

Redesign Box Geometry

Changing the dimensions of a corrugated box can reduce fiber content and packaging waste. Recall that the volume of a box equals its height multiplied by width and length. By changing these three dimensions, you may be able to maintain the same volume but reduce the amount of fiber used.

The most common types of corrugated shipping cartons are Regular Slotted Cartons (RSCs). RSCs have top and bottom flaps that fold and meet in the center, thus helping to prevent bursting by evenly distributing the weight over the flap surfaces. Generally speaking, with RSCs, the most efficient shape (least fiber per unit of volume) is a carton where the length and height (also referred to as “depth”) are the same (or very similar), and the width is about half of the length. Very shallow RSCs, where the height is less than either length or width, have excessively large flap areas in comparison to the body of the carton.

You can evaluate different box geometries for RSCs using the following formula. The goal is to maximize the ratio of box volume to “flat area”. Flat area is illustrated in Figure 1. This provides you with the most volume for the least amount of fiber.

Step one: Calculate box volume

$$\text{Box volume} = H \times L \times W$$

Where H = box height; L = box length; and W = box width

Step two: Calculate flat area

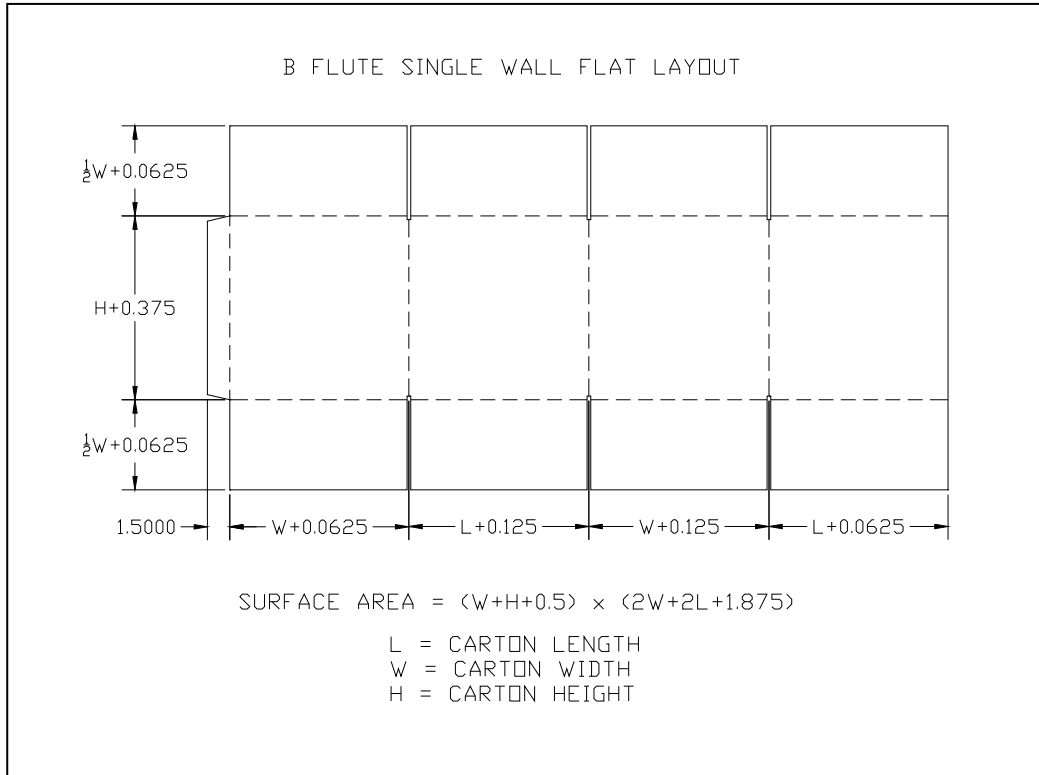
$$\text{Flat area} = (H + W + 0.5 \text{ inches}) \times (2W + 2L + 1.875 \text{ inches})$$

(Note: This formula is for a B-flute single wall corrugated RSC, but is a reasonable approximation for other common flute types.)

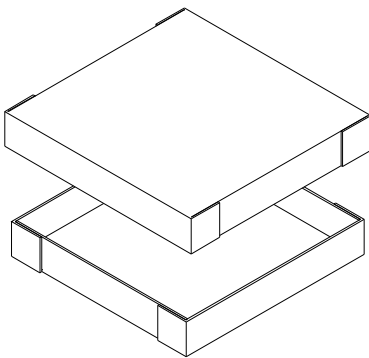
Step three: Divide box volume by flat area (volume/flat area).

Repeat these three steps for an alternative box geometry (ideally, one with the same volume). The box with the highest result (box volume divided by flat area) provides more shipping volume per material used.

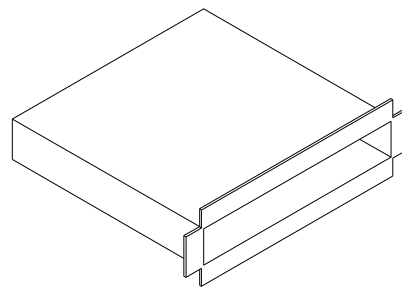
**Figure 1.
Regular Slotted Carton – Flat Area**



If very shallow cartons are necessary, consider using either an end loading carton (which will have a much smaller flap area and total fiber content), a telescoping design style tray, or a die cut carton (also referred to as “corrugated mailers”). All things being equal, an end-loading carton will contain less corrugated than a telescoping design style tray with the same dimensions.



**Figure 2:
Full Telescoping Design Style Tray**



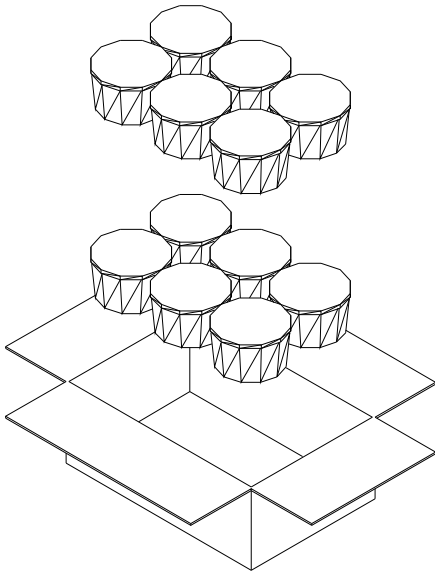
**Figure 3:
End Loading Carton**

An Example

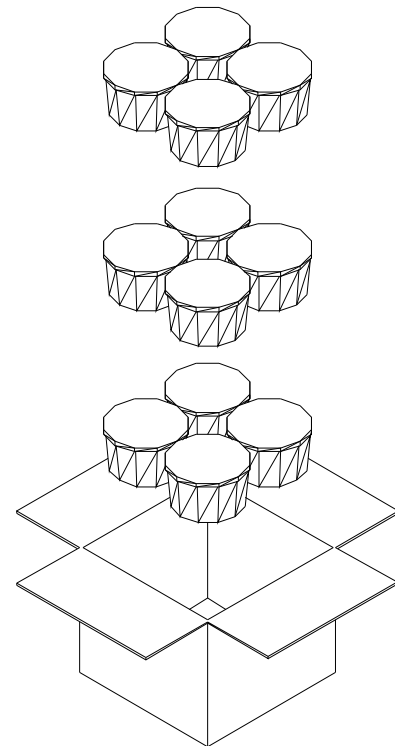
An Oregon manufacturer of bean dips and salsas packages product in 16-ounce polypropylene tubs. The tubs are frequently shipped 12 per carton. The conventional layout is “6 down, 2 up” (2 layers of 6 tubs each; see Figure 4). The resulting carton is very shallow and requires a total of 745 square inches of corrugated.

An alternative layout (Figure 5) is “4 down, 3 up”. In this approach, the carton holds 3 layers of 4 tubs each. The carton only requires 704 square inches of corrugated. It holds the same number of tubs but with a 5.6% reduction of fiber when compared to the conventional design. As an added advantage, the filled cartons ship more compactly on standard pallets, allowing 7.7% more product on a typical 40 x 48” pallet.

**Figure 4.
Conventional Design**



**Figure 5.
Improved Design**



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