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METAL STRAPS ON BOXES

The recommendations of this note and the six charts on the inside pages are offered as a definite guide for the selection of sizes and the practical use of metal strapping for boxes. The primary purposes of metal bindings or straps for packing boxes are to reduce the direct pull of the box content on the nails and to reduce splitting and breaking of the box sides, top, and bottom. Bindings larger than necessary for a box of given weight are wasteful of material and may increase costs. Bindings smaller than necessary result in failure of boxes and loss or damage to contents.

1. 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, if nailless, they should be applied about 1/6 the length of the box from the ends; if nailed, they should be applied around the extreme ends. When three or more nailless straps are used, the two outer straps should be applied slightly closer to the end than specified for two straps, and the others should be spaced equally between them. Three or more straps are recommended for long boxes.

Nailless straps placed some distance from the ends of the box distribute the shocks which otherwise would be locally absorbed. 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 as a cleat and give more rigidity than nailless straps, and are usually preferable on uncleated-end boxes.

2. Size of Straps

The same total cross-sectional area of strapping is recommended for two and for three or more straps, and the same reduction in thickness of box material (see Paragraph 6) 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. The proper size of straps can be determined from the accompanying six charts. The curves are based on thousands of tests and have been verified by practical experience. Under each curve is given the mathematical formula which the particular curve represents.

3. Use of Charts

To find the required size of one, two, or three straps, either round or flat, first turn to the chart for the quality (unit strength) of strapping selected. Then, starting with the weight of the box and its contents, move directly upward to the curve for the number of straps decided upon and then move horizontally to the left to the diagonal line representing the thickness of the strap. The first vertical line at or beyond this point represents the width of strap required. Or, after reaching the first curve, move to the left, as far as the vertical line representing the width of the strap decided upon, and the first diagonal line at or above this point represents the thickness of strap required. To find the required size of wire, move from the curve to the right, to the vertical line carrying the gauge numbers. The first number at or above this point represents the size required.

For example, a box having a gross weight of 200 pounds is to be bound with two nailed or nailless straps,

either round or flat, having a tensile strength of 85,000 pounds per square inch. Start with 200 on the horizontal scale at the bottom of the third chart and move directly upward to the curve entitled "two straps," then move horizontally to the left and find the size of flat strap to use, 5/8 inch by 0.02 inch, or move horizontally from the curve to the right and find the size of wire, No. 10-1/2 Steel Wire Gauge single-stranded nailless wire straps. Two strands of 13-gauge wire twisted together can also be used; this information comes from the first right-hand scale.

Caution -- Joint Strength: In making use of these charts, the strength of the strap must be assumed as not more than four-thirds of the strength of the joint, regardless of what it actually is. This means that if the joint does not develop at least 75 per cent of the strength of the strapping, the size of the strapping must be increased sufficiently to produce the required strength at the joint.

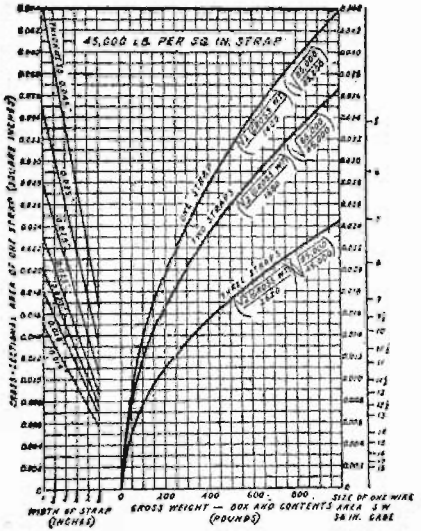
4. Application of Strapping

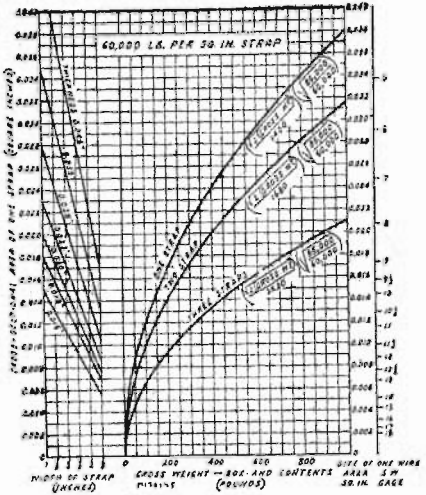
All strapping should be applied immediately before the box is ready for shipment and should be drawn sufficiently tight to sink into the edges of the box. To be effective, strapping should remain taut all the way to destination.

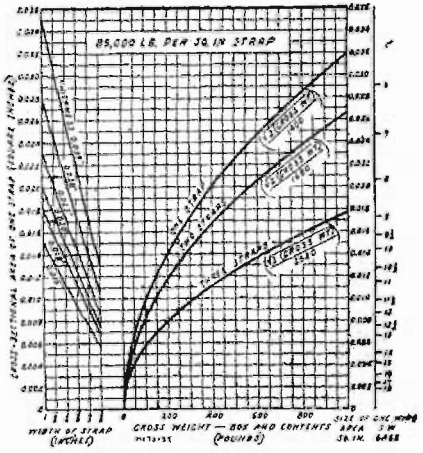
5. Factors in Choosing Type of Strap

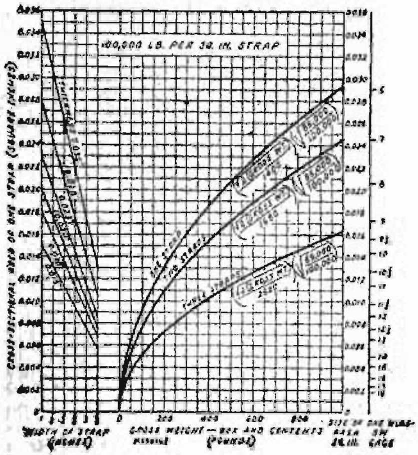
(a) Wide straps are more likely to remain taut than narrow or round ones of the same cross-sectional area. However, wide straps are more likely to catch and tear on nail heads and the like in transit than round straps. Wide straps also have less security against slipping off if the box shrinks.

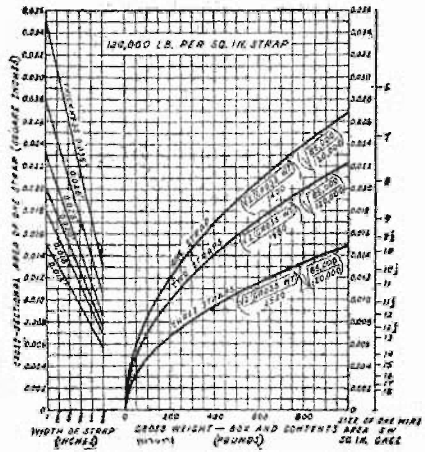
(b) Hard straps, having higher unit strength, are more likely to remain taut than soft straps. However, they are more apt to break under the shocks of

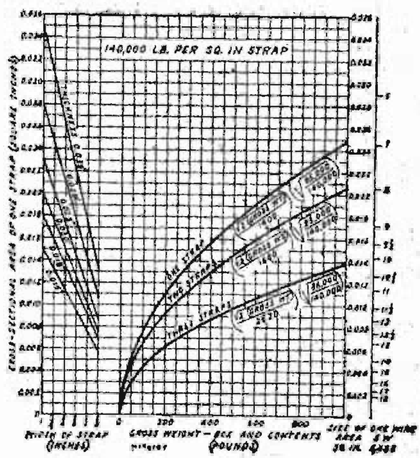

45,000 LB. PER SQ. IN. STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE B.W.G. OR U.S.S. GAGE


60,000 LB. PER SQ. IN. STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE B.W.G. OR U.S.S. GAGE


85,000 LB. PER SQ. IN. STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE B.W.G. OR U.S.S. GAGE


100,000 LB. PER SQ. IN. STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE AREA SQ. IN. SW GAGE
ONE STRAP
TWO STRAPS
THREE STRAPS


120,000 LB. PER SQ. IN. STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE AREA SQ. IN. SW GAGE
TWO STRAPS
THREE STRAPS


140,000 LB. PER SQ. IN STRAP
CROSS-SECTIONAL AREA OF ONE STRAP (SQUARE INCHES)
WIDTH OF STRAP (INCHES)
GROSS WEIGHT — BOX AND CONTENTS (POUNDS)
SIZE OF ONE WIRE AREA SQ. IN. SW GAGE
ONE STRAP
TWO STRAPS
THREE STRAPS

transportation than soft straps of the same tensile strength, and if too hard they will crack when their ends are joined.

(c) A nailless strap should be soft enough to permit it to yield slightly and thus absorb shocks, but must be sufficiently hard to hold effectively where the ends are joined. The strap should also be so thick that it will not tear in two easily when caught on projecting nail heads.

Since no one kind of strapping possesses all of the various desirable characteristics that strapping should have, the choice between round and flat straps of any quality will depend upon the character of the container, the nature of the commodity, and the hazards to be encountered by the particular shipment.

6. Permissible Reduction in Thickness of Lumber

If boxes are to be strapped in accordance with the foregoing provisions, the thicknesses of their sides, tops, and bottoms may be reduced below that required for unstrapped boxes designed for the same service, as follows:

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

The use of strapping normally does not justify any reduction in the thickness of the box ends or cleats.

7. Nailing Required on Strapped Boxes

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