

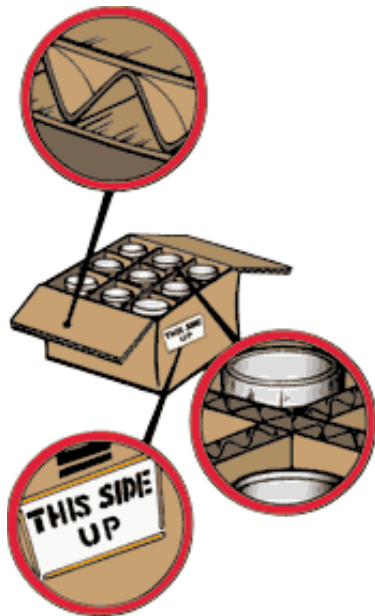


How are Corrugated Boxes Made?



How are corrugated boxes made?

Corrugated boxes are everywhere, carrying products from all over the world and just down the street. Your favorite pizza probably comes delivered in a brightly colored corrugated box. Your little brother or sister might use a big corrugated washer, dryer or dishwasher box for a playhouse. You might flatten and collect corrugated boxes for recycling. Where do all those boxes come from?



Do boxes come in boxes?

Boxes are about the only product not often shipped in boxes. They're usually shipped in bundles. They are made in special factories called "**box plants.**"

Corrugated boxes are designed to be very strong. They are made of **corrugated paperboard**, which is different from the stiff paper known as "cardboard." Look at the edge of corrugated paperboard, and you will see a row of air columns. The air acts as a cushion, while the paper columns make the material strong. Each box is made to hold something just right, protect it from banging around, and keep it from spilling. Boxes are made with important information printed on them about what's inside, or how to lift or move them. Carefully designed inserts hold items in place so they won't spill or become damaged.



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How many ways are there to build a box?

There's a box for practically every purpose, and building it begins when the box-plant salesperson asks the box-buying customer just what kind of box is needed, how many, and how soon?

Then a box designer starts planning. He or she has plenty to consider: the size and shape of the customer's product, the size and shape of the finished box, the strength of the material it's made of, the color of the corrugated board, the size of the **flutes** or paper ridges within it, the number of boxes to be made, the coatings and printing they'll bear, and just when they need to be made and shipped.



How will the customer put the box together, fill it, and close it? How will the customer's customer open the box? Will the product-filled box be moved by hand or by fork lift? Stacked in tall piles or singly? How roughly will it be treated?

A computer helps crunch the numbers. The box designer adds human creativity and insight. The design, drawn on paper or a computer screen, might look like a puzzle.

What is the first step in box building?

As you've learned, boxes are made of corrugated paperboard, or simply "**board.**" for short. There are several kinds of corrugated board, all made by combining paper, heat, adhesives, and pressure.

It starts off as rolls of **liner** or **paperboard**, similar in appearance to the brown paper in grocery bags. These rolls can weigh more than two tons each, and hold paper that could stretch several miles.

Corrugated board can be made up of one, two, or even three layers of flutes and liners, depending on how strong the box needs to be.

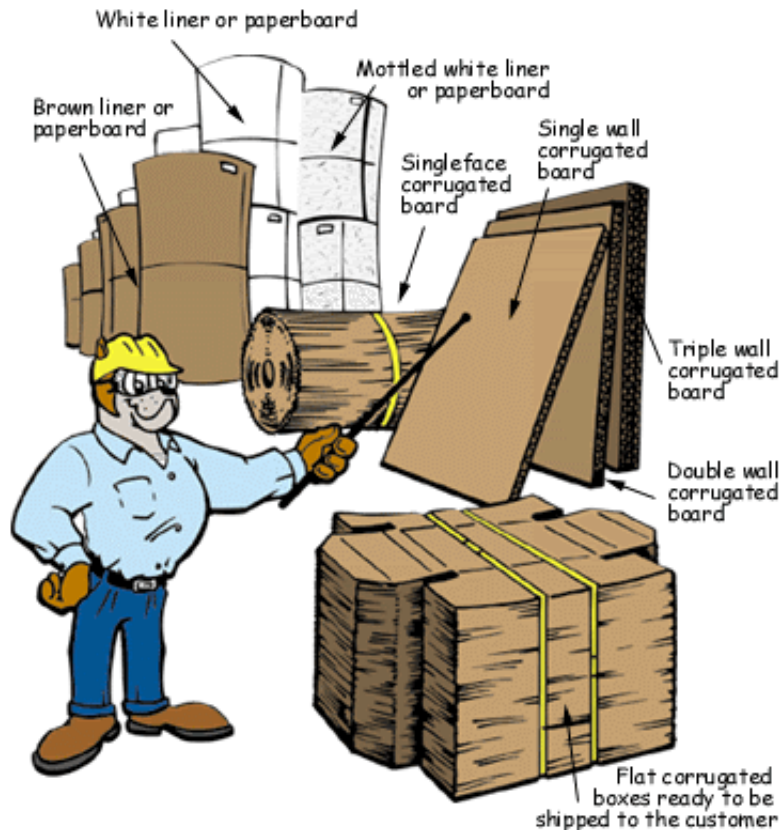
Did You Know ...

More than 95 percent of all products in the U.S. are shipped in corrugated boxes. Nearly three-fourths of all corrugated boxes produced in the U.S. are recovered.

Corrugated paperboard accounts for more than half of all the paper recycled in the United States. Grocery stores recycle six million tons of old corrugated boxes each year.



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Who's who? What's what?

First, a little vocabulary lesson. The wavy paper inside the corrugated board is called the **corrugating medium**. The flat sheets on the outside are called liners.

Liner paperboard can be a natural brown color, mottled white, or all white. Most is made with about 35 percent recycled fiber, but recycled content can be up to 100 percent.

There are standard sizes of **flutes**, the ridges in the corrugated medium. Some corrugated boards have small numbers of very large flutes; others have higher numbers of very small flutes. The use of the box determines which flute style is best.

A single liner, glued to corrugating medium, creates a **singleface corrugated board**. This flexible material is sometimes used to cushion items such as light bulbs.

Corrugating medium glued between two flat liners forms a **single wall corrugated board**. Most of the boxes we see every day are made of this material, and in fact about 90 percent of corrugated board is single wall.

Adding another corrugating medium and a third flat liner creates a **double wall corrugated board**. Stronger than the single wall board, it's also heavier and more expensive. Furniture, appliances and products such as nails, meat, and bulk peanuts are packed in boxes made from double wall corrugated board.

There are also **triple wall corrugated boards**, big tough boards with three layers of corrugating medium and four flat liners, used for very large or very heavy products.

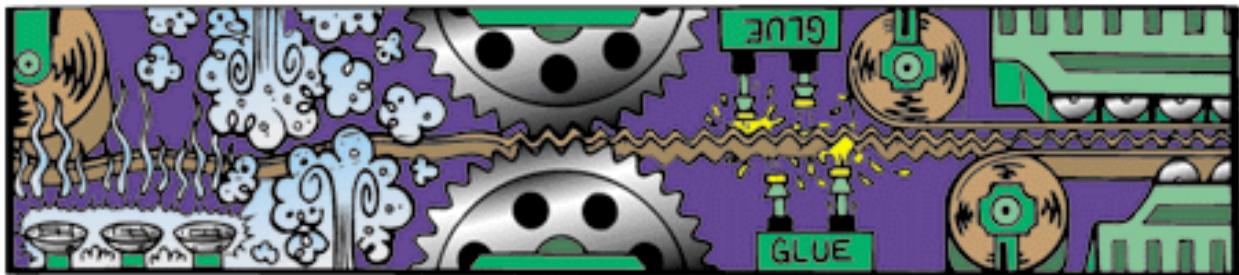


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Roll 'em!

Let's start making a box by making corrugated board, on a long series of linked machines called a **corrugating line**.

The corrugating medium, which will become the wavy middle layer in the typical three-layer corrugated board “sandwich,” is pre-heated and steamed so its temperature nearly reaches the boiling point of water, 212°F. This softens the natural ingredients in the paperboard, making it easier to form into flutes.



The **web**, or long sheet of paper unwinding from the roll, is drawn between a pair of gear-like cylinders called **corrugating rolls**. This shapes the paper into a series of precise waves. Glue is applied to the tips of these flutes on one side — just the right amount, and at just the right places — and the flute tips are pressed against a flat liner.

This creates a **singleface web**, a continuous sheet of flat paper with fluted paper glued to it. To make single wall corrugated board, the exposed flutes of the singleface web have glue applied to them, and they're pressed against a second flat liner.

Other parts of the corrugating line press creases into the corrugated board at precise places, so later it will fold on these creases to create a three-dimensional box.

The continuous web of corrugated board is now so stiff that it can't be rolled up. Instead, it's cut into flat sheets, just the right size for making the boxes that have been ordered. The sheets are then stacked and set aside so the glue can dry properly.

How swiftly does all this happen? Modern corrugating lines can move at more than 1,000 feet per minute—more than 11 miles per hour, or three times as fast as a comfortable walk!



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How does a board become a box?



Converting machines “convert” flat corrugated boards into boxes. The most common kinds of converting machines are flexo-folder gluers and die cutters.

Flexo-folder gluers print, crease, slot, trim, fold and glue the box so that it can be shipped flat and then be easily formed by the customer and packed.

Die-cut machines cut the corrugated board into a pattern the customer will fold and glue into the box shape.

A **rotary die cutter** uses cutting edges called **dies**, and **creasing rules**, on a big roller to cut and score the corrugated board as it moves beneath it.

A **flat die cutter** presses knives and creasing rules against a stationary board, the same way you press a cookie cutter into cookie dough.

Whichever converting system was used, the corrugated box is now complete, and ready to carry, contain and cushion a product that might be on its way to you!



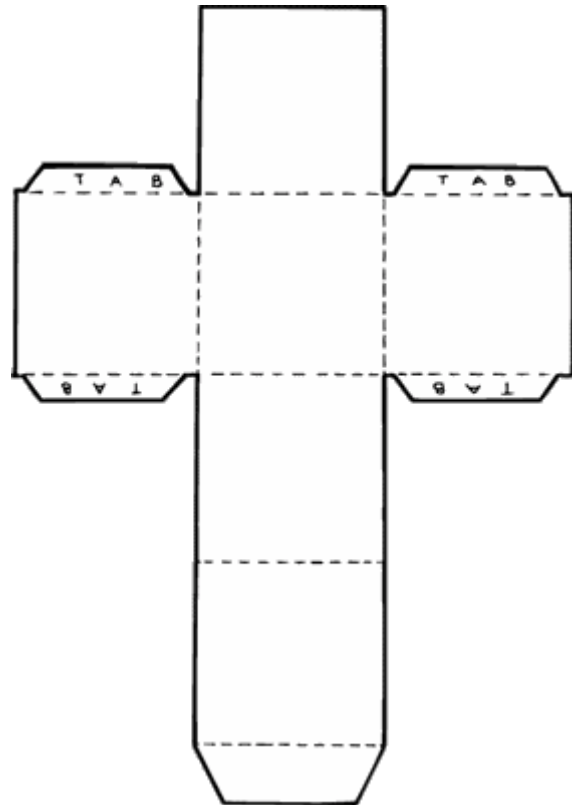
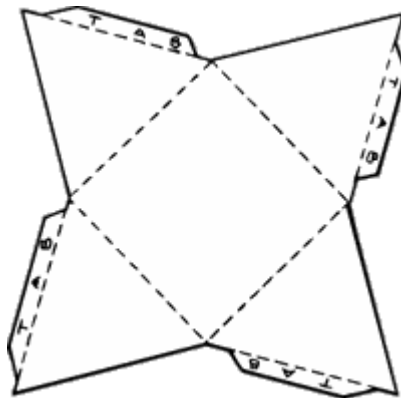
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GREENQUIZ

Here are some patterns for boxes. Can you imagine how they would look folded up?

Now test your theory. Make enlarged copies of these patterns on your photocopier, cut them out, and fold them into boxes. Use glue or tape to hold the tabs in place.

Have fun!



Sources:

- Video Tour of Boxplant Operations: TAPPI PRESS, 1991.
- Paper and Paperboard Converting: Finish Paper Engineers' Association, 1998

These facts are presented by individual scientists, engineers, and researchers who work at universities, research laboratories, and companies across the country. They work at the science of papermaking every day -- researching and testing the facts. It is their full-time job to understand and report the facts concerning the nature of forest practices, the processes involved in papermaking, and how these affect the environment -- good and bad.

TAPPI is the leading technical association for the worldwide pulp, paper, and converting industry. The Association provides a neutral forum for members to come together to share their technical knowledge and expertise in an effort to further advance professional achievement and sound technology.