A Key for the Forest Service Hardwood Tree Grades

Gary W. Miller, *USDA Forest Service, Timber and Watershed Laboratory, P.O. Box 404, Parsons, WV 26287;* **Leland F. Hanks,** *USDA Forest Service, 310 W. Wisconsin Avenue, Milwaukee, WI 53203; and* **Harry V. Wiant, Jr.,** *Division of Forestry, West Virginia University, Morgantown, WV 26506.*

ABSTRACT. A dichotomous key organizes the USDA Forest Service hardwood tree grade specifications into a stepwise procedure for those learning to grade hardwood sawtimber. The key addresses the major grade factors, tree size, surface characteristics, and allowable cull deductions in a series of paired choices that lead the user to a decision regarding tree grade. Subtle grading rules, previously presented as footnotes to the major specifications, are included in the key. It simplifies the process so that the beginner can learn the system quickly, without detailed instruction from experienced tree graders.

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USDA Forest Service hardwood tree grades are used to predict factory lumber grade yields for many commercial hardwood tree species (Hanks 1976, Hanks and Brisbin 1978). The grading system makes it possible to calculate the dollar value of standing timber from the grades and prices of lumber that can be sawn from individual trees. Once familiar with the system, timber graders can provide consistent estimates of timber quality and stand value. The key presented in this paper serves as a teaching aid for those learning to grade hardwood trees. It provides a stepwise procedure for determining the grades of individual trees and organizes the grade specifications so that the beginner is not overwhelmed with choices (Table 1).

Many people find it difficult to learn the tree grading system using existing references, especially when experienced graders are not available to provide detailed instruction. The key overcomes three major problems beginners often encounter when trying to learn tree grading from earlier presentations. First, the key contains the subtle grade specifications previously presented as footnotes to the major grade factors. This improvement makes the beginner aware of the fine points without disrupting the step-by-step process of grading. Second, the key addresses the grade factors in a sequence that reduces confusion and improves comprehension. Third, the key can be used to learn how to grade hardwood trees without detailed instruction. Field trials have indicated that beginners can use the key to determine the correct tree grade, while those using other references require outside help. This feature of the key allows the beginner to become competent without the delays and costs associated with more formal training. As a result, tree grades can be used to assess tree quality and value in a shorter period of time.

BACKGROUND

The most difficult part of tree grading is recognizing defect indicators on the surface of the tree. Photographic guides are available for some commercial species (Rast 1982, Shigo 1983, Marden and Stayton 1970, Lockard et al. 1963). Estimating interior cull deductions is also difficult for the beginner. References are available for making adjustments for sweep, crook, and rot (Rast et al. 1973, Petro 1971, USDA Forest Service 1973). In addition to learning the grade specifications, the trainee should use and review these references to maintain competence in all aspects of grading and scaling.

TREE GRADE SPECIFICATIONS

Tree grade is generally determined by characteristics of the best 12-ft grading section in the butt 16-ft log. A 14- or 16-ft grading section may be used if it results in a better grade than the 12-ft section. Field experience with Forest Service tree grades has shown that tree grade is usually defined by characteristics of the bottom 12-ft section or the top 12-ft section in the butt log. Occasionally, however, using a 14- or 16-ft grading section results in a higher grade. A simple rule is to use the grading section that results in the highest tree grade.

Forest Service tree grade specifications involve three major characteristics of the grading section:

(1) size—diameter breast height (dbh) and diameter inside bark (dib) at the top of the grading section,
(2) clear cuttings—the total length of allowable clear cuttings on the second worst face of the grading section, and
(3) cull deductions—the percentage of volume deducted for sweep and crook and the percentage of volume deducted for sweep, crook, and rot combined.

As a tree is graded, each of these characteristics is examined to determine whether the tree qualifies for a particular grade. The key addresses each characteristic in a logical, stepwise procedure. In effect, the key systematically tests each characteristic until the tree is graded.

Size

Both dbh and dib at the top of the grading section must satisfy the minimum requirements of the assigned tree grade (Hanks 1976). The first step in determining tree grade is to measure dbh to the nearest inch. For grades 1, 2, and 3 the minimum dbh requirements are 16, 13, and 10 in, respectively. Dib at the top of the grading section, however, is the more important specification for determining grade. This is because dib and another major tree grade characteristic, clear cuttings, are interrelated. Dib at the top of the grading section defines the minimum length or the maximum number of clear cuttings allowed in grades 1 and 2.

Since dib at the top of the grading section cannot be measured directly, it must be estimated from dbh and an assigned form class. Recall that the top of the grading section can be 12, 14, or 16 ft above stump height. For a given dbh, dib will differ at 12, 14, and 16 ft above stump height because of taper. Tables 2 and 3 show the minimum dbh required to meet the dib limitations for Girard form classes 79 and 82, respectively.

To use the tables, locate the appropriate dib limitation in the column of numbers at the left. Then find the position of the grading section across the top of the table. The number shown in the table is the minimum dbh required to meet the dib limitation at that position. For example, the key indicates a minimum dib of 12.6 in for a tree that measures 15.8 in dbh. The top of the grading section is at 16 ft above stump height and form class is 79. Is the tree at least 12.6 in in dib at 16 ft above stump height? From Table 2, a tree of form class 79 must be at least 16.0 in dbh to have an inside bark diameter of 12.6 in at 16 ft above stump height.

Table 1. Key for hardwood tree grades based on the second worst face of the best 12-foot section of the butt 16-ft log.

1. Minimum dbh of 15.6 inches (14.6 inches for basswood and ash)	2
1. Minimum dbh of 12.6 inches	10
1. Minimum dbh of 9.6 inches (If dbh is less than 9.6 inches stop here; tree is below grade)	18
2. Clear cuttings total at least 10 feet in 1 or 2 cuttings—each cutting at least 7 feet long	5
2. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 7 feet long	3
2. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 7 feet long...(due to rot only)	15
3. Clear cuttings total at least 10 feet in 1 or 2 cuttings—each cutting at least 5 feet long	6
3. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 5 feet long	4
3. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 5 feet long... (due to rot only)	15
4. Clear cuttings total at least 10 feet in 1 or 2 cuttings—each cutting at least 3 feet long	7
4. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 3 feet long	11
4. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 3 feet long... (due to rot only)	15
5. Dib at top of grading section at least 12.6 inches (11.6 inches for basswood and ash)	8
5. Dib at top of grading section less than 12.6 inches (11.6 inches for basswood and ash)	17
6. Dib at top of grading section at least 15.6 inches	8
6. Dib at top of grading section less than 15.6 inches	17
7. Dib at top of grading section at least 19.6 inches	8
7. Dib at top of grading section less than 19.6 inches	17
8. Total cull deduction, including sweep, crook, and rot does not exceed 9%	GRADE 1
8. Total cull deduction exceeds 9%	9
9. Cull deduction does not exceed 15% for sweep and crook, and total cull deduction does not exceed 40%	GRADE 2
9. Cull deduction for sweep and crook exceeds 15% or total cull deduction exceeds 40%	20
10. Clear cuttings total at least 10 feet in 1 or 2 cuttings—each cutting at least 7 feet long	17
10. Clear cuttings total less than 10 feet in 1 or 2 cuttings—each cutting at least 7 feet long	11
11. Clear cuttings total at least 8 feet in 1 or 2 cuttings—each cutting at least 3 feet long	13
11. Clear cuttings total less than 8 feet in 1 or 2 cuttings—each cutting at least 3 feet long	12
12. Clear cuttings total at least 8 feet in 1, 2, or 3 cuttings—each cutting at least 3 feet long	14
12. Clear cuttings total less than 8 feet in 1, 2, or 3 cuttings—each cutting at least 3 feet long	18
13. Dib at top of grading section at least 10.6 inches	17
13. Dib at top of grading section less than 10.6 inches	20
14. Dib at top of grading section at least 11.6 inches	17
14. Dib at top of grading section less than 11.6 inches	20
15. Clear cuttings total at least 8 feet in 1, 2, or 3 cuttings—each cutting at least 3 feet long	16
15. Clear cuttings total less than 8 feet in 1, 2, or 3 cuttings—each cutting at least 3 feet long	18
16. Cull deduction for rot does not exceed 40%	GRADE 2
16. Cull deduction for rot exceeds 40%	20
17. Total cull deduction, including sweep, crook, and rot does not exceed 9%	GRADE 2
17. Total cull deduction exceeds 9%	20
18. Clear cuttings total at least 6 feet, all cuttings at least 2 feet long	19
18. Clear cuttings total less than 6 feet, all cuttings at least 2 feet long	BELOW GRADE
19. Dib at top of grading section at least 7.6 inches	20
19. Dib at top of grading section less than 7.6 inches	BELOW GRADE
20. Total cull deduction, including sweep, crook, and rot does not exceed 50%	GRADE 3
20. Total cull deduction exceeds 50%	BELOW GRADE

Dib at the top of the grading section is less than 12.6 in because the dbh of this particular tree is only 15.8 in.

Clear Cuttings

To determine the total length of clear cuttings on the grading section, the first step is to identify the grading face of the tree. Visually square the butt log into four faces, using imaginary vertical lines. Arrange the faces so that most defect indicators, such as bumps and knots, are concentrated on one face. The worst face is ignored, and the next-to-worst face becomes the grading face of the tree.

A clear cutting is a portion of the grading face that is free of defects and extends the width of the face. The grade specifications define the minimum length of clear cuttings, the

Table 2. Minimum dbh (in inches) required to meet dib limitations—trees with form class 79.

Dib	Position of grading section, feet above stump height		
	0–12	2–14	4–16
19.6	23.0	23.9	24.9
15.6	18.3	19.0	19.8
12.6	14.8	15.4	16.0
11.6	13.6	14.2	14.7
10.6	12.4	12.9	13.5
9.6	11.3	11.7	12.2
7.6	8.9	9.3	9.6

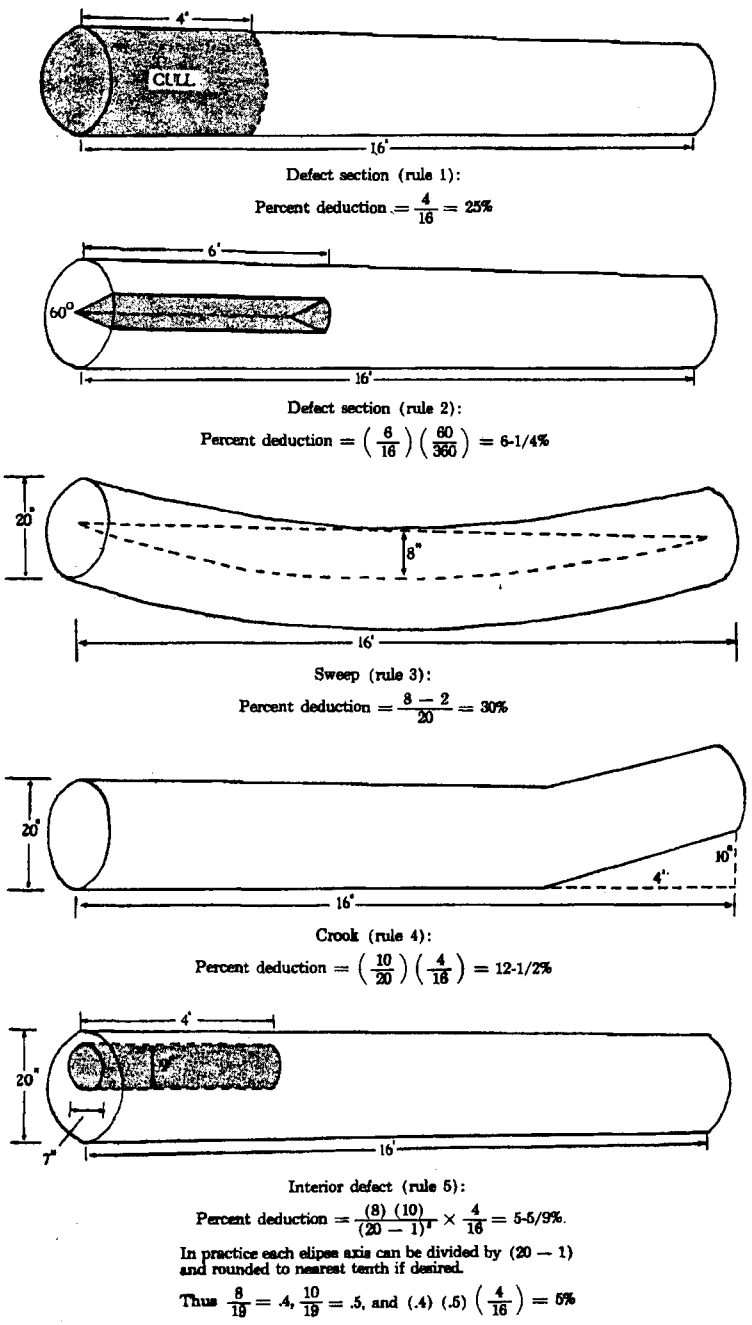
Table 3. Minimum dbh (in inches) required to meet dib limitations—trees with form class 82.

Dib	Position of grading section, feet above stump height		
	0–12	2–14	4–16
19.6	22.4	23.2	24.0
15.6	17.9	18.4	19.1
12.6	14.4	14.9	15.4
11.6	13.3	13.7	14.2
10.6	12.1	12.5	13.0
9.6	11.0	11.4	11.7
7.6	8.7	9.0	9.3

Table 4. Minimum total length (in feet and inches) of clear cuttings required for each grade and length of grading section.

Length of grading section	Minimum total length of clear cuttings[a]		
	Grade 1	Grade 2	Grade 3
12′	10′	8′	6′
14′	11′8″	9′4″	7′
16′	13′4″	10′8″	8′

[a] Clear cuttings must total 5/6, 4/6, and 3/6 of the length of the grading section for grades 1, 2, and 3, respectively.



From: Grosenbaugh, L. R., Short cuts for cruisers and scalers, USDA Forest Serv. South. Forest Exp. Sta., Occas. Paper 128, 1952.

Fig. 1. Methods of determining scaling deduction *(examples based on a 16-ft log with 20-in scaling diameter).*

maximum number of cuttings allowed, and the minimum total length of clear cuttings for each tree grade Clear cuttings must total 5/6, 4/6, and 3/6 of the length of the grading face for grades 1, 2, and 3, respectively. The key assumes a 12-ft grading section. If a longer grading section is used, the minimum total length of clear cuttings stated in the key should be adjusted according to Table 4.

Cull Deductions

The key also defines maximum allowable deductions for sweep, crook, and rot. Figure 1 shows how most scaling deductions are determined. In calculating percent sweep deduction, the number subtracted from actual sweep varies with log length. When calculating percent deduction for sweep, the numerator is the sweep (in inches) minus 1½ in for a 12-ft grading section and 2 in for a 14- or 16-ft grading section (Rast et al. 1973). Estimating internal rot requires good judgment and a lot of practice. The National Forest Log Scaling Handbook (USDA For. Serv. 1973) provides detailed instructions for estimating most scaling deductions.

USING THE KEY

Specific instructions on tree grading are presented in "Hardwood tree grades for factory lumber" (Hanks 1976). The key simply organizes all the grade specifications and provides a stepwise procedure for the beginner For each tree, start at the top of the key and proceed to the step indicated in the right-hand column of numbers Continue following the key until the tree is graded. At first the beginner should rely on the key and consult Figure 1 to estimate scaling deductions. With more experience, grading can be done from memory. □

LITERATURE CITED

Hanks, L. F. 1976. Hardwood tree grades for factory lumber. USDA For. Serv. Res. Pap NE-333. 81 p.

Hanks, L. F., and R. L. Brisbin. 1978. Lumber grade yields for graded aspen logs and trees USDA For. Serv. Res. Pap. NE-423. 13 p.

LOCKARD, C. R., J. A. PUTNAM, and R. D. CARPENTER. 1963. Grade defects in hardwood timber and logs. USDA For. Serv. Agric. Handb. 244. 39 p.

MARDEN, R. M., and C. L. STAYTON. 1970. Defect indicators in sugar-maple: a photographic guide. USDA For. Serv. Res. Pap. NC-37. 29 p.

PETRO, F. J. 1971. Felling and bucking hardwoods: how to improve your profits. Can. Dep. Fish. and For., Can. For. Serv., Ottawa, Ontario. Publ. No. 1291. 140 p.

RAST, E. D. 1982. Photographic guide of selected external defect indicators and associated internal defects in northern red oak. USDA For. Serv. Res. Pap. NE-511. 20 p.

RAST, E. D., D. L. SONDERMAN, and G. L. GAMMON. 1973. A guide to hardwood log grading. USDA For. Serv. Gen. Tech. Rep. NE-1. 32 p.

SHIGO, A. L. 1983. Tree defects: a photo guide. USDA For. Serv. Gen. Tech. Rep. NE-82. 167 p.

USDA FOR. SERV. 1973. National forest log scaling handbook. Wash., DC. 184 p.