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No. 1 and No. 2 Common Red Oak Yields: Similar Part Sizes When Gang-Ripping Is Used to Process Boards with Crook

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Abstract

Computer simulation was used to gang rip No. 1 and No. 2 Common red oak boards before and after removal of crook. While No. 1 Common produced slightly more total yield, the part yields were very similar. No. 1 Common was clearly superior only in yielding 75-inch-long pieces. Either grade is an excellent choice for the furniture and cabinet industries.

The Author

CHARLES J. GATCHELL received a B.S. degree in forestry from the University of Massachusetts in 1955 and an M.S. degree in wood-products engineering from the New York State College of Forestry at Syracuse University in 1961. After 4 years in product and process development research at the Forest Products Laboratory in Madison, Wisconsin, he went to the Forestry Sciences Laboratory in Princeton, West Virginia, to establish the utilization research program. As Project Leader, he conducted research on the drivability and strength of guardrail post systems and on the conversion of small-diameter logs and low-grade lumber to rough dimension furniture parts. He is currently a Research Forest Products Technologist engaged in research on yields from low-grade lumber from gang ripping and the suitability of use of these yields for solid wood furniture and cabinets.

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When gang-ripping is the first breakdown step in a furniture or kitchen cabinet rough mill, the length and width yield distributions of parts from No. 1 and No. 2 Common lumber are surprisingly similar. This conclusion is drawn from results of recent computer simulation studies of gang-ripping of narrow boards containing crook or side bend. The reasons for this conclusion include the way the lumber grades are constructed and the needs of the industries.

No. 1 and No. 2 Common Lumber Grades

The NHLA (National Hardwood Lumber Association 1986) rules for No. 1 and No. 2 Common lumber are given in Table 1. Grading rules define only the poorest piece in each grade. The grading rules also allow No. 2 Common boards to sometimes have clear-face surface areas in the typical No. 1 Common range. The minimum yield in clear-face cuttings is 50 percent for No. 2 Common and 66⅔ percent for No. 1 Common. The minimum size of a clear-face cutting is 3 inches by 2 feet for No. 2 Common. For No. 1 Common, there are two minimum sizes: 3 inches by 3 feet or 4 inches by 2 feet. But—and this is important—it is not only possible to have a No. 2 Common board with a clear-face yield of 66⅔ percent or more (when a cutting used for grading is smaller than that allowed in No. 1 Common), it is a requirement when the special rule allowing an extra cutting is used (boards with 2 to 7 feet surface measure).

In general, while more cuttings are allowed in determining No. 2 Common, this is not true for boards with a surface measure of 2, 3, or 5 feet where the number of cuttings allowed is the same for both grades. A board with 4 feet of surface measure will be No. 2 Common if the clear-face yield is, for example, 73 percent when two cuttings are required to obtain this yield. This is true even if both cuttings were above the minimum for the No. 1 Common grade.

Further, it is often possible to "pay the penalty" of a minimum 66⅔ percent in surface area of clear-face cuttings for No. 2 Common by using an extra cutting in the 2- to 7-foot surface measure range for boards that are already graded No. 2 Common. This is not done in practice, but this illustrates that there is a wider range of yields possible for No. 2 Common than first meets the eye. We can state with certainty that a No. 2 Common board is No. 2 Common because it does not contain sufficient area in few enough clear-face cuttings of adequate size to be No. 1 Common.

Grading rules have little to do with the way the boards will be used. Fully one-fourth of the clear quality 4/4 solid wood furniture parts and one-third of the 4/4 kitchen cabinet parts are less than the 2-foot minimum length required in establishing the No. 2 Common grade (Araman et al. 1982). And, there will be areas in No. 2 Common that will contribute to the yield but that cannot be used to establish the grade. The real question is how easily can we get needed parts out of a board.

The interaction of grading rules and gang ripping is illustrated in Figure 1. In Pair A, a straight board with 7-foot surface measure grades out at No. 1 Common because it has a 70 percent clear-face cuttings area in two cuttings. When gang-ripped as shown, the parts yield is 72 percent. An additional knot is added to get the Pair B boards. While the grading yield stays the same at 70 percent, the grade itself drops to No. 2 Common because three cuttings are needed. The parts yield drops slightly to 69.5 percent. Finally, we add another knot and some wane to get the Pair C boards. This pair is No. 2 Common with a grading surface area of only 54 percent. The parts yield, though, is about 10 percent higher than the grading yield.

Table 1.—National Hardwood Lumber Association grading rules for No. 1 and No. 2 Common lumber[a]

Surface measure (feet)	Percent in clear-face cuttings	Number of cuttings
	NO. 1 COMMON[b]	
1	100	
2	75	1
3 & 4	66⅔	1
5 to 7	66⅔	2
8 to 10	66⅔	3
11 to 13	66⅔	4
14 & up	66⅔	5
	NO. 2 COMMON[c]	
1	66⅔	1
2 & 3	50	1
4 & 5	50	2
6 & 7	50	3
8 & 9	50	4
10 & 11	50	5
12 & 13	50	6
14 & up	50	7

[a]Board widths = 3 inches and wider; board lengths = 4 to 16 feet.

[b]Minimum. 3- to 10-foot surface measure will admit 1 additional cut to yield 75 percent clear-face. Minimum cutting sizes are 4 inches by 2 feet or 3 inches by 3 feet.

[c]Minimum. 2- to 7-foot surface measure will admit 1 additional cut to yield 66⅔ percent clear-face. Minimum cutting size is 3 inches by 2 feet.

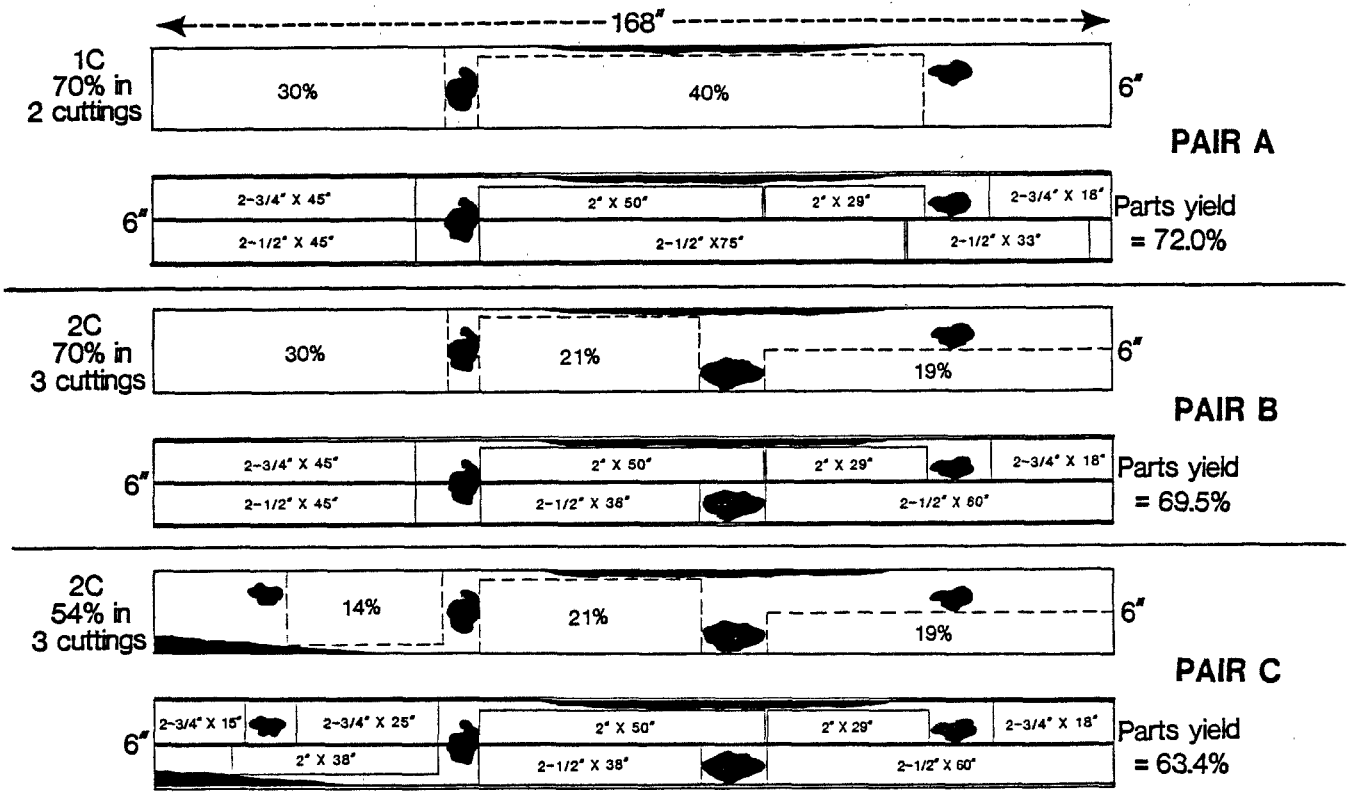

Figure 1.—Examples of the effects of decreasing grade on the yields from gang-ripping No. 1 and No. 2 Common lumber. Additional defects were added to Pair A to get the Pair B and Pair C boards. Drawing is approximately to scale.

The Study: Evaluating Parts Yields

A worst case scenario for gang-ripping is the processing of narrow boards that contain crook or side bend. Twenty-nine No. 1 Common boards and thirty-two No. 2 Common boards from 10 to 16 feet long and 5 to 8 inches wide (mostly 5 to 6 inches) and containing ½ to more than 2 inches of crook were examined. These boards were graded after being kiln-dried using the Special Kiln Dried Rule (National Hardwood Lumber Association 1986). After the computer simulation of fixed-arbor gang-ripping was completed, the boards were physically crosscut to remove the crook. Defects were again recorded. The gang-ripping of the crosscut pieces was then simulated. The summary results presented in this article are for fixed-arbor simulations where the saw spacings plus kerf equal the board width plus crook. Saw spacings ranged from 1½ to 3 inches, and the widest spacing was always placed first in the sequence.

When viewing the results, the reader should focus on distribution comparisons between grades rather than on the specific yield in any given length or width. Width distributions depend on the saw spacings chosen, and some widths (1.0 and 2.5 inches in this report) may be obtained only from salvage operations. Our simulations did not produce edgings. This means that three 5-inch-wide boards, each with a different amount of crook, will be fed through three different saw spacing sequences. And, after the crook is removed by crosscutting, all resulting pieces will be fed through still another, narrower set of saw spacings. Since the original board samples of No. 1 and No. 2 Common lumber were similar in width and crook amounts, comparisons between grades are valid.

The average clear-face grading area was 77 percent for No. 1 Common and 62 percent for No. 2 Common. Yields from the simulated gang-ripping of full-length boards with crook was 70 percent for No. 1 Common and 65 percent for No. 2 Common. After crosscutting to remove crook, the overall yields were 74 percent for No. 1 Common and 67 percent for No. 2 Common. Distributions of lengths and widths before and after removing crook by crosscutting are shown in Figures 2 through 5.

An in-depth discussion of saw setups for fixed-arbor gang-ripping is beyond the scope of this paper. It is possible to

analyze saw spacings and board widths (plus crook) and predict the yields in each width class. Because our spacing sequences did not call for 1- or 2½-inch spacings, these pieces came only from salvage operations. Except for the 3.0-inch-wide yields that contain no salvage pieces, all other width yields are a combination of pieces from crosscutting of strips to length and from salvage. The width yields from No. 1 and No. 2 Common were judged to be about the same whether from the full-length boards with crook or from the resulting pieces when the crook was removed.

The length distribution comparisons between the grades also are very similar except for the 75-inch class where No. 1 Common had about 10 percent more yield than No. 2 Common. After crook removal, the 75-inch yield for No. 1 Common stayed about the same, but the No. 2 Common yield dropped 10 percentage points. Most of the drop was picked up in the 50- and 60-inch lengths. The reader should note that length groupings are not in equal increments but reflect, instead, the needs of the industry (Araman et al. 1982). When these needs are considered, the differences in length distributions between No. 1 Common and No. 2 Common are not important. Even after crosscutting to remove crook, gang ripped No. 2 Common still contains too many long lengths and not enough short lengths (Fig. 6).

Are Yields from No. 2 Common Really Equal to No. 1 Common?

The actual yields reported may seem high, yet the comparisons between the grades should be realistic. The actual yields are based on computer simulations that generally exceed human operator capabilities. We used 18 combinations of saw spacings to ensure that no edgings were made. In practice, saw spacings on a single arbor will not always equal the full width of the board plus crook. Thus, width yields probably will be less. Length distributions, however, should be similar, particularly if a backgauge is used. Ripped strips are easy to handle and

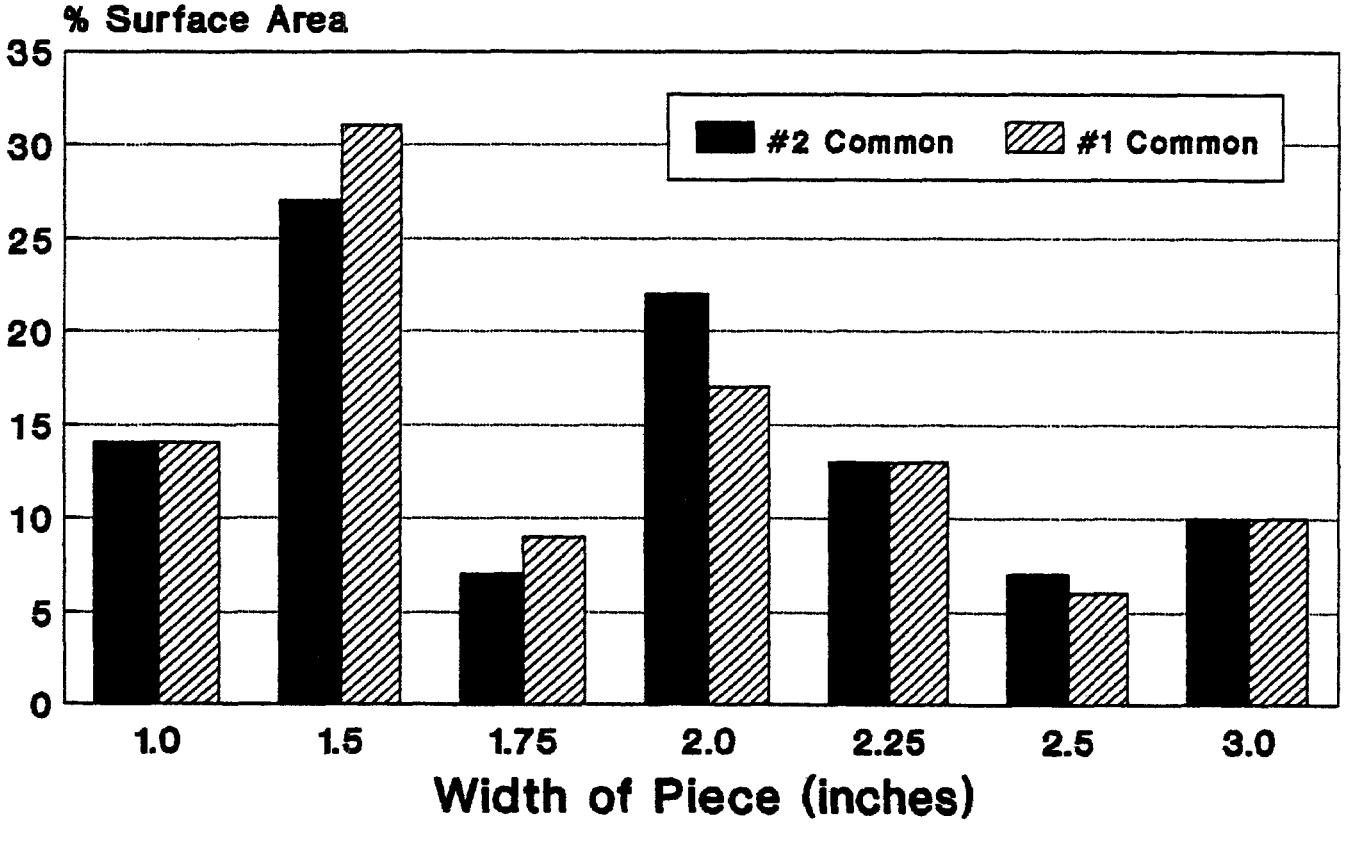

Figure 2.—Distribution of parts widths, full-length boards with crook, fixed-arbor saw spacings—widest first.

can be turned often when being cut to length to maximize clear-face cuttings.

The comparisons of No. 1 and No. 2 Common narrow boards with crook or sidebend show slightly more overall yield for No. 1 Common but a similar distribution of length and width yields. These results will be further tested with straight-board data banks currently being developed. The similar distribution of part lengths and widths and minor differences in overall part yields when combined with the price differential between the grades for fine hardwoods suggests no real difference between the two grades for furniture and cabinet parts. In June 1989, the cost of air dried, 4/4 Appalachian red oak was $530 per thousand board feet for No. 1 Common and $250 per thousand board feet for No. 2 Common (Barrett 1988).

Literature Cited

Araman, P. A.; Gatchell, C.J.; Reynolds, H.W. 1982. **Meeting the solid wood needs of the furniture and cabinet industries: standard-size hardwood blanks.** Res. Pap. NE-494. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 27 p.

Barrett, G.B. [ed.] 1988. Weekly Hardwood Review 3(33):24.

National Hardwood Lumber Association. 1986. **Rules for the measurement & inspection of hardwood & cypress.** Memphis, TN: National Hardwood Lumber Association. 118 p.

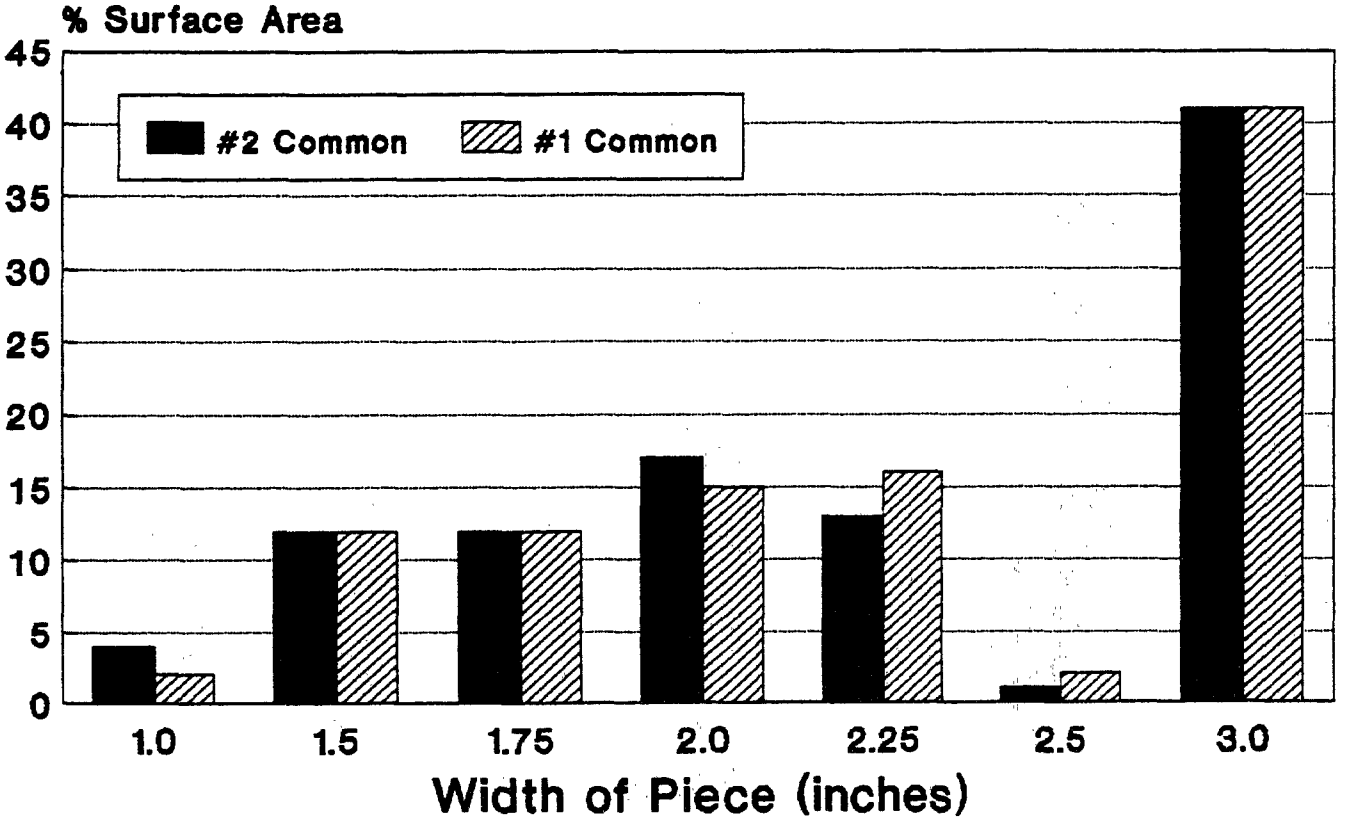

Figure 3.—Distribution of parts widths, crook removed, fixed-arbor saw spacings—widest first.

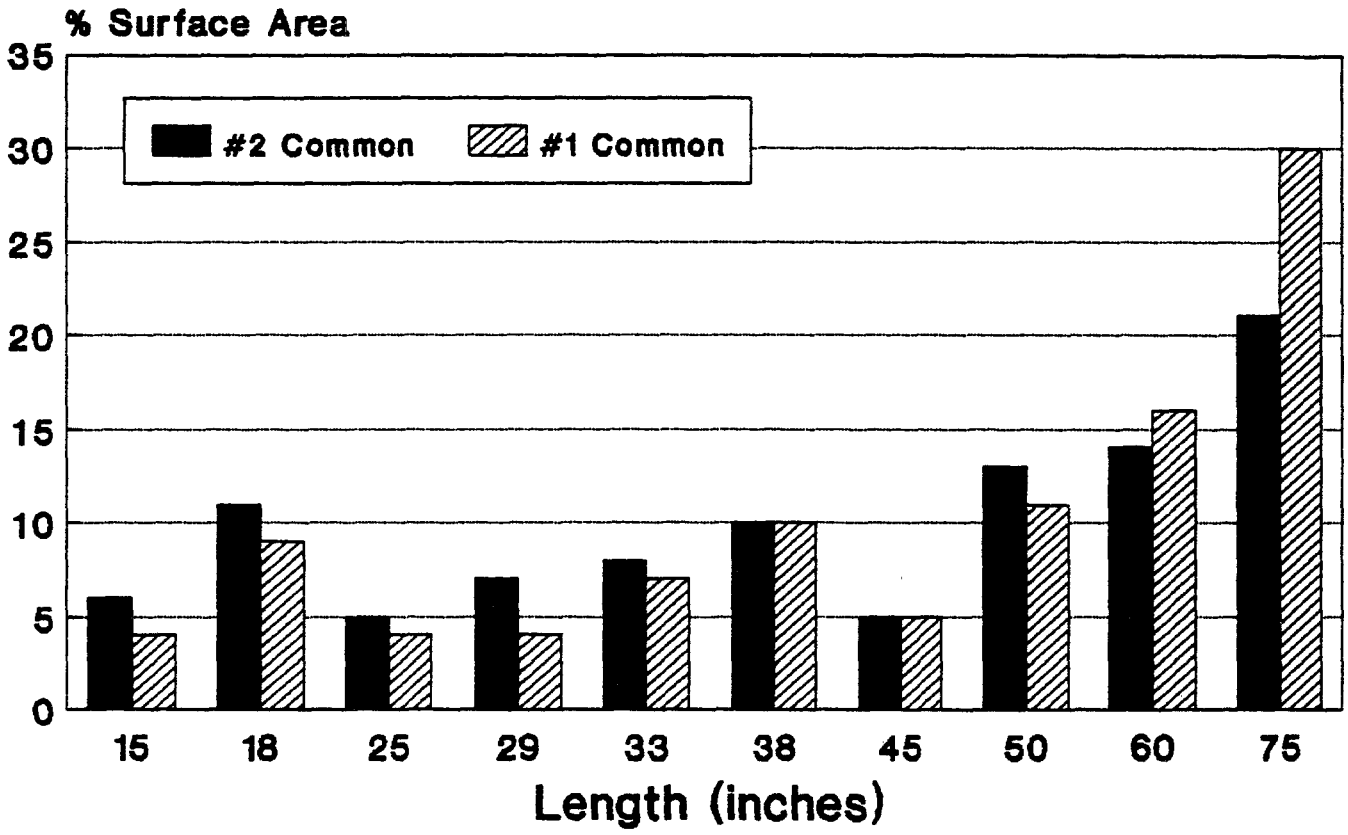

Figure 4.—Distribution of parts lengths, full-length boards with crook, fixed-arbor saw spacings—widest first.

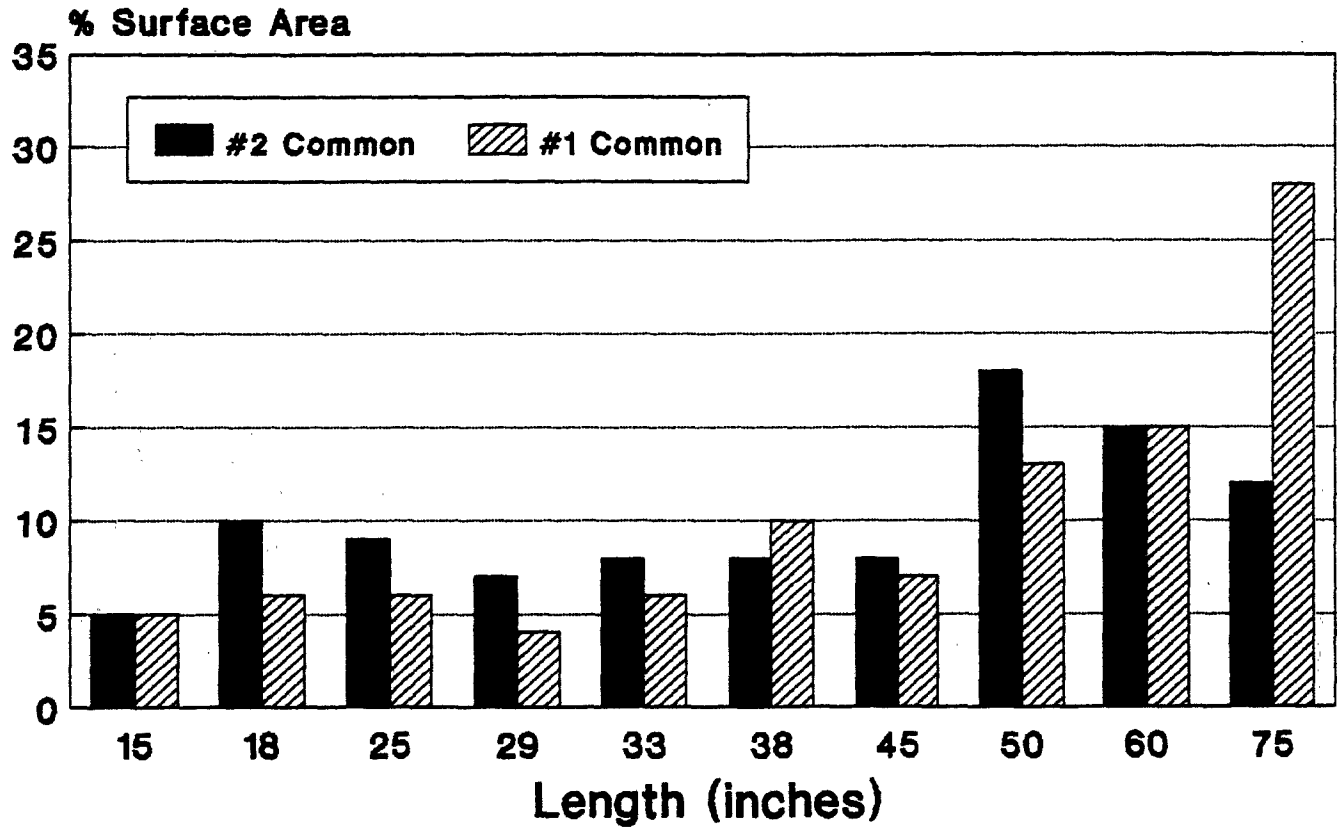

Figure 5.—Distribution of parts lengths, crook removed, fixed-arbor saw spacings—widest first.

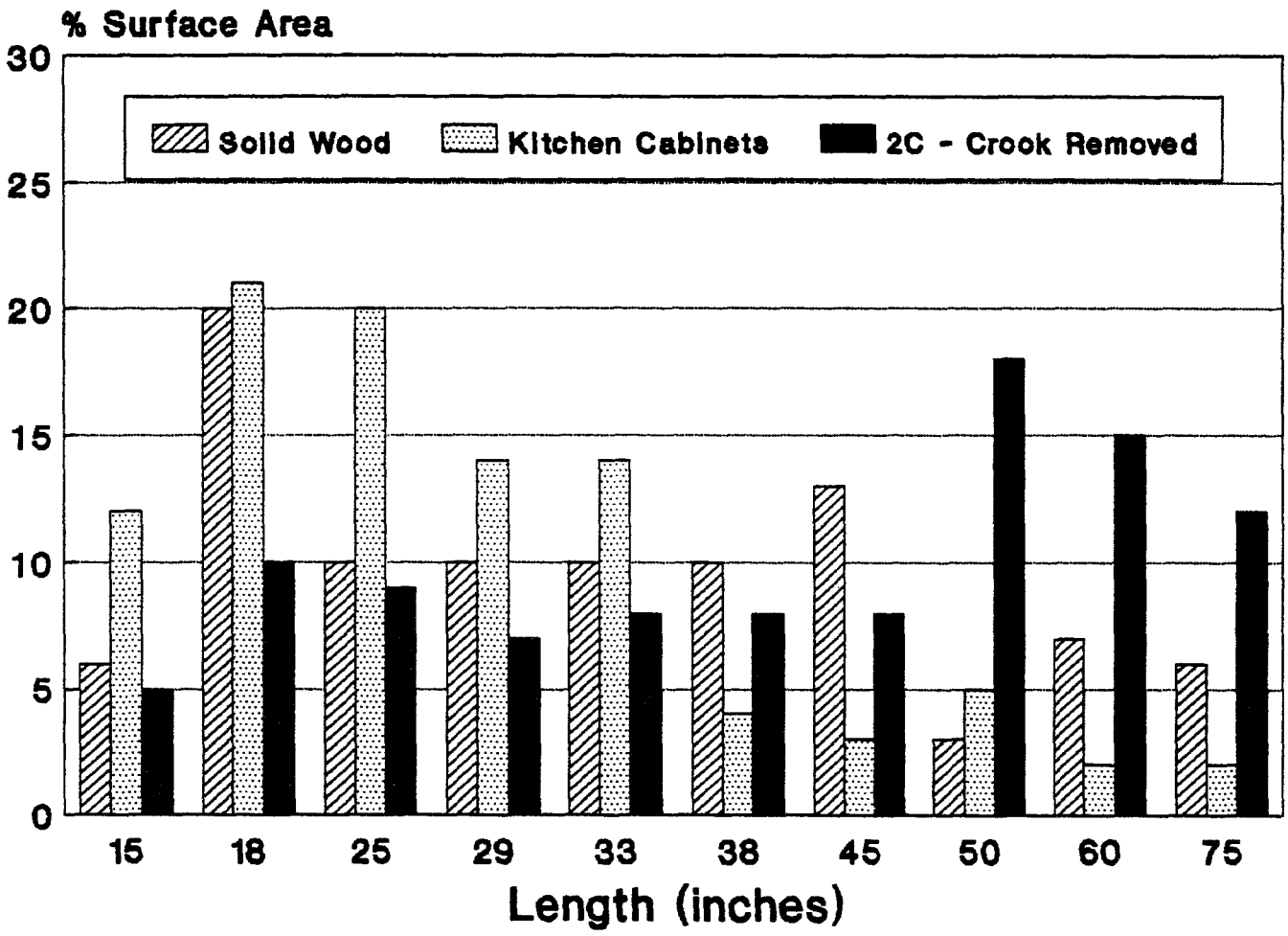

Figure 6.—Industry needs versus 2C yield.

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