

TECHNICAL NOTE NUMBER 183

FOREST PRODUCTS LABORATORY · U. S. FOREST SERVICE · MADISON, WISCONSIN

METAL STRAPS ON BOXES

The thickness of lumber required in the sides, top, and bottom of a nailed wooden box to give it adequate strength and serviceability without metal bindings may safely be reduced 20 to 40 per cent if the box is properly bound with metal straps. This conclusion is based on numerous observations of boxes in commercial service and on the results of tests made on some 2000 strapped wooden boxes by the Forest Products Laboratory of the U. S. Forest Service, Madison, Wisconsin.

Although the numerous factors affecting the economic use of metal bindings have not all been studied, the general conclusions derived from this investigation should serve as a guide in the use of metal bindings on common types of nailed wooden boxes.

Number and Position of Straps

As a rule, straps should encircle the small dimensions of the box and act perpendicular to the grain in the sides, top, and bottom. If only one strap is used, it should be nailless and applied around the center of the box. When two straps are used, they should be applied $1/6$ the length of the box from the ends or around the extreme ends, depending on whether they are nailless or nailed. When three or more straps are used, the two outer straps should be applied as specified for two straps, and the others spaced equally between them. Three or more straps are recommended on relatively long boxes.

Nailless straps placed some distance from the ends of the box distribute the shocks which otherwise would be

locally absorbed. This action relieves the direct pull on the nails and reduces splitting or breaking of the sides, top, and bottom. On boxes with adequate end cleats nailless straps properly spaced along the length of the box might sometimes permit the use of thinner lumber than would straps nailed around the extreme ends.

Straps nailed around the extreme ends act somewhat as a cleat and give more rigidity to the box than nailless straps, and are usually preferable on uncleated-end boxes.

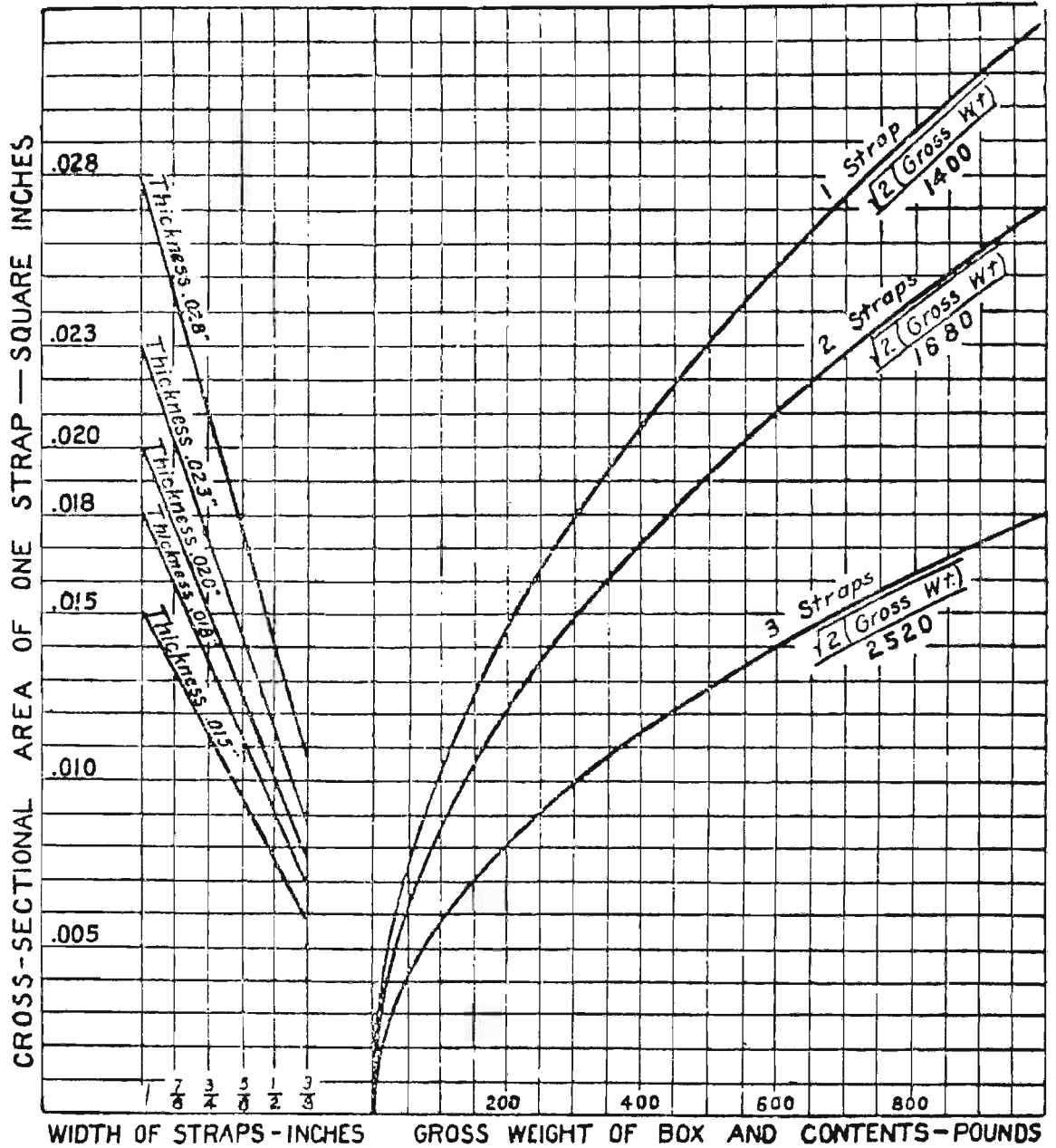
Size of Straps

The same total cross-sectional area of strapping is recommended for two and three straps, and the same reduction in thickness of box material is permitted; but when one strap is used it should have 60 per cent of this total cross-sectional area, and a lesser reduction in thickness of lumber is permitted.

Tests made thus far indicate that the total cross-sectional area of one strap in square inches should equal approximately $1/1400$, and of two or more straps $1/840$, of the square root of twice the gross weight of the box and contents in pounds.

The required size for one, two, and three straps may readily be found by means of the accompanying chart, as follows: Starting with the weight of the box and contents, move directly upward to the curve for the number of straps decided upon; then move left to the line representing the thickness of the strap to be used. The first vertical line at or left of this point of intersection represents the width of strap required. Or, move to the left, as above, to the vertical line representing the width of strap decided upon, and the first diagonal line at or above this point of intersection will represent the thickness of strap required.

Recommended Sizes of Flat Metal Straps for Nailed Wooden Boxes



Application of Strapping

All strapping should be applied immediately before the box is ready for shipment and should be drawn sufficiently tight to sink into the edges of the box. Nailless straps should be applied at right angles to the edges of a box; otherwise they are quite likely to adjust themselves and become loose during service.

Tensile Strength of Strapping

The following table gives the maximum tensile strength recommended for various sizes of nailed and nailless strapping.

Size of strap in inches	Tensile strength in pounds	
	<i>Nailless strapping</i>	<i>Nailed strapping</i>
3/8 x .015	473	405
3/8 x .018	566	486
3/8 x .020	630	540
3/8 x .023	725	621
1/2 x .015	630	540
1/2 x .018	756	648
1/2 x .020	840	720
1/2 x .023	966	829
5/8 x .015	786	675
5/8 x .018	946	810
5/8 x .020	1050	900
5/8 x .023	1207	1035
3/4 x .018	1132	972
3/4 x .020	1260	1080
3/4 x .023	1450	1240
3/4 x .028	1760	1510
7/8 x .018	1320	1135
7/8 x .020	1470	1260
7/8 x .023	1690	1450
7/8 x .028	2050	1765
1 x .018	1512	1295
1 x .020	1680	1440
1 x .023	1930	1655
1 x .028	2350	2015

The ends of nailless strapping should be joined in such a manner that the joint will have not less than 75 per cent of the strength of the strap.

Permissible Reduction in Thickness of Lumber

If boxes are to be strapped in accordance with these rules, the thicknesses of their sides, tops, and bottoms may be reduced below that required for unstrapped boxes designed for the same service, according to the following schedule.

Thickness of sides, tops, and bottoms of unstrapped boxes, in inches	Thickness of sides, tops, and bottoms of strapped boxes, in inches	
	One strap	Two or more straps
7/8	5/8	1/2
13/16	5/8	1/2
5/8	1/2	3/8
9/16	7/16	5/16
1/2	3/8	5/16
7/16	5/16	1/4
3/8	5/16	1/4

Nailing Required on Strapped Boxes

The information obtained shows that it is not economical to use fewer nails in strapped boxes than in unstrapped boxes. On the contrary, with the reduction in the thickness of sides, top, and bottom, more nails though somewhat smaller ones should be used than are required in the nailing schedule for unstrapped boxes of the same kind and thickness of end material. Copies of the nailing schedule for unstrapped boxes may be obtained on request from the Forest Products Laboratory, Madison, Wisconsin.

The nails used in fastening strapping to the box should be of the same size and spaced twice as far apart as those used in the box.