

# **The Packaging Designer's Book of Patterns**

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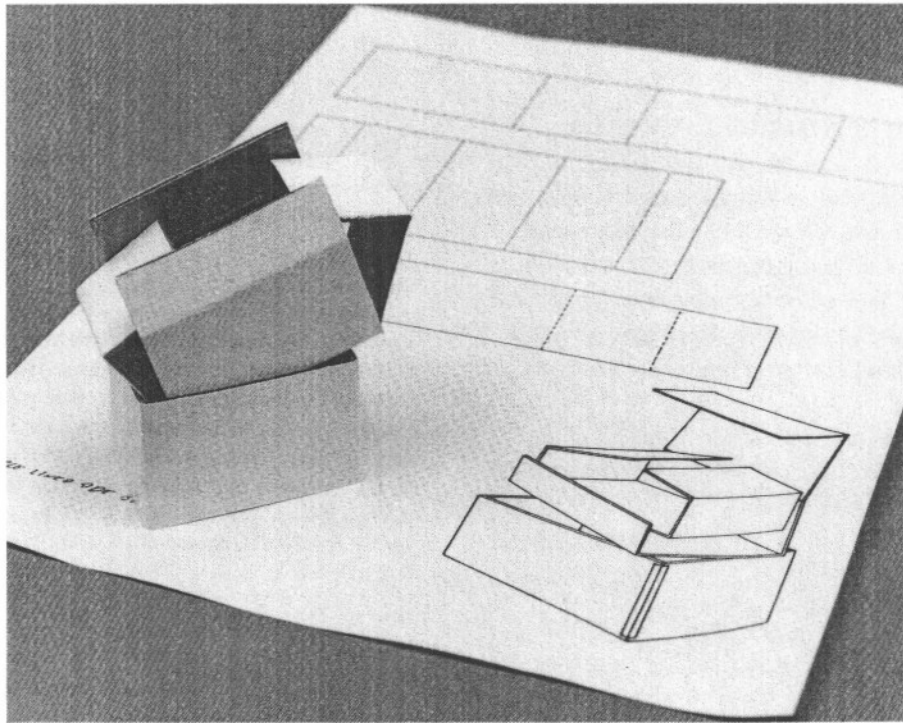


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# Corrugated Containers

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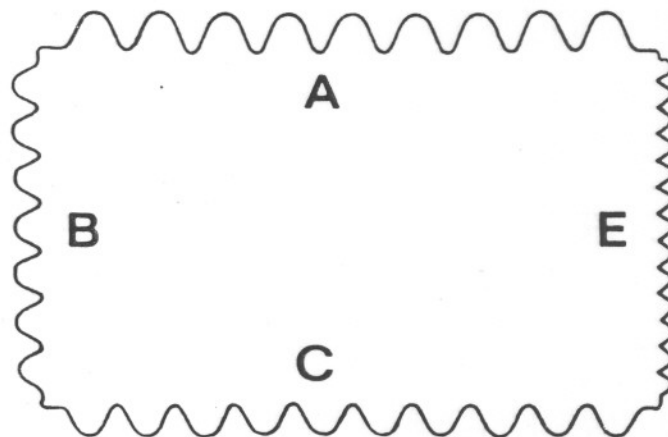


Fluted medium, the heart of the corrugated board, is one of the most unusual of all packaging materials. Originally it was an article of wear. In the mid-nineteenth century men's hats were fashioned with a sweatband of fluted paper. In 1871 an American, Albert L. Johnes, patented fluted medium for the protection of bottles during storage and shipment. Three years later another American, Oliver Long, patented a process for sandwiching the fluted medium between paperboard sheets. This was the origin of corrugated containers, the workhorse of the packaging industry.

### THE STRUCTURE OF CORRUGATED BOARD

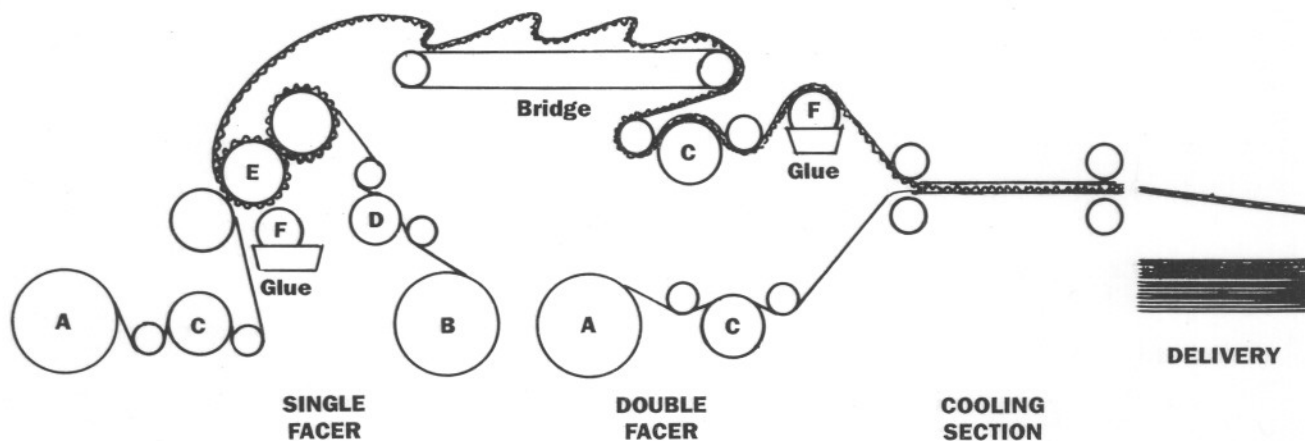
The basic structure of corrugated board is simple. It consists of a fluted sheet glued to one or more liners. The most common construction is a sheet of "corrugated medium" sandwiched between two liners. A wide variety of combinations are possible, depending on packaging requirements. Where great strength is required, the three sheets of medium can be combined with appropriate liners.

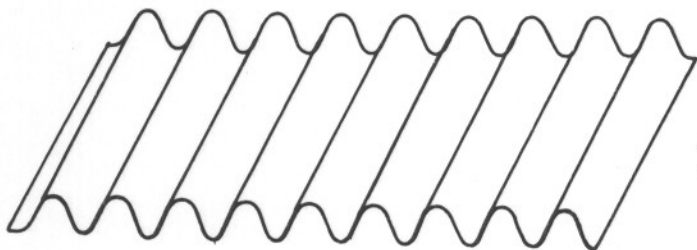
The structural characteristics of corrugated board are governed by four variables: (1) the strength of the liners, (2) the strength of the corrugated medium, (3) the height and number of flutes per foot, and (4) the number of walls (single, double, or triple).



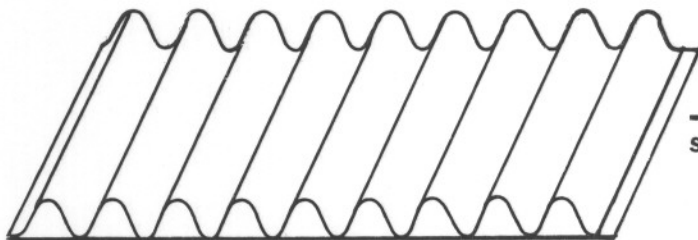
A corrugated flute gauge (actual size).

Simplified schematic of a corrugator. The corrugating medium is preconditioned and shaped by the corrugating rolls. The preheated linerboard is then glued to the face of the corrugated paper and conveyed to the double facer for attachment of the liner on the opposite side. The assembly is then dried over hot plates and run through pressure rolls for stability. Once the medium has passed through the cooling section, it is cut to the required size at the delivery section. A, linerboard; B, corrugating medium; C, preheaters; D, preconditioner; E, corrugating rolls; F, glue.

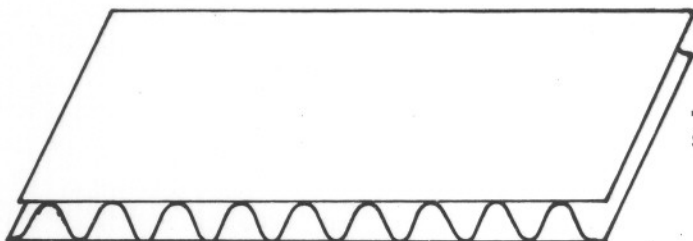




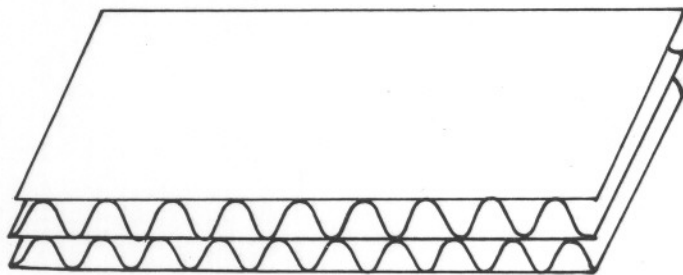
Unlined Corrugated (A Flute)



Single Face Corrugated (A Flute)

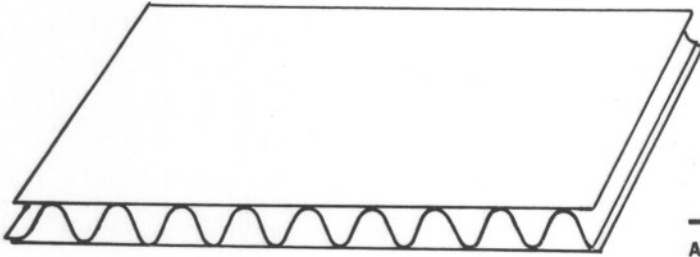


Single Wall (Double Face) Corrugated (A Flute)



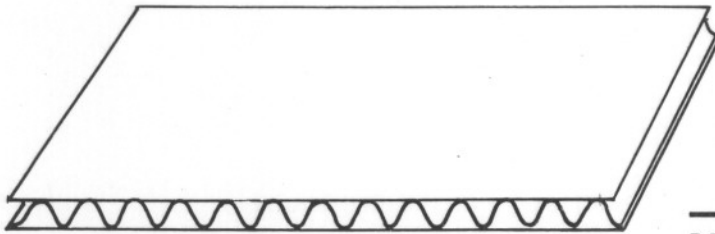
Double Wall Corrugated (A and C Flute)

A number of flute structures are available, depending on packaging specifications. *A-flute* has great capacity to absorb shocks owing to the wider spacing of the flutes. *B-flute*, because of the larger number of flutes per foot, provides maximum crush resistance. *C-flute* combines the properties of the first two types, and *E-flute* is used where very thin corrugated board is recommended. In addition, a new grade of corrugated board has recently been developed which has a series of uniquely formed grooves and ridges that are smaller than those in the E-flute and which has 15–20% more ridges per lineal foot than the E-flute.



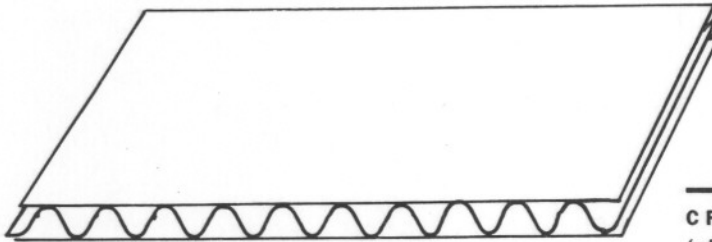
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**A Flute Corrugated**—33 flutes per linear foot. Approximately  $\frac{3}{16}$ "  
(without thickness of facings).



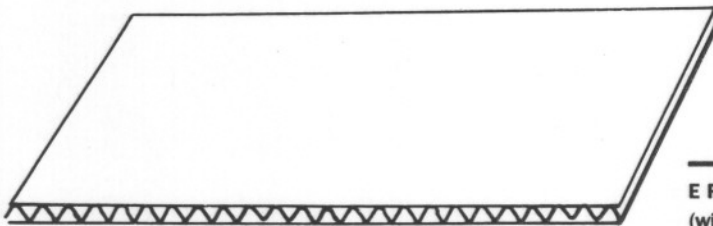
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**B Flute Corrugated**—47 flutes per linear foot. Approximately  $\frac{3}{32}$ "  
(without thickness of facings).



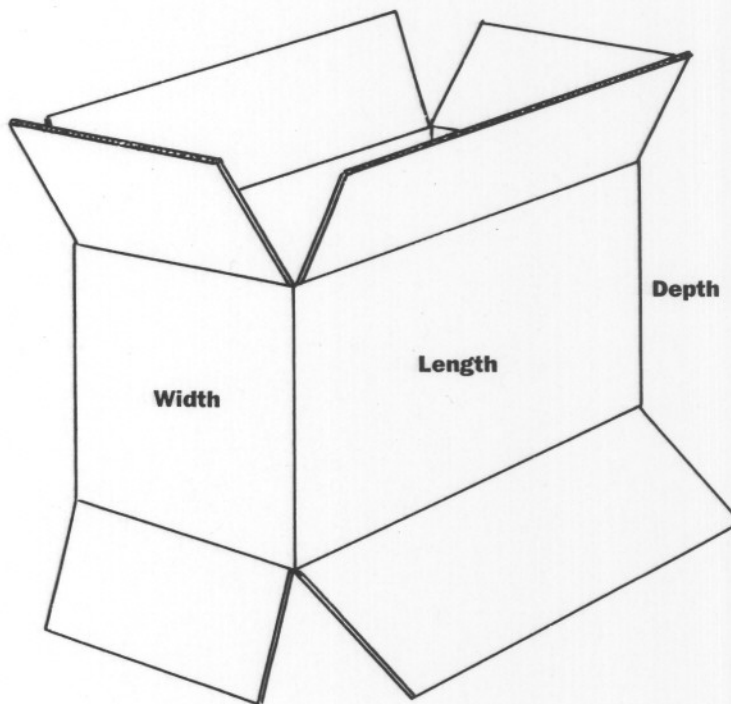
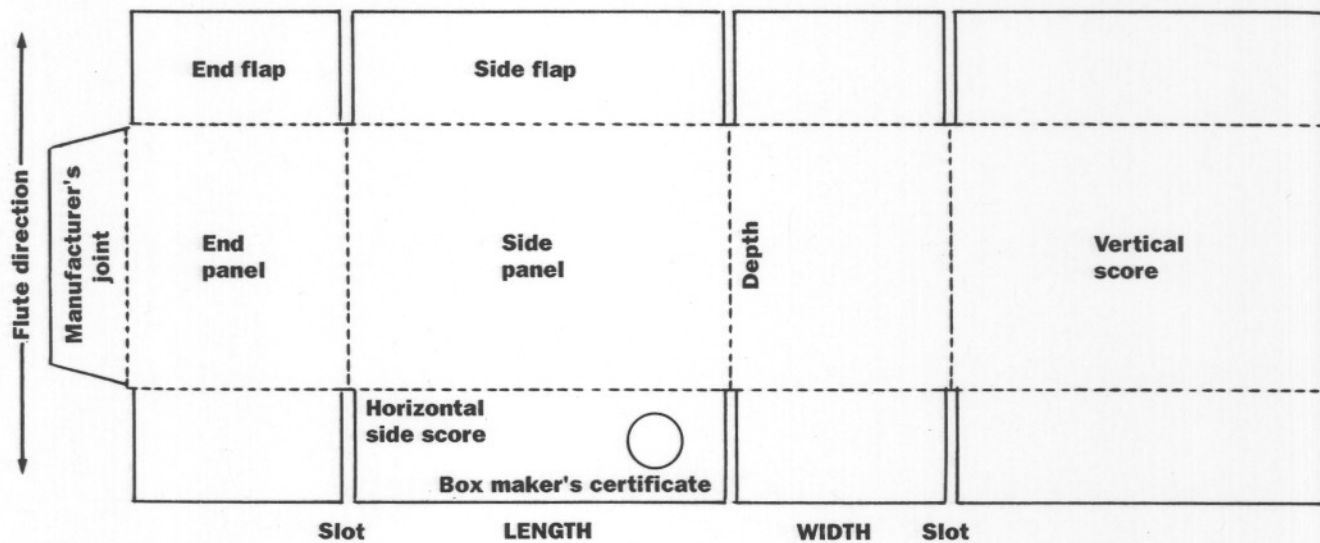
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**C Flute Corrugated**—39 flutes per linear foot. Approximately  $\frac{9}{64}$ "  
(without thickness of facings).



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**E Flute Corrugated**—90 flutes per linear foot. Approximately  $\frac{3}{64}$ "  
(without thickness of facings).





So universal is the use of corrugated board that its production is viewed as a barometer of the economy as a whole. It is hard to imagine products that cannot be packaged and shipped in corrugated boxes. Today more than 1,160 products—including live fish!—are shipped in corrugated boxes.

Corrugated board is used in multicolored shippers and point-of-purchase displays. It is among the least expensive of all packaging materials.

### DESIGNING A CORRUGATED BOX

The design of a corrugated box is a major undertaking. The process of selecting the correct package design for a particular product has grown more complex as new technologies and materials present ever-increasing manufacturing options.

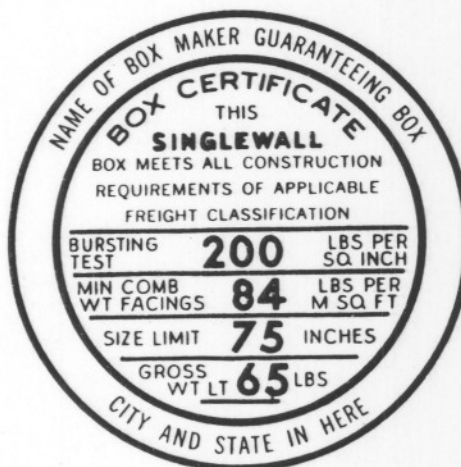
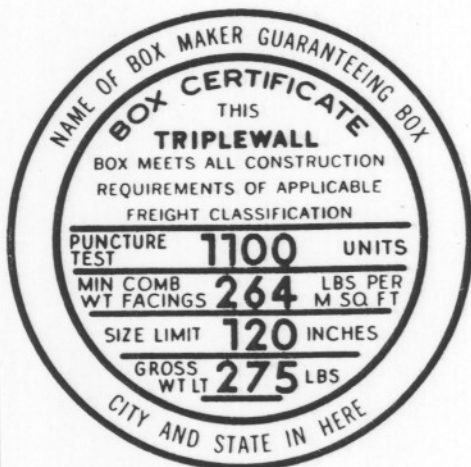
The ways in which corrugated board may be used are practically limitless. Certain basic container styles and designs

are suitable for packaging a wide range of products. There are some corrugated interior devices (platforms, padding, or inserts) and plastics (molded polystyrene foam) used to provide reinforcement, bracing, and shock absorption. These are illustrated and described on pages 401–437.

Specialty containers are tailored to the requirements of a particular product. Those requirements may involve everything from the “shipability” of the product itself to how the container is filled, stored, loaded, stacked, braced, dropped, and unpacked. Specialty or custom-made boxes are usually required for special products in large quantities (10,000 or more). Master cartons, which are shipping cartons that hold smaller cartons, are used for food, detergents, housewares, and hardware.

Government and industry standards and regulations are designed to protect the users of cartons. There are laws pertaining to method of shipment, such as rail, air freight, truck, and parcel post (U.S. Postal Service). In addition, all corrugated materials and cartons must be certified by the manufacturer. Weight, paper content, and puncture and bursting test certificates must be displayed on all corrugated boxes.

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A significant trend in corrugated technology is impregnating and coating corrugated board with waxes and plastics. The moisture-resistant coating permits reuse of the carton and shipment of products, such as produce, that were previously shipped in expensive wooden crates and barrels.

### **PRINTING ON CORRUGATED BOARD**

Direct printing on brown corrugated board, which has a highly absorbent surface, is usually limited to the use of line art. This is the least expensive type of printing usable on corrugated board. Letterpress and, more recently, flexography are the typical printing methods.

*Preprint* is a term used to refer to the process in which a roll of printed stock is used as the top liner in making a corrugated sheet. Flexography and rotogravure are the printing methods used in most preprint processes. The surface may be kraft, white clay-coated kraft, clay-coated bleached liner, or foil. The set-up costs for preprinting are high.

It is difficult to print full color on most corrugated board, with the exception of E-flute. Therefore, labels are often prepared to cover the boxes on one or more of their sides: full-sized labels cover the top and all four sides of a box; partial labels may be used only on the top of a box or on one or two of its sides. There are several variations of label application, including lamination onto the box, depending on size, shape, and cost considerations.

*Litho labeling* refers to lithographic printing of a sheet of paper that is then adhered (laminated) to corrugated board. Labels can be full or partial. Litho labeling and lamination are used on large boxes for toys, games, housewares, and sporting goods.