

COMMON STYLES OF NAILED-WOOD BOXES

There are seven styles of nailed-wood boxes so universally used that they may be called the standard styles. These boxes can be adapted to a wide range of uses, and it is the experience of the Forest Products Laboratory that they are the most efficient of the nailed-wood boxes. Some of the advantages and disadvantages of each style, as revealed in laboratory tests and by observation of boxes in service, are given in the following paragraphs.

In style 1, the grain of the end and side boards runs approximately parallel to the top and bottom surfaces of the box. Since the strength of wood in tension across the grain is not great, one of the common causes of failure in this style of box is the tendency of the ends and sides to split along the grain. Another common cause of failure is the low holding power of nails driven into the end grain of the wood.

The disadvantages of style 1 may be corrected by nailing rectangular or triangular corner cleats to the inside of the ends, as shown in style 5. These cleats help prevent the ends and sides from splitting without increasing the outside dimensions or displacement of the box. If the cleats are made large enough, the side boards as well as the end boards may be nailed to them, thus increasing the strength of the nailing at this point. The inside cleats should be shorter than the inside depth of the box, so that, if the sides and ends shrink, the cleats will not force open the joints at the top and bottom of the box. In all boxes with cleated ends, the nails holding the cleats to the ends should be long enough to permit a good clinch and should be spaced approximately the same as the nails in the adjacent edges of the box.

The most common method of preventing box ends from splitting and of supplementing the holding power of nails driven into the end grain is the addition of two outside cleats on each end, as shown in style 4. These cleats should be of the same thickness as the end boards, so that the same-size nail can be used to fasten the sides to the ends and cleats as

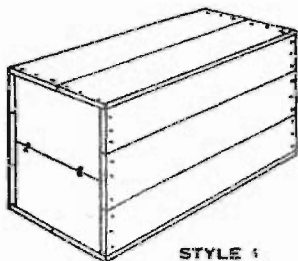
is used to fasten the top and bottom to the ends. The side nails should be alternately driven into the ends and cleats. This staggered nailing permits a closer spacing of the nails and results in a stronger joint than that obtained by driving the nails in a single row. The holding power of the nails may be substantially increased by using woods of greater density for the ends and cleats.

The cleats in the style 4 boxes should not come flush with the outer surface of the top and bottom but should have clearance of from 1/8 to 3/16 inch at each end of the cleat. They will thus help keep the top and bottom in place and will absorb some of the thrust normally taken by the nails when the box is dropped on a corner. If the cleats are made flush with the outer surfaces of the top and bottom, subsequent shrinkage could cause the cleats to project, so that they might be pulled loose in handling.

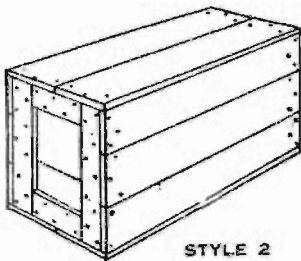
The two horizontal cleats in styles 2, 2-1/2, and 3 permit a staggered nailing pattern to be used for fastening the tops and bottoms to the ends and cleats as well as for fastening the sides to the ends and cleats. The additional holding power of the nails and the stronger end construction make these styles adaptable for heavy, difficult loads. Failure in these boxes may be caused by nails pulling out of the ends and cleats or shearing out at the ends of the side, top, and bottom boards or by splitting of the end boards along the inner edges of the horizontal cleats.

Styles 2 and 2-1/2 have an advantage over style 3 in that it is possible to place more nails near the top and bottom edges of those boxes when nailing the vertical cleats than it is when nailing the mitered corners of the style 3 box. Style 2-1/2 has an additional advantage in that, when the top and bottom are being nailed to the cleats, the notches in the vertical cleats will absorb some of the thrust that would otherwise be taken by the nails holding the horizontal cleats. This thrust can be severe when the boxes are assembled in a nailing machine where several nails are driven into the cleat at the same time. Style 3 is advantageous when manufacturing boxes with square ends because the four cleats are of the same length and thus are interchangeable.

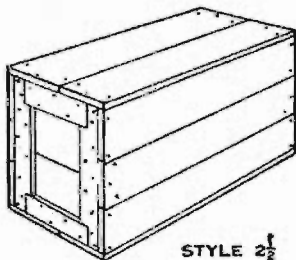
The style 6 box has sides and ends joined together by a series of interlocking tenons held together by glue. The top and bottom of the box are usually nailed to the ends. If properly glued, the lock corners give a more rigid box than do nailed corners. Tests show that some of the common failures in lock-corner boxes occur because the ends and sides split, the nails pull from or split the edges of the ends, the locks open, or the matched joints lack sufficient strength. Experience has shown that adequate performance of this container is largely dependent upon good gluing and proper manufacture.



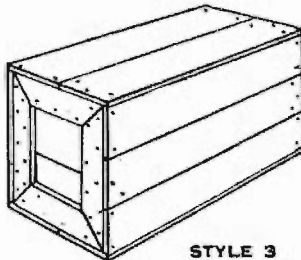
STYLE 1



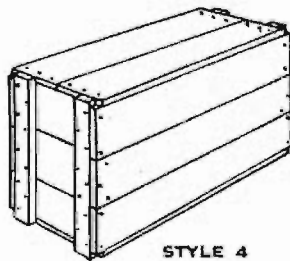
STYLE 2



STYLE 2 $\frac{1}{2}$

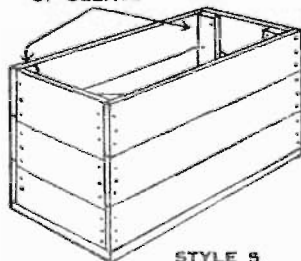


STYLE 3

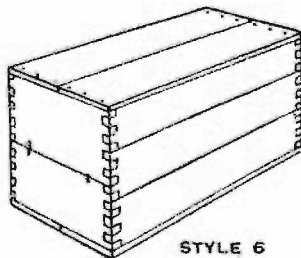


STYLE 4

ALTERNATE FORMS
OF CLEATS



STYLE 5



STYLE 6