materials

Shipping & Reusable Trays

➢ PVC

Primary Use: *Small Part Shipping Trays*

Advantages:

1. *Clear*
2. *Low cost, Durable (longer lasting than styrene in comparable thickness)*
3. *Good chemical resistance (see chart).*
4. *Available in ESD with an anti-static non silicone coating (see ESD Options).*

Disadvantages:

1. *Generally has a de-nesting agent allowing trays to be separated when nested. This is an applied coating which often includes silicone.*
2. *Due to silicone coating, may not be good option for medical applications depending on sensitivity of application.*

➢ HIPS (thin & heavy gauge)

High Impact Polystyrene

Advantages*:*

1. *Low cost material for shipping or reusable trays comparable in price to PVC Clear.*
2. *Styrene is readily available in black and white. (ESD options below)*

Disadvantages: *Styrene is more rigid than PVC with the possibility of cracking on corners with reuse.*

➢ PETG

Clear Polyester: *Thin & Thick Gauge Options*

Primary Use: *Common applications include Medical & Optics*

Advantages:

1. *It has excellent strength for use in packaging trays and is a low outgassing material.*

Disadvantages: *Some versions have a de-nesting agent similar to PVC which can be silicone.*

Materials for Custom Trays

➢ HDPE (thin & heavy gauge)

Primary Use: *Shipping Trays in Special Applications & Automotive Trays*

Advantages:

1. *Low cost*
2. *Durable (longer lasting than styrene in comparable thickness)*
3. *Clear*
4. *Good chemical resistance (see chart).*
5. *Available in ESD with an anti-static non silicone coating (see ESD Options).*

Disadvantages:

1. *Tendency to warp which make it difficult to use for trays that need to be flat for automation applications.*
2. *Also very difficult to bond to HDPE.*

➢ Polypropylene (thin & heavy gauge)

Primary Use: *Often used in Medical Trays for Shipping & Storage*

Advantages:

1. *Polypropylene has unique chemical resistance properties, and resists heat allowing it to go through some sterilization processes like autoclave.*
2. *Often used in medical applications.*

Disadvantages:

1. *PP is a softer material and also can be difficult to maintain flatness*

➢ Polycarbonate

Primary Use: *High Heat Applications & Lab Trays*

Advantage:

1. *Key advantage to using polycarbonate is the higher heat deflection temperature.*
   - *Heat Deflection Temperature* *270 degrees Fahrenheit*
   - *Continuous Temperature (=24/7)* *180 degrees Fahrenheit*
   - *Intermittent Use Temperature* *257 degrees Fahrenheit*

Disadvantages:

1. *Polycarbonate is more expensive by a factor of 5 compared to the low cost packaging items.*

Materials for Custom Trays

➢ **ABS** (thin & heavy gauge)

Primary Use: *Reusable Trays & Medical Applications*

Advantages:

1. *Material has good impact resistance.*
2. *It is often used with drip trays or automation trays as material stays flat.*
3. *Most common color is black.*

Disadvantages:

1. *Fairly low price but more expensive than Styrene, PVC, and PETG.*

➢ **Foam**

Option: *Rigid*

Materials: *Polyethylene & Polyurethane in multiple densities, Anti-Static & Conductive Materials*

Advantages:

1. *Polyethylene is a stiffer material better if parts have weight.*
2. *Polyurethane is a softer material potentially better if parts scratch easily.*

ESD Tray Materials

Shipping & Semi-Reusable Trays (thin gauge)

➢ **Anti-Static PVC** (thin gauge)

Primary Use: *Shipping Applications*

Advantages:

1. *Generally a thin gauge option in .030 starting thickness*
2. *Surface Resistivity (see data page BVDC-H1X)*

Disadvantages:

1. *Not for long term use*
2. *Coating will become less effective with time and use.*

Materials for Custom Trays

➢ Conductive Styrene – Black (thin gauge)

Primary Use: *Semi-reusable and reusable trays (as ESD properties are set in the material)*

Advantages:

1. *Generally a thin gauge option stocked in .030" starting thickness / Not coated.*
2. *Surface resistivity 10e^4 to 10e^7*

Disadvantages:

1. *More expensive*

➢ PETG Anti- Static (thin gauge)

Primary Use: *Shipping Applications*

Advantages:

1. *Generally a thin gauge option in .030 starting thickness.*
2. *Surface Resistivity of material 10e^9 (see SC-E773 data page)*

Disadvantages:

1. *Coating will become less effective with time and use (not for long term use).*

Reusable & Material Handling Trays (heavy gauge)

➢ HDPE Blue Anti-Static

Anti-static, generally blue, do not hold a charge for very long. A charge of 5000 volts is fully decayed in less than 2 seconds.

Options: *Heavy Gauge*

Primary Use: *Material Handling*

Advantages:

1. *This material is that it does not slough conductive particles and is therefore usable in clean room situations. Trays meet minimum specifications per MILB-81705B.*
2. *The base material, high density polyethylene, has high impact strength.*
3. *Tested to less than 1012 ohms per square inch.*

Disadvantages:

1. *This material requires a relative humidity of 15% or greater, so it won't do the job in very dry atmospheres.*

Materials for Custom Trays

HDPE Black Conductive

Conductive containers are always black because the material contains carbon black.

Options: *Heavy Gauge*

Primary Use: *Material Handling*

Advantages:

1. *The carbon black allows the containers to conduct, and therefore if grounded, they will not create an ESD moment.*
2. *The conductivity of the containers is a permanent part of the high density polyethylene material used to manufacture the containers.*

Disadvantages:

1. *There is, however, a tendency for minute particles of the carbon black to slough. This trait may make the containers unacceptable in certain clean rooms. Surface tested to make sure that it is 105 or less ohms per square inch.*

Conductive ABS (heavy gauge)

Primary Use: *Storage Trays*

Advantages:

1. *Used for long term ESD Applications*

Disadvantages:

1. *Expensive compared to conductive HIPS (see above) and standard PETG.*

Inherently Static Dissipative (heavy gauge)

Primary Use: *Storage & Handling Trays*

Advantages:

1. *Used for long term ESD Trays.*

Disadvantages:

1. *Expensive compared to conductive HIPS (see above) and standard PETG.*

Tray Cavity

Tray Cavity Options

Custom Tray Cavities

Tray cavities formed to exactly match part or made to contact part only in certain areas building in clearance (areas of no contact) for fragile or areas requiring optical clarity.

Custom Geometric Cavities

Tray cavities can be formed in more standard geometric shapes to hold on part or act as a universal cavity tray for use with multiple part sizes. Simpler cavities in standard geometric shapes generally have lower tooling cost.

Prototype Cavity Trays

These trays can be made inexpensively or as a step in the design process. A small 3- 5 cavity tray can be made to insure tray function before the final tool is built. This step usually costs less than $250 and validates the cavity. Full size prototypes can also be made for low cost allowing for design and fit issues to be used prior to tray production.

Cavities sized to specific part in automation application.

Tray Design Features

Common Design Features Which Can Be Designed Into Custom Trays

Easy Handling

Trays can be designed with finger or tweezer clearance for easy placement or removal of parts.

Numbered & Easy Counting Cavities

Cavities can be in even numbers like 50 or 100 to facilitate counting. Numbers can be molded in for each cavity for inspection or other applications.

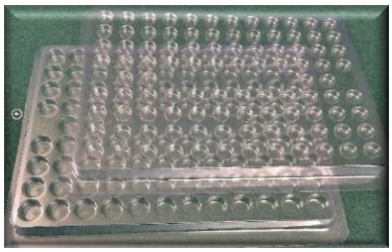
Kitting

Trays can be made for assembly operations. This can be a tray with a specific number of cavities or with cavities sized to fit part. The tray color can contrast the parts allowing easy identification if missing a part needed for an assembly. These kits can be prepared for assembly stations in lean manufacturing environments and help insure there are no items left out when assembled. An example is a medical device tray.

Tray Design Features and Best Practices

Lids

Tray lids can be designed to fit a custom or stock tray. Lid can be clear for visibility or can include form features which fit into cavities and prevent movement; or parts jumping cavities in very small part packaging.



Stacking

Stacking features can be designed to allow tray stacking with no load on parts. This is different than nesting (see below). Stacking features and nesting features can be designed into the same tray. Click the following link to watch Stacking Video.

Automation

Locating features can be added to assist with optical or mechanical robotic part placement. Consistency from tray to tray is good which allows for robotic cavity placement.

Nested

Nesting built into the tray design keeps space requirements low for the packaging. Nesting is different than stacking. Nesting is when a tray fits inside another tray when empty like plastic cups. Stacking is when features are built in tray to stack at a specific dimensional height where no weight is on the packaged part.

Tray Design Features and Best Practices

Snaps, Friction Fit, Indentations & Undercuts

These can be used to hold part or to fasten cover or tray lid.

Engraving

Company Name or Company Website can be molded into tray with no additional part cost. Numbered cavities can be molded on tray. Special notes can be molded into tray. Notes such as “Return to …..”.

De-nesting Lugs

Some materials stick when nested. This design feature allows for easier handling of trays by operators.

Living Hinge

This is a feature in plastic clamshells which attaches the cover to the tray. Often snap features are included with clamshell packaging or clamshell can be heat sealed. This is usually used with retail packaging. There is added design cost compared to a unhinged tray and cover, or a stacking tray.

Printing & Contour Printing

Printing and contour printing is available on packaging for higher volume applications. This process creates a 3D image on the formed thin gauge packaging. Main area for this is retail and food. Not typically used for industrial packaging.

Related Documents

- Thermoform Design Guide
- Polycarbonate High Heat Guideline
- SC-E773 Material Data Page
- BVDC-H1X Material Data Page
- Conductive Styrene Data Page

This guide was prepared by Engineered Components & Packaging, LLC. Founded in 2008, ECP offers the largest selection of stock trays that are not available from general purpose packaging houses or box suppliers. ECP also provides custom trays for a wide range of applications in industries including Medical, Optics, Transportation, Machining and others.

For more information on plastic packaging tray design, contact a packaging specialist at info@ecpplastictrays.com or call (585) 750-5187.

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