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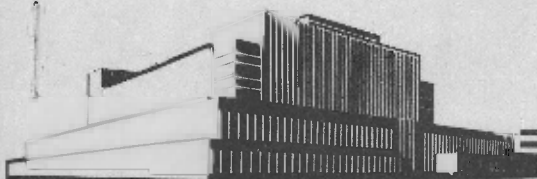
# EFFECT OF NAIL POINTS ON THE WITHDRAWAL RESISTANCE OF PLAIN NAILS

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UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

In Cooperation with the University of Wisconsin

# EFFECT OF NAIL POINTS ON THE WITHDRAWAL

## RESISTANCE OF PLAIN NAILS<sup>1</sup>

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Many factors affect the behavior of nails during driving and the manner in which the nails subsequently function in holding wooden members. These factors include size of nail, type of shank, and kind of point. This report is concerned chiefly with the effect of the kind of point on the withdrawal resistance of plain round smooth-shank nails.

To determine the effect of the point on the withdrawal load, tests were made on some types of nails available on the market and also on nails with special points made up at the Laboratory.

The tests were conducted on several species of wood according to standard laboratory practice. The results included in table 1 were obtained from withdrawal tests made immediately after the nails were driven in the side grain of the specimens. Additional tests were made, however, with blunt points of nails in ponderosa pine to evaluate the effect of moisture changes in the specimen and to determine the withdrawal resistance of nails driven in the end grain of ponderosa pine.

The tests are not extensive enough to afford a comparison of the relative nail-holding ability of the different woods used. As several nails were driven in equal numbers in the same piece of wood, however, the results do afford a comparison of the effectiveness of the various nail points.

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<sup>1</sup>Based on data collected in a previous investigation on containers by L. J. Markwardt and J. M. Gahagan, Forest Products Laboratory engineers; reaffirmed May 1959. Original report published in 1930.

<sup>2</sup>Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Table 1 shows six types of points. Extreme variations in points were used in order to bring out any differences in performance that might exist between the types.

In general, table 1 shows that in all species tested, the highest withdrawal loads were obtained with nails having the sharpest points, and the lowest withdrawal loads were obtained with nails having the bluntest points. In southern yellow pine, Douglas-fir, and oak, the nail with a truncated point had a withdrawal resistance that was about equal to or greater than that of the nail with the diamond point. In ponderosa pine, however, the nail with a diamond point gave higher values than did the nail with the truncated point.

When the ponderosa pine specimens were subjected to changes in moisture content after the nails were driven, the effect of these different kinds of points on the withdrawal resistance varied in the same order as with immediate withdrawal but not necessarily in the same magnitude.

Tests with ponderosa pine, however, indicate that the reduction in load that accompanies the blunting of a nail is not so great in end grain as in side grain. The reduction in load for a nail with a blunt point as compared to a nail with a diamond point is greater in dry wood than in green wood.

It is well known that in the lightweight woods little difficulty is experienced with splitting, so that sharp-pointed nails can be used to advantage. With the dense species, however, the tendency to split in nailing becomes more pronounced. Here the attempt to increase the withdrawal resistance by increasing the sharpness of the point may be more than offset by the loss from splitting, and an attempt to prevent splitting by the use of a very blunt nail may result in low withdrawal resistance.

Of the types tested, the truncated point provides a good general purpose point for plain smooth-shank nails. Table 1 shows that in the heavier woods, the nails with the truncated points were fully equal in withdrawal resistance to the nails with diamond points, and in addition were more effective in reducing splitting.

This nail has some of the advantages of the cut nail. Like the cut nail, the nail with the truncated point breaks down the wood fibers as it enters, and the tapered sides restore surface contact and increase the withdrawal resistance. Unlike the cut nail, the greatest portion of the shank of the truncated nail is uniform in cross section. Therefore, the shank maintains contact with the fibers after withdrawal is started.

Considering that nails with blunt points are less apt to split the wood in nailing, and that the withdrawal resistance of plain nails is somewhat







proportional to the area of the nail in contact with the members receiving the point, the following general suggestions are made regarding nailing practice as affected by the type of nail point of common nails.

(1) In lightweight woods, or in dense species that do not split in nailing, the highest withdrawal resistance is obtained with sharp-pointed nails.

(2) In woods that split seriously with common nails having a diamond point, the following procedures can be followed:

- (a) Where practicable use bored holes.
- (b) Use nails of smaller diameter and increase the number to give equivalent withdrawal resistance.
- (c) When it is desirable to use nails of the same length and diameter as would be used if there were no splitting, use nails with a blunt point.
- (d) If but a few nails are needed, the points of ordinary nails may be blunted with a hammer or a grind stone to provide a truncated point.

Table 1. --Effect of type of point on the withdrawal loads of sevenpenny (0.098 inch diameter) plain nails driven into side grain

Species of wood	Specific: Moisture : : grav- : content : ity <sub>2</sub> :	Loads for nails with different types of point					
		Diamond <sub>3</sub>	Sharp <sub>4</sub>	Truncated <sub>5</sub>	Truncated <sub>6</sub>	Truncated <sub>5</sub>	Blunt <sub>7</sub>
							
		Percent	Pounds	Pounds	Pounds	Pounds	Pounds
Ponderosa pine	11.0	57	115				
Hard maple	9.0	265	413				
Ponderosa pine	0.34	78		58			
Ponderosa pine	9.7	79			71		
Southern yellow pine	9.8	136		159		153	
Southern yellow pine	11.2	116	158	150			68
Douglas-fir	48	166	201	159			93
Douglas-fir <sub>8</sub>	47	193		208			
Oak	59	232	264	241			192
Oak <sub>8</sub>	63	417		452			
Southern yellow pine	43	113		173			

<sup>1</sup> Nails with common points driven 1-3/8 inches, with sharp points 1-7/16 inches, all others 1-5/16 inches; the slight difference in depth of driving makes the area of contact of the different nails approximately equal.

<sup>2</sup> Based on oven-dry weight and volume at test.

<sup>3</sup> Point 1/8 inch long.

<sup>4</sup> Point 3/8 inch long.

<sup>5</sup> Point 3/8 inch long tapered to three-fourths of shank diameter.

<sup>6</sup> Point 3/8 inch long tapered to one-half of shank diameter.

<sup>7</sup> No taper.

<sup>8</sup> Nail with common point driven 1-7/16 inches, with truncated point 1-3/8 inches; but loads adjusted to 1-3/8 inches and 1-5/16 inches respectively.

GROUPING OF WOODS ACCORDING TO NAIL-HOLDING QUALITIES AND OTHER  
PROPERTIES OF IMPORTANCE IN CONTAINER CONSTRUCTION

GROUP I embraces the softer woods of both the coniferous and the board-leaved species. These woods are relatively free from splitting in nailing, have moderate nail-holding power, moderate strength as a beam, and moderate shock-resisting capacity. They are soft, light in weight, easy to work, hold their shape well after manufacture, and, as a rule, are easy to dry.

Aspen (popple)	Magnolia
Basswood	Pine (except southern
Buckeye	yellow pine)
Cedar	Redwood
Chestnut	Spruce
Cottonwood	Willow
Cypress	Yellow-poplar
Fir (true firs)	

GROUP II consists of the heavier coniferous woods and includes no hardwood species. These woods usually have a pronounced contrast in the hardness of the springwood and the summerwood. They have greater nail-holding power than the group I woods, but are more inclined to split and the hard summerwood bands often deflect the nails and cause them to run out at the side of the piece.

Douglas-fir	Tamarack
Hemlock	Western larch
Southern yellow pine	

GROUP III consists of hardwoods of medium density. No coniferous species are included. These woods have about the same nail-holding power and strength as a beam as the group II woods, but are less inclined to split and shatter under impacts. Group III species are the most useful woods for box ends and cleats. They also furnish most of the rotary-cut lumber for wirebound and plywood boxes.

Ash (except white ash)	Sweetgum
Soft elm	Sycamore
Soft maple	Tupelo

GROUP IV woods are hardwood species. They have both the greatest shock-resisting capacity and the greatest nail-holding power, but because of their extreme hardness, they present difficulties with respect to the driving of nails and also have the greatest tendency to split at the nails. They are the heaviest and hardest domestic woods and are difficult to work. They are especially useful where high nail-holding power is required and many of them make excellent rotary-cut lumber for wirebound and plywood boxes.

Beech  
Birch  
Hackberry  
Hard maple  
Hickory

Oak  
Pecan  
Rock elm  
White ash

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