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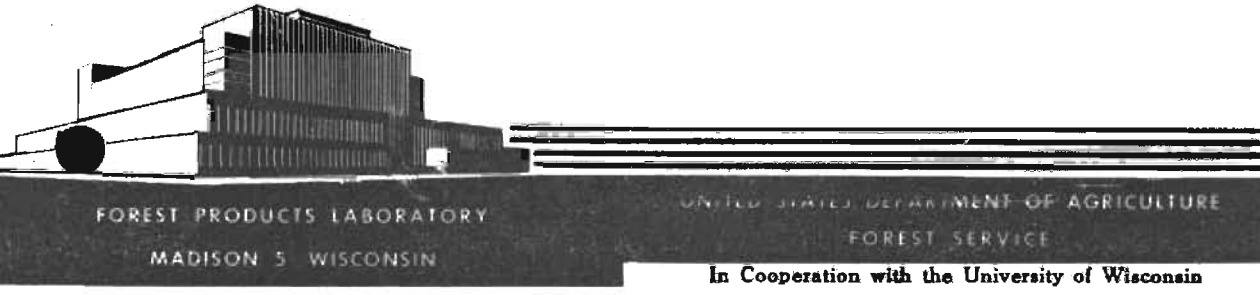

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
In Cooperation with the University of Wisconsin

# YIELD IN CLEAR CUTTINGS FROM STANDARD GRADE EASTERN WHITE PINE BOARDS IN NEW ENGLAND

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## Summary

Estimations of yields in clear cuttings were made on 4,954 boards of 4/4 Standard grade eastern white pine at 10 mills in New England. Board width had a decided influence on yields, but locality of growth and board length had no significant bearing on yields. Measurement of yields on one-tenth of the boards proved that the estimates were accurate in the aggregate. Estimates of probable yields on individual boards can also be made rapidly by visual observation.

## Introduction

One of the challenges in the utilization of eastern white pine (*Pinus strobus* L.) in New England is the marketing of Standard (No. 4 Common) boards. This grade is used chiefly for construction and industrial purposes, but competition by other species and materials resulted in a loss of markets and an accumulation of Standard grade boards in the mill yards.

Although the grading rules of the Northeastern Lumber Manufacturers Association, Inc., permit all thicknesses in standard grade, the nominal 1-inch thickness is most common, and this report concerns this thickness

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[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

exclusively. The boards in this grade may be 3 inches wide and wider and from 6 to 16 feet long. The boards may contain various types of knots and such other features as bark pockets, medium worm holes, mass pitch and pitch pockets, wane, pith, blue stain, decay, checks, end splits, shake, and bow in specified amounts as related to the grade.

Portions of the surface areas of the boards in Standard grade, however, have clear, sound wood that might be utilized as clear cuttings. If these clear cuttings are ripped and crosscut from the boards, they can be finger jointed and edge glued together to produce clear panels. The idea of end and edge joining relatively small pieces of wood to produce a large panel is not new or untried. Several plants in this country and in Canada successfully manufacture panels of this type. The success of such an operation, however, is dependent on whether the boards contain a sufficient amount of clear or otherwise suitable material to justify the cost of the operation.

The possibility of joining cuttings from Standard eastern white pine boards to produce large panels was intriguing, but it brought up these questions:

1. Is there a variation in yield within the grade and, if so, what are the controlling factors?

2. Is it possible to determine the yield potential of individual boards or shipments in terms of clear cuttings?

3. What proportion of an "average" shipment of Standard grade lumber can be recovered in clear cuttings suitable for the end joining and edge gluing process?

4. Is there a regional difference in yields?

5. What lengths of clear cuttings can be cut from this grade of eastern white pine lumber?

To answer these questions, an investigation was made in December 1961 by the U.S. Forest Products Laboratory and the Northeastern Forest Experiment Station in cooperation with the Northeastern Lumber Manufacturers Association and 10 of its members. This report presents the results of this investigation.

## Boards Sampled

Altogether, 4,954 Standard grade eastern white pine boards, totaling 40,474 board feet obtained from 10 mills in Maine and New Hampshire were

examined. Approximately 100 boards each in widths of 4, 6, 8, 10, and 12 inches were selected from each of the mills. Data from a preliminary investigation indicated that 100 boards of a width were more than sufficient to give an adequate sample at a 95 percent level of accuracy for each mill. The sampling was also adequate to give a very good picture of each width for subregions and for the region as a whole. Since the lengths were sampled as they occurred in the lumber piles, their distribution (table 1) approximates the actual distribution of lengths in this grade in Maine and New Hampshire.

The boards were randomly selected from the piles in the air-drying yards where they had been drying for several months or longer. For the most part, the top layers of boards in a pile were rejected in order to eliminate any undue influence of excessive weathering.

The deciding factors for grading the boards Standard grade had been such points as knots, pith, and wane. Practically no boards were degraded to Standard grade because of the presence of blue stain or sap stain, as it is sometimes called.

## Procedure

An experienced lumber grader examined the boards directly as they came from the air-seasoning piles without being surfaced. He estimated the percentage of clear cuttings in each board. His estimations were checked by actual measurement of clear cuttings present in one out of each 10 boards. This was done by marking the assumed rippings with a carpenter's chalk line and then measuring them.

Specifications for clear cuttings were:

1. The minimum length of a cutting was set at 12 inches. No limit was placed on the length.

2. The width of the cuttings could vary from 2-2/3 to 4 inches, depending on the width of the board and what it was assumed would be done in commercial ripping operations. It was assumed that: 4-inch-wide boards would not be ripped and therefore would give an approximate 4-inch-wide cutting; 6-inch-wide boards would be ripped once to give two approximate 3-inch-wide cuttings; 8- and 10-inch-wide boards would be ripped twice to give three approximate 2-2/3- and 3-1/3-inch-wide cuttings, respectively; and 12-inch-wide boards would be ripped thrice to give four approximate 3-inch-wide cuttings.

3. The thickness of the clear cuttings had to be sufficient to yield 25/32-inch-thick cuttings when surfaced on two sides.

4. The face and the back of the cuttings had to be free of all types of knots, wane, pith, shake, pitch pockets, mass pitch, and blue stain. Since blue stain can be prevented by proper antistain treatments, data also were recorded and analyzed with blue stain not being considered an imperfection.

5. The ends and edges of each cutting had to be free of all types of knots, cross grain, wane, or other factors that might obstruct finger jointing or edge gluing, or mar the appearance of the edges and ends of the cuttings.

## Results

Although the estimated yields did not always correspond with the measured yields for individual boards, the agreement between results by the two methods was surprisingly close, as is shown in table 2. No correction factors, therefore, were applied to the yields shown in tables 3 to 5; the data for all these tables were based on estimations.

The boards were classified according to the percentage of clear cuttings that the estimator calculated could be obtained from each board. Three classes were established: Low-yield boards, 30 percent or less of clear cuttings; medium-yield boards, between 30 and 60 percent; and high-yield boards, 60 percent and over.

### Influence of Width and Length on Yield

Board width proved to be the most significant factor in determining yields. Table 3 shows the percentile distribution of all the boards examined by boards according to the three classes, both when blue stain was considered an imperfection and when it was not.

This table also shows the average yield per board for all the boards examined. The occurrence of blue stain was more prevalent in the 4- and 8-inch-wide boards. The greatest change in the distribution of the boards affected by the presence of blue stain was in the 8-inch widths where the acceptance of blue stain would increase the percentage of high-yield boards from 35 to 47 percent. Generally, the wider boards contained less sapwood; thus, there was less probability of the occurrence of blue stain. The 6-inch-wide boards might have been an exception on this score in that some of those examined may have originated from a central cant that contained little or no sapwood and, consequently, a relatively low amount of blue stain.

Within a given width, length had no significant influence on yields, as is shown in table 4, which gives the percentile distribution of the boards by lengths according to the three yield classes. Blue-stained cuttings were included in this analysis.

## Regional Differences

Most mills in New England were cutting second-growth eastern white pine logs, although some of the northern mills may operate in old-growth timber. It would appear that lumber from the mills in northern New England may contain a higher proportion of clear cuttings than that produced in central and southern New England. In order to check the accuracy of this assumption, the data from the 10 mills were computed according to the mill location. Three of the mills were located in northern New England, three in southern New England, and four in central New England. The results of these computations are shown in table 5.

The 10- and 12-inch boards from central and southern New England had a larger percentage of high yield boards and slightly higher yields than those boards from northern New England, while the 4- and 6-inch boards from northern mills had somewhat higher yields than those mills further south. The differences in yields between regions, however, amounted to less than 10 percent, except for the 4-inch width. The yields in this width were unusually high at one mill in northern New England, which accounted for the high variation. While some differences appear to exist between regions for a given width, no significance can be attached to them since there were greater differences between mills in the same region than there were between regions.

## Size and Number of Clear Cuttings

The distribution and number of clear cuttings within a given width are shown in table 6. Blue-stained cuttings were included since this factor has no influence in restricting the lengths of the cuttings. Occasionally, 16-foot-long boards, especially those of 12-inch widths, may have contained clear cuttings 140 inches long or longer, but this was an exception rather than a common occurrence. For convenience, the clear cuttings are grouped in 4-inch length classes to 40 inches, 8-inch length classes to 56 inches, and all those cuttings over 56 inches in length are grouped in one length class. Although the greatest number of cuttings occur in the lower length classes, table 6 shows that a good distribution of clear cuttings also occurs in the longer length classes. The average cutting was 20 inches long for the 4-inch-wide boards, 23 inches long for the 6- and 8-inch boards, 26 inches long for the 10-inch boards, and 27 inches long for the 12-inch boards.

To better illustrate the distribution of clear cuttings, table 7 shows the distribution of clear cuttings in a thousand board feet of lumber for each width. In commercial practice, an operator would deal in board feet measure rather than by the number of boards. In this table it is shown that the narrow-width boards contain a higher percentage of short-length clear cuttings than did the wider boards. About 50 percent of the clear cuttings are 21 inches or longer in 12-inch-wide boards, as compared to only 30 percent in the 4-inch-wide boards.

The lengths of clear cuttings were longer in boards with high yields of clear cuttings, regardless of width or length of boards, than in those boards with low yields.

## Conclusions and Observations

1. If a manufacturer uses mill-run material of 4/4 Standard grade eastern white pine, he can expect an average yield of 57 percent in clear cuttings for all widths when blue-stained pieces are excluded or 60 percent when blue-stained material is included. Distribution in the widths of such material, however, varies from mill to mill; thus, these average percentages will also vary. These percentages are based upon production figures obtained from the 10 mills supplying the boards examined in this study: 4-inch-wide boards comprised 12 percent of their production of standard grade lumber; 6-inch widths, 18 percent; 8-inch widths, 23 percent; 10-inch widths, 20 percent; and 12-inch widths, 18 percent. The remaining 9 percent are odd widths.

2. There would be little or no advantage to sort the boards by length alone in an effort to segregate low-yield boards because length has no significant influence on yields.

3. In this study, data were obtained on the yield of clear cuttings only with or without blue stain. The question arose as to what yields might be obtained by not considering sound cuttings--cuttings containing small tight knots, incipient decay (also known as hard rot), and small spots of mass pitch--as imperfections. Information on the amount of cuttings containing such characteristics in Standard grade eastern white pine had been obtained in a preliminary study. It was found that such cuttings added only about 5 percent or less to yields. The amount of secondary sound cuttings, therefore, was not estimated or measured during the course of the main study.

4. Warp, cup, and sweep were uncommon, as only 4 of the 500 boards measured contained these types of imperfections. It is not known how much sweep, cup, or warp might develop from kiln drying, but the loss from sweep amounted to only a fraction of 1 percent of the volume after air drying.

5. Scant thickness of the boards was not observed on any of the 500 boards that were measured; thus, this type of imperfection should have little influence on yields.

6. It was not a difficult task, nor time consuming, to estimate with reasonable accuracy the yield potential of individual boards or of shipments. An experienced lumber grader can make these estimations almost as fast as he can grade lumber.

Table 1.--Number and board foot volume of Standard grade eastern white pine boards examined

| Length of boards | Number of boards of a width of-- | | | | | | Nominal footage for board widths of-- | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 inches | 6 inches | 8 inches | 10 inches | 12 inches | Total | 4 inches | 6 inches | 8 inches | 10 inches | 12 inches | Total |
| Ft. | | | | | | | Bd. ft. | Bd. ft. | Bd. ft. | Bd. ft. | Bd. ft. | Bd. ft. |
| 6 | 65 | 42 | 50 | 26 | 8 | 191 | 130 | 126 | 200 | 130 | 48 | 634 |
| 8 | 184 | 103 | 108 | 56 | 56 | 507 | 490 | 412 | 576 | 373 | 448 | 2,299 |
| 10 | 306 | 198 | 230 | 159 | 160 | 1,053 | 1,020 | 990 | 1,533 | 1,325 | 1,600 | 6,468 |
| 12 | 248 | 272 | 325 | 316 | 329 | 1,490 | 992 | 1,632 | 2,600 | 3,160 | 3,948 | 12,332 |
| 14 | 100 | 126 | 113 | 169 | 173 | 681 | 466 | 882 | 1,054 | 1,971 | 2,422 | 6,795 |
| 16 | 129 | 185 | 187 | 267 | 264 | 1,032 | 688 | 1,480 | 1,994 | 3,560 | 4,224 | 11,946 |
| Total | 1,032 | 926 | 1,013 | 993 | 990 | 4,954 | 3,786 | 5,522 | 7,957 | 10,519 | 12,690 | 40,474 |

Table 2.--Comparison between the average yields of clear cuttings obtained by estimating and measureing 4/4 Standard grade eastern white pine boards, with and without blue stain

| Board width | Clear only | | Clear and blue stain | |
|---|---|---|---|---|
| | Measured cuttings | Estimated cuttings | Measured cuttings | Estimated cuttings |
| In. | Percent | Percent | Percent | Percent |
| 4 | 42 | 40 | 54 | 50 |
| 6 | 56 | 51 | 62 | 56 |
| 8 | 53 | 53 | 62 | 59 |
| 10 | 61 | 61 | 63 | 64 |
| 12 | 63 | 64 | 66 | 67 |

Table 3.--Distribution of Standard grade boards by width and yield classes[1] of clear cuttings, with and without blue stain

| Board width group | Distribution of boards by yield | | | Average yield of clear cuttings per board |
|---|---|---|---|---|
| | Low | Medium | High | |
| In. | Percent | Percent | Percent | Percent |
| | | CLEAR ONLY | | |
| 4 | 46 | 27 | 27 | 38 |
| 6 | 27 | 40 | 33 | 49 |
| 8 | 17 | 48 | 35 | 52 |
| 10 | 6 | 38 | 56 | 62 |
| 12 | 3 | 35 | 62 | 66 |
| | | CLEAR AND BLUE STAIN | | |
| 4 | 26 | 41 | 33 | 51 |
| 6 | 15 | 46 | 39 | 52 |
| 8 | 4 | 49 | 47 | 59 |
| 10 | 2 | 37 | 61 | 65 |
| 12 | 1 | 32 | 67 | 68 |

[1]Yield of clear cuttings was based on percentage of total board area: Low, 30 percent and below; medium, between 30 and 60 percent; and high, 60 percent and above.

Table 4.--Distribution of Standard grade boards by length in the various widths and yield classes[1] of clear cuttings

| Board width | Distribution of boards by lengths of-- | | | | | |
|---|---|---|---|---|---|---|
| | 6 feet | 8 feet | 10 feet | 12 feet | 14 feet | 16 feet |
| In. | Percent | Percent | Percent | Percent | Percent | Percent |
| | | | LOW YIELD | | | |
| 4 | 31 | 29 | 34 | 21 | 17 | 18 |
| 6 | 17 | 18 | 23 | 20 | 12 | 18 |
| 8 | 10 | 7 | 5 | 4 | 1 | 4 |
| 10 | 4 | 2 | 3 | 1 | ..... | 2 |
| 12 | ..... | 4 | 1 | ..... | ..... | 2 |
| | | | MEDIUM YIELD | | | |
| 4 | 31 | 37 | 40 | 44 | 47 | 40 |
| 6 | 36 | 38 | 44 | 47 | 39 | 42 |
| 8 | 48 | 54 | 52 | 50 | 41 | 45 |
| 10 | 23 | 43 | 30 | 38 | 33 | 43 |
| 12 | 37 | 53 | 36 | 37 | 33 | 27 |
| | | | HIGH YIELD | | | |
| 4 | 38 | 34 | 26 | 35 | 36 | 42 |
| 6 | 47 | 44 | 33 | 33 | 49 | 40 |
| 8 | 42 | 39 | 43 | 46 | 58 | 51 |
| 10 | 73 | 55 | 67 | 61 | 67 | 55 |
| 12 | 63 | 43 | 63 | 63 | 67 | 71 |

[1]Yield of clear cuttings was based on percentage of total board area: Low, 30 percent and below; medium, between 30 and 60 percent; and high, 60 percent and above.

Table 5.--Distribution of Standard grade boards by mill locations, yield classes[1] of clear cuttings, and width groups; blue-stained cuttings included.

| Board width | Distribution of boards by yield | | | Average yield of clear cuttings per board |
|---|---|---|---|---|
| | Low | Medium | High | |
| In. | Percent | Percent | Percent | Percent |
| | | NORTHERN NEW ENGLAND | | |
| 4 | 14 | 33 | 53 | 61 |
| 6 | 18 | 38 | 44 | 56 |
| 8 | 6 | 49 | 45 | 59 |
| 10 | 3 | 51 | 46 | 60 |
| 12 | 2 | 38 | 60 | 65 |
| | | CENTRAL NEW ENGLAND | | |
| 4 | 34 | 46 | 20 | 44 |
| 6 | 21 | 40 | 39 | 53 |
| 8 | 2 | 41 | 57 | 63 |
| 10 | 1 | 30 | 69 | 68 |
| 12 | 1 | 29 | 70 | 69 |
| | | SOUTHERN NEW ENGLAND | | |
| 4 | 27 | 41 | 32 | 50 |
| 6 | 17 | 50 | 33 | 53 |
| 8 | 7 | 59 | 34 | 65 |
| 10 | 2 | 32 | 66 | 66 |
| 12 | ..... | 30 | 70 | 68 |

[1] Yield of clear cuttings was based on percentage of total board area: Low, 30 percent or below; medium, between 30 and 60 percent; high, 60 percent and over.

Table 6.--Length and average number of clear cuttings in 100 boards in each indicated width, blue-stained cuttings included

| Length of clear cuttings | Average number of clear cuttings | | | | |
|---|---|---|---|---|---|
| | 4 inches | 6 inches | 8 inches | 10 inches | 12 inches |
| In. | | | | | |
| 12 to 17 | 181 | 292 | 430 | 433 | 442 |
| 17 to 21 | 66 | 120 | 212 | 154 | 249 |
| 21 to 25 | 30 | 71 | 106 | 126 | 179 |
| 25 to 29 | 34 | 48 | 92 | 88 | 118 |
| 29 to 33 | 8 | 37 | 55 | 63 | 76 |
| 33 to 37 | 6 | 22 | 49 | 39 | 86 |
| 37 to 41 | 8 | 16 | 21 | 38 | 54 |
| 41 to 49 | 9 | 24 | 35 | 61 | 92 |
| 49 to 57 | 5 | 11 | 15 | 36 | 55 |
| 57 and over | 7 | 27 | 47 | 65 | 95 |

Table 7.--Number and percent of clear cuttings in 1,000 board feet in each indicated width of board, blue-stained cuttings included

| Length of clear cuttings | Number of clear cuttings | | | | | Percent of clear cuttings | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 4 inches | 6 inches | 8 inches | 10 inches | 12 inches | 4 inches | 6 inches | 8 inches | 10 inches | 12 inches |
| In. | | | | | | | | | | |
| 12 to 17 | 510 | 524 | 554 | 403 | 347 | 51 | 45 | 41 | 39 | 31 |
| 17 to 21 | 186 | 220 | 273 | 143 | 196 | 19 | 19 | 20 | 14 | 17 |
| 21 to 25 | 85 | 117 | 137 | 117 | 141 | 8 | 10 | 10 | 11 | 12 |
| 25 to 29 | 96 | 100 | 118 | 82 | 93 | 10 | 9 | 9 | 8 | 8 |
| 29 to 33 | 22 | 47 | 71 | 59 | 60 | 2 | 5 | 5 | 6 | 5 |
| 33 to 37 | 17 | 29 | 63 | 36 | 68 | 2 | 3 | 5 | 4 | 6 |
| 37 to 41 | 22 | 24 | 27 | 35 | 42 | 2 | 2 | 2 | 3 | 4 |
| 41 to 49 | 25 | 33 | 45 | 57 | 72 | 3 | 3 | 3 | 6 | 6 |
| 49 to 57 | 14 | 18 | 19 | 33 | 43 | 1 | 1 | 1 | 3 | 4 |
| 57 and over | 20 | 40 | 60 | 60 | 75 | 2 | 3 | 4 | 6 | 7 |