

Taper Equations for the Lake States Composite
Volume Tables and Their Application

by

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INTRODUCTION

The composite volume tables developed by Gevorkiantz and Olson (1955) and presented in USDA Technical Bulletin 1104 have been widely used in the Lake States. Table 6 of that bulletin, for example, has served as the primary pulpwood volume table in the Lake States. That table describes tree volume from a 1 foot stump to an upper stem top diameter inside bark (tdib) that is variable but not less than 3 inches. This table and others in Bulletin 1104 describe utilization standards prevalent in the 1950's. Since then there has been greater utilization of trees, particularly to lower stump heights and smaller top diameters. This report describes computerization of the table that summarizes the taper relationships upon which these volume tables were based and use of the resultant software to create new volume tables.

TAPER EQUATION DEVELOPMENT

The taper table in Gevorkiantz and Olson (Table 8) was fitted with a wide range of models including polynomial expressions, spline functions and segmented polynomial models (Burkhart et al. [1982]). From these trials it was determined that the following model fit taper by height class in that table best:

$$\begin{aligned} \ln(\text{tdib}/\text{Dbh}) = & b + b_1 X + b_2 X \ln X + b_3 X^2 \ln X + b_4 X^3 \ln X \\ & + b_5 X^4 \ln X + b_6 (\ln X / (1.01 - X))^2 \end{aligned} \quad (1)$$

where: $x = h/H$

Dbh = diameter at breast height outside bark

h = height to tdib

H = total tree height

Deviations from observed values were never more than .01%. Subsequently, the model fits for taper within each height class were assembled in the form of computer subprograms that are contained in subroutine TAPER listed in APPENDIX A. The coefficients in the subprogram DRATIO of TAPER are those resulting from the fit of model 1 to the separate columns of Table 8 of Gevorkiantz and Olson. As a further refinement, the taper for the 20' height class was also used to describe taper for an assumed 10' height class. These subprograms were designed to interpolate between the total tree height classes and between percent of total height classes given in Table 8. The results of this interpolation are shown in the expanded taper table noted here as Table 8 (Revised) in APPENDIX C.

A calling program for using the TAPER subprograms^{on an IBM-PC} is listed in APPENDIX B and was then used to construct volume tables to different top diameters. In particular, APPENDIX D presents volume tables based on these relationships for a range of top diameters and stump heights. Users may refine the calling program to produce other tables and taper relationships as local situations suggest.

TABLE COMPARISONS

The taper equations and interpolation package appendices described here will allow expanded usage of the taper information in technical bulletin 1104. Users should also note that Stone's equation (given by Hahn [1984]) can also provide rapid computations of tree volume for top diameters different than those used in Table 6 of Gevorkiantz and Olson. Actually, Stone's equation was developed by weighted regression analysis of tree volume/Dbh/height/top diameter relationships in Table 6. The top

diameters were determined from Table 8.¹ Stone's equation is used by the USDA Forest Service North Central Forest Experiment Station forest survey project to estimate gross volume to a merchantable top diameter outside bark (dob) of 4 inches (see Hahn (1984)). Martin (1984) has also noted that Stone's equation (and indirectly Bulletin 1104) is among the most accurate sources of tree volume information for the region. Comparability between the expanded taper table and Stone's equation is shown in APPENDIX E. Since deviations are small, users may find Stone's equation adequate except for extreme diameter and height combinations. The single equation also executes faster on computer systems than the interpolation process involved in the TAPER routine. A model like that of Stone's equation could also be fitted to volume, diameter, height and top diameter information generated from the taper routines to simplify computations for other levels of tree utilization.

¹Personal communication from Dr. Robert N. Stone, USDA, Forest Service Forest Products Laboratory, Madison, Wisconsin, November 29, 1978.

LITERATURE CITED

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- Max, T. A. and H. E. Burkhart. 1976. Segmented polynomial regression applied to taper equations. Forest Science 22:283-289.
- Martin, A. J. 1984. Testing volume equation accuracy with water displacement techniques. Forest Science 30:41-50.
- Hahn, J. T. 1984. Tree volume and biomass equations for the Lake States. Research Paper NC-250. 10 pp.

APPENDIX A
TAPER Subroutines

```

SUBROUTINE TAPER (TYPE, D, H, DM, HM)
C*****      PROGRAM IDENTIFICATION      ***** TAPER
C
C          THIS IS THE DRIVER ROUTINE FOR TAPER FUNCTIONS DEVELOPED * TAPER
C          FOR TABLE B, USDA TECH. BULL. 1104. TAPER FIRST VALIDATES * TAPER
C          THE INPUTS AND THEN CALLS THE REQUESTED FUNCTION. IF * TAPER
C          ANY ERRORS OCCURE, AN ERROR MESSAGE IS PRINTED AND THE * TAPER
C          RUN TERMINATED. ALAN R. EK AND MICHAEL T. CHECKY * TAPER
C          COLLEGE OF FORESTRY, UNIV. OF MINN. * TAPER
C          * TAPER
C          THE REQUESTED FUNCTIONS ARE: * TAPER
C          1 FIND DM, GIVEN D, H AND HM * TAPER
C          2 FIND HM, GIVEN D, H AND DM * TAPER
C          3 FIND H, GIVEN D, DM AND HM * TAPER
C          * TAPER
C****      SIMPLE VARIABLES      **** TAPER
C          * TAPER
C          D      = TREE DIAMETER AT 4.5 FEET ABOVE GROUND (DBH) * TAPER
C          DM     = DIAMETER AT MERCHANTABLE HEIGHT * TAPER
C          H      = TOTAL TREE HEIGHT * TAPER
C          HM     = MERCHANTABLE HEIGHT * TAPER
C          TYPE   = REQUESTED FUNCTION TYPE * TAPER
C          * TAPER
C****      EXTERNALS      **** TAPER
C          * TAPER
C          FINDDM = FUNCTION TO CALCULATE DM * TAPER
C          FINDH  = FUNCTION TO CALCULATE H * TAPER
C          FINDHM = FUNCTION TO CALCULATE HM * TAPER
C          * TAPER
C*****      VARIABLE TYPING      ***** TAPER
C          * TAPER
C          REAL   D,DM,FINDDM,FINDH,FINDHM,H,HM TAPER
C          INTEGER TYPE TAPER
C          * TAPER
C*****      SELECTION BLOCK      BLOCK 100 TAPER
C          * TAPER
C          IF (TYPE .LT. 1 .OR. TYPE .GT. 3) GO TO 901 TAPER
C          GO TO (201, 301, 401), TYPE TAPER
C          * TAPER
C*****      FIND DM BLOCK      BLOCK 200 TAPER
C          * TAPER
C          201 IF (H .LT. 10.0) GO TO 901 TAPER
C          IF (D .LT. 0.0) GO TO 901 TAPER
C          IF (HM .LE. 0.0) HM = .00001 TAPER
C          IF (HM .GT. H) GO TO 901 TAPER
C          DM = FINDDM (D, H, HM) TAPER
C          RETURN TAPER
C          * TAPER
C*****      FIND HM BLOCK      BLOCK 300 TAPER
C          * TAPER

```

```

301 IF (H .LT. 10.0) GO TO 901          TAPER
    IF (D .LT. 0.0) GO TO 901          TAPER
    IF (DM .LT. 0.0) GO TO 901        TAPER
    HM = FINDHM (D, DM, H)            TAPER
    RETURN                             TAPER
C                                     * TAPER
C*****          FIND H BLOCK          BLOCK 400 TAPER
C                                     * TAPER
401 IF (D .LT. 0.0) GO TO 901          TAPER
    IF (DM .LT. 0.0) GO TO 901        TAPER
    IF (HM .LE. 0.0) HM = .00001      TAPER
    H = FINDH (D, DM, HM)            TAPER
    RETURN                             TAPER
C                                     * TAPER
C*****          ERROR BLOCK          BLOCK 900 TAPER
C                                     * TAPER
901 PRINT 991, TYPE,D,H,DM,HM          TAPER
991 FORMAT (/ ' DATA ERROR, ITYPE = ', I4, ' D = ', F8.1,
1' H = ', F8.1, ' DM = ', F8.1, ' HM = ', F8.1)
    STOP                               TAPER
    END                                 TAPER
    REAL FUNCTION FINDDM (D, H, HM)     FINDDM
C*****          PROGRAM IDENTIFICATION ***** FINDDM
C                                     * FINDDM
C    THIS FUNCTION WILL CALCULATE THE MERCHANTABLE DIAMETER * FINDDM
C    GIVEN THE DBH, TREE HEIGHT AND MERCHANTABLE HEIGHT * FINDDM
C    USING THE TAPER EQUATIONS.        * FINDDM
C                                     * FINDDM
C****          SIMPLE VARIABLES        ***** FINDDM
C                                     * FINDDM
C    D          = TREE DBH              * FINDDM
C    H          = TOTAL TREE HEIGHT     * FINDDM
C    HM         = MERCHANTABLE HEIGHT   * FINDDM
C    LH         = LOWER ENDPOINT OF TREE HEIGHT * FINDDM
C    RH         = (H-HM)/H RATIO        * FINDDM
C    RD1        = DIAMETER RATIO ENDPOINT * FINDDM
C    RD2        = DIAMETER RATIO ENDPOINT * FINDDM
C    UH         = UPPER ENDPOINT OF TREE HEIGHT * FINDDM
C                                     * FINDDM
C****          EXTERNALS               ***** FINDDM
C                                     * FINDDM
C    DRATIO = FUNCTION TO CALCULATE THE DIAMETER RATIO * FINDDM
C    USING THE TAPER EQUATIONS.        * FINDDM
C                                     * FINDDM
C*****          VARIABLE TYPING        ***** FINDDM
C                                     * FINDDM
C    REAL      D,H,HM,RD1,RD2,RH,DRATIO FINDDM
C    INTEGER   LH,UH                    FINDDM
C                                     * FINDDM
C*****          EXECUTION BLOCK        BLOCK 100 FINDDM

```



```

      FDL = FINDDM (D, LOWER, HM) - DM
      IF (ABS(FDL) .LT. TOL) RETURN
101  FINDH = (LOWER + UPPER)/2.0
      FDM = FINDDM (D, FINDH, HM) - DM
C*   PRINT 108, FDL,FINDH,FDM,LOWER,UPPER
108  FORMAT(BF15.10)
      IF (ABS(FDM) .LT. TOL) RETURN
      IF (FDL*FDM .LT. 0.0) GO TO 102
      LOWER = FINDH
      FDL = FDM
      GO TO 101
102  UPPER = FINDH
      GO TO 101
      END
      REAL FUNCTION DRATIO (COLUMN, HRATIO)
C*****      PROGRAM IDENTIFICATION      *****      DRATIO
C
C          THIS FUNCTION CALCULATES THE DIAMETER RATIO BASED ON
C          TABLE 8, USDA TECH. BULL. 1104. EACH COLUMN HAS ITS
C          OWN COEFFICIENTS FOR THE TAPER MODEL.
C
C*****      SIMPLE VARIABLES      *****      DRATIO
C
C          COLUMN = COLUMN NUMBER CORRESPONDING TO COLUMNS IN TABLE
C          COL     = SAME AS COLUMN
C          HRATIO = (H - HM)/H  RATIO
C          RATIO  = SAME AS HRATIO
C          LNX    = LOG OF HRATIO
C
C*****      ARRAY VARIABLES      *****      DRATIO
C
C          B0 - B6 = B0 - B6 COEFFICIENTS
C
C*****      EXTERNALS      *****      DRATIO
C
C          ALOG   = NATURAL LOG FUNCTION
C          EXP    = EXPONENTIAL FUNCTION
C          MINO   = MINIMUM NUMBER FUNCTION
C
C*****      VARIABLE TYPING AND INITIALIZATION      *****      DRATIO
C
      REAL  ALOG,B0(10),B1(10),B2(10),B3(10),B4(10),B5(10),B6(10),
1      EXP,HRATIO,LNX
      INTEGER COLUMN,COL,MINO
      DATA B0 /-0.48045931E-03, 0.52389048E-02, 0.96436017E-02,
1      0.18644302E-01, 0.40249202E-01, 0.67601562E-01,
2      0.86395258E-01, 0.95382778E-01, 0.95150644E-01,
3      0.94915826E-01/
      DATA B1 / 0.78179622, 0.78309812, 0.25221803, 0.66225457,
1      0.69321402, 0.71983541, 0.15234808, 0.10801306E-02,

```

```

2          -0.10035714, -0.20296713/ DRATIO
DATA B2 / 0.52361625, 1.3023264, 3.2370018, 1.7469758, DRATIO
1          -0.17262028, -1.1756091, 0.82167879, 1.0684588, DRATIO
2          1.2372062, 1.4079044/ DRATIO
DATA B3 / -4.1157003, -6.5356015, -14.713911, -10.224678, DRATIO
1          -0.25601526, 5.5888322, -1.3919054, -1.6021691, DRATIO
2          -1.8489858, -2.0986559/ DRATIO
DATA B4 / 2.9652256, 8.3340580, 23.996100, 19.280528, 1.5720255, DRATIO
1          -9.6154809, 1.2710004, 0.94621379, 0.90239499, DRATIO
2          0.85806961/ DRATIO
DATA B5 / 0.0, -3.9378469, -14.531740, -11.108049, -.24209978, DRATIO
1          6.9715143, 4*0.0/ DRATIO
DATA B6 / 2*0.0, -0.14644816, 3*0.0, -0.15656549, DRATIO
1          -0.20442503, -0.23576293, -0.26746314/ DRATIO

C * DRATIO
C***** EXECUTION BLOCK BLOCK 100 DRATIO
C * DRATIO
COL = MINO (COLUMN, 10) DRATIO
RATIO = AMAX1(HRATIO,.05) DRATIO
LNx = ALOG (RATIO) DRATIO
DRATIO = EXP (B0(COL) + B1(COL)*LNx + B2(COL)*RATIO*LNx DRATIO
1 + B3(COL)*RATIO*RATIO*LNx + B4(COL)*RATIO*RATIO DRATIO
2 *RATIO*LNx + B5(COL)*RATIO*RATIO*RATIO*RATIO*LNx DRATIO
3 +B6(COL)*(LNx/(1.01 - RATIO))**2) DRATIO
IF (HRATIO .LT. .05) DRATIO = DRATIO - (.05-HRATIO)/.05 * DRATIO DRATIO
RETURN DRATIO
END DRATIO
REAL FUNCTION INTEG (D, H, A, B) INTEG
C***** PROGRAM IDENTIFICATION ***** INTEG
C * INTEG
C THIS FUNCTION INTEGRATES THE TAPER EQUATION FROM A * INTEG
C TO B, GIVEN D AND H. * INTEG
C * INTEG
C***** VARIABLE IDENTIFICATION ***** INTEG
C * INTEG
C**** SIMPLE VARIABLES ***** INTEG
C * INTEG
C A = LOWER BOUND OF INTEGRATION * INTEG
C B = UPPER BOUND OF INTEGRATION * INTEG
C CH = INTEGRATION STEP SIZE * INTEG
C D = TREE DBH * INTEG
C DM = MERCHANTABLE DIAMETER * INTEG
C H = TREE HEIGHT * INTEG
C HM = MERCHANTABLE HEIGHT * INTEG
C N2 = INTEGRATION STEP COUNTER * INTEG
C S = CUMULATIVE INTEGRATION SUM * INTEG
C * INTEG
C***** VARIABLE TYPEING ***** INTEG
C * INTEG
REAL A,B,CH,D,DM,F,H,HM,S,X INTEG

```

INTEGER N2	INTEG
C	* INTEG
C STATEMENT FUNCTION TO CALCULATE BASAL AREA	* INTEG
C	* INTEG
F (X) = 0.005454*X*X	INTEG
C	* INTEG
C***** EXECUTION BLOCK	BLOCK 100 INTEG
C	* INTEG
N = IFIX (B - A + 0.5) + 4	INTEG
N2 = N/2	INTEG
N = N2*2	INTEG
CH = (B - A)/FLOAT (N)	INTEG
HM = A	INTEG
CALL TAPER (1, D, H, DM, HM)	INTEG
S = F (DM)	INTEG
HM = HM + CH	INTEG
CALL TAPER (1, D, H, DM, HM)	INTEG
S = S + 4.0*F (DM)	INTEG
N2 = N2 - 1	INTEG
DO 101 I = 1,N2	INTEG
HM = A + CH*FLOAT (2*I)	INTEG
CALL TAPER (1, D, H, DM, HM)	INTEG
S = S + 2.0*F (DM)	INTEG
HM = A + CH*FLOAT (2*I + 1)	INTEG
CALL TAPER (1, D, H, DM, HM)	INTEG
S = S + 4.0*F (DM)	INTEG
101 CONTINUE	INTEG
HM = B	INTEG
CALL TAPER (1, D, H, DM, HM)	INTEG
INTEG = CH*(F (DM) + S)/3.0	INTEG
RETURN	INTEG
END	INTEG

APPENDIX B

Calling program for use of TAPER subroutines
for volume table construction

```

PROGRAM TDSCRIB(INPUT,OUTPUT,SCRIB18,TAPE7=SCRIB18)
C*****      PROGRAM IDENTIFICATION      *****
C
C      This is an example main program for producing a
C      composite table of gross volume in board-feet
C      ( Scribner rule ) from a 1 foot stump to an 8 inch
C      top diameter inside bark by number of 8 foot logs
C      or bolts utilizing the TAPER routines.
C
C      Written by: Terry D. Droessler, Research Assistant
C                  Department of Forest Resources
C                  University of Minnesota
C                  St. Paul, MN 55108
C
C      Hardware: Control Data Corporation Cyber Series
C                  University of Minnesota Computing Center
C
C      Date: July 24, 1985
C
C*****
C
C***** SIMPLE VARIABLES *****
C
C      B,IBOLT = BOLT POSITION IN THE TREE
C      D,IDBH = DBH OF THE TREE
C      DIFF = DIFFERENCE BETWEEN MERCHANTABLE HEIGHT
C              AND THE LOWER ENDPPOINT OF TREE HEIGHT
C      H = TOTAL TREE HEIGHT
C      HL = LOWER ENDPPOINT OF TREE HEIGHT
C      HM = MERCHANTABLE HEIGHT
C      NB = NUMBER OF 8 FOOT BOLTS IN THE TREE
C      SCRIB = SCRIBNER BOARD FEET
C      TDM = MERCHANTABLE TOP DIAMETER INSIDE BARK
C      THM = TOTAL MERCHANTABLE HEIGHT IN 8 FOOT BOLTS
C      TOPDIA = DIAMETER AT MERCHANTABLE HEIGHT
C      TOTAL = SUM OF SCRIBNER VOLUME
C
C***** ARRAY VARIABLE *****
C
C      BDFT(50,10) = SCRIBNER BOARD FEET BY DBH AND # OF BOLTS
C
C*****
C*****
C      REAL BDFT(50,10),D,DIFF,H,HL,HM,SCRIB,TDM,TDH,TOPDIA,TOTAL,B
C      INTEGER IDBH,IBOLT,NB
C
C      CONSTRUCT TABLE FOR TREES FROM 10 TO 30 INCHES DBH
C

```

```

DO 200 IDBH=10,30
C
C SPECIFY LIMITS FOR WHICH VOLUMES ARE DESIRED OR REASONABLE
C
    IF(IDBH.EQ.10)THEN
        NB=1
    ELSEIF(IDBH.EQ.11)THEN
        NB=6
    ELSEIF(IDBH.EQ.12)THEN
        NB=8
    ELSEIF(IDBH.EQ.13)THEN
        NB=9
    ELSE
        NB=10
    ENDIF
C
C CONSTRUCT TABLE FOR TREES WITHIN THE ABOVE LIMITS
C
    DO 100 IBOLT =1,NB
        D=IDBH
        B=IBOLT
        TDM=8.0
        THM=IBOLT*8.0+1.0
C
C FIND THE TOTAL TREE HEIGHT GIVEN DBH, MERCHANTABLE DIAMETER
C AND THE MERCHANTABLE HEIGHT OF THE TREE
C
        CALL TAPER(3,D,H,TDM,THM)
C
C CALCULATE THE SCRIBNER BOARD FEET VOLUME OF EACH 8 FOOT BOLT
C FROM THE STUMP TO THE TOTAL MERCHANTABLE HEIGHT
C
        DO 50 I=1,THM,8
            IF(IBOLT.EQ.1.AND.I.GT.1)GO TO 50
            IF(I.EQ.1)THEN
                HL=1.0
            ELSE
                HL=I
            ENDIF
            IF(HL.GT.60.0)GO TO 50
            HM=HL+8.0
            DIFF=HM-HL
            IF(DIFF.LT.7.0)GO TO 50
            IF(IBOLT.EQ.2.AND.HL.GT.16)GO TO 50
            IF(IBOLT.EQ.3.AND.HL.GT.24)GO TO 50
            IF(IBOLT.EQ.4.AND.HL.GT.32)GO TO 50
            IF(IBOLT.EQ.5.AND.HL.GT.40)GO TO 50
            IF(IBOLT.EQ.6.AND.HL.GT.48)GO TO 50
            IF(IBOLT.EQ.7.AND.HL.GT.56)GO TO 50
            IF(IBOLT.EQ.8.AND.HL.GT.64)GO TO 50

```

```

                IF(HH.GT.THM)HH=THM
C
C      FIND THE MERCHANTABLE DIAMETER AT THE TOP OF THE CURRENT BOLT*
C
                CALL TAPER(I,D,H,TPDIA,HH)
                SCRIB=((0.79*TPDIA*TPDIA)-(2.0*TPDIA)-4.0)/2.0
                IF(I.EQ.1)TOTAL=0.0
                TOTAL=TOTAL+SCRIB
50          CONTINUE
                BOFT(IDBH,IBOLT)=TOTAL
100         CONTINUE
200         CONTINUE
C
C      PRINT OUT THE RESULTS IN A TABLE
C
                WRITE(7,1051)
                WRITE(7,1000)
                WRITE(7,1050)
                WRITE(7,1051)
                DO 300 I=10,24
                    WRITE(7,1100)I,(BOFT(I,J),J=1,10)
300         CONTINUE
1000        FORMAT(" DBH",11X," SCRIBNER BOARD FOOT VOLUME WHEN NUMBER ",
&              "OF BOLTS IS--")
1050        FORMAT(" ",10X,"1",6X,"2",6X,"3",6X,"4",6X,"5",6X,"6",6X,
&              "7",6X,"8",6X,"9",6X,"10"////////)
1051        FORMAT(" ",1X)
1100        FORMAT(" ",12,5X,10(F5.0,2X))
                STOP
                END

```

APPENDIX C

Table 8 (Revised), general taper for trees of
various heights

Table B (Revised), general taper for trees of various heights

Percent of total height	Taper factors when total height is --																				
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	
0	99	100	100	100	100	101	101	102	104	105	106	108	109	109	110	109	109	109	109	109	109
1	99	100	100	99	98	100	101	101	102	103	104	104	103	103	104	103	103	103	102	102	102
2	99	100	100	98	97	99	100	100	100	101	102	100	99	99	99	98	98	97	97	97	97
3	99	100	100	98	96	98	100	99	99	99	99	98	97	96	96	95	95	94	94	94	94
4	99	99	100	98	96	98	99	98	98	97	97	96	95	94	94	93	93	92	92	92	92
5	99	99	100	98	96	97	98	97	96	96	96	94	93	93	92	92	91	91	90	90	90
6	99	99	100	98	96	97	98	96	95	94	94	93	92	91	91	91	90	89	89	89	89
7	99	99	99	98	96	96	97	95	94	93	92	91	90	90	90	89	89	88	88	88	88
8	99	99	99	97	96	96	96	94	92	92	91	90	89	89	89	89	88	88	87	87	87
9	99	99	99	97	96	95	95	93	91	90	90	89	88	88	88	88	87	87	86	86	86
10	99	99	98	97	95	95	94	92	90	89	88	88	87	87	87	87	86	86	86	86	86
11	99	98	98	97	95	94	93	91	89	88	87	87	86	87	87	86	86	85	85	85	85
12	98	98	98	96	95	93	92	90	88	87	86	86	86	86	86	86	85	85	84	84	84
13	98	98	97	96	94	93	91	89	87	86	85	85	85	85	85	85	85	84	84	84	84
14	98	98	97	95	94	92	90	88	86	85	84	84	84	84	84	84	84	84	83	83	83
15	98	97	96	95	93	91	89	87	85	84	83	83	83	84	84	84	83	83	83	83	83
16	98	97	96	94	93	90	88	86	84	83	83	83	83	83	83	83	83	83	82	82	82
17	98	97	95	94	92	89	87	85	83	83	82	82	82	82	82	82	82	82	82	82	82
18	98	96	95	93	91	89	86	84	83	82	81	81	81	81	81	81	81	81	81	81	81
19	98	96	94	92	91	88	85	83	82	81	80	81	81	81	81	81	81	81	81	81	81
20	98	96	94	92	90	87	84	83	81	80	80	80	80	80	81	81	81	81	80	80	80
21	97	95	93	91	89	86	83	82	80	80	79	79	79	80	80	80	80	80	80	80	80
22	97	95	92	90	88	85	82	81	80	79	79	79	79	79	80	80	80	80	79	79	79
23	97	94	92	90	87	84	81	80	79	78	78	78	78	79	79	79	79	79	79	79	79
24	97	94	91	89	87	83	80	79	78	78	77	77	78	78	79	79	79	79	78	78	78
25	96	93	90	88	86	83	80	78	77	77	77	77	77	78	78	78	78	78	78	78	78
26	96	93	90	87	85	82	79	78	77	77	76	76	76	76	77	77	77	77	77	77	77
27	96	92	89	86	84	81	78	77	76	76	76	76	76	76	77	77	77	77	77	77	77
28	95	92	88	86	83	80	77	76	76	75	75	75	75	75	76	76	76	76	76	76	76
29	95	91	87	85	82	79	76	76	75	75	75	75	75	75	76	76	76	76	76	76	76
30	94	90	86	84	81	78	76	75	74	74	74	74	74	74	75	75	75	75	75	75	75
31	94	90	86	83	80	78	75	74	74	74	74	74	74	74	75	75	75	75	75	75	75
32	93	89	85	82	79	77	74	74	73	73	73	73	73	74	74	74	74	74	74	74	74
33	93	88	84	81	79	76	73	73	72	73	73	72	72	73	73	74	74	74	74	74	74
34	92	88	83	80	78	75	73	72	72	72	72	72	72	72	73	73	73	73	73	73	73
35	91	87	82	79	77	74	72	72	71	71	71	71	71	71	72	72	72	72	72	73	73
36	91	86	81	79	76	74	71	71	71	71	71	71	71	71	72	72	72	72	72	72	72
37	90	85	80	78	75	73	71	70	70	70	70	70	70	70	71	71	71	71	71	71	71
38	89	84	79	77	74	72	70	70	70	70	70	70	70	70	71	71	71	71	71	71	71
39	88	83	78	76	73	71	69	69	69	69	69	69	69	70	70	70	70	70	70	70	70
40	87	82	77	75	72	71	69	69	68	69	69	69	69	69	69	69	69	69	69	69	69
41	86	81	76	74	71	70	68	68	68	68	68	68	68	68	69	69	69	69	69	69	69
42	85	80	75	73	70	69	68	67	67	67	68	67	67	68	68	68	68	68	68	68	68
43	84	79	74	72	69	68	67	67	67	67	67	67	67	67	67	67	67	68	68	68	68
44	83	78	73	71	69	67	66	66	66	66	66	66	66	66	67	67	67	67	67	67	67
45	82	77	72	70	68	67	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
46	81	76	71	69	67	66	65	65	65	65	65	65	65	65	65	65	66	66	66	66	66

APPENDIX D

Volume tables for a range of utilization
levels and product units

Table D-1.

Composite table: gross volume in cubic feet from a 6 inch stump to a 3 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.6	1.0	1.5	2.0	2.5	---	---	---	---	---
5	.8	1.5	2.1	2.7	3.3	4.0	4.6	5.3	5.9	6.6
6	1.1	2.1	2.8	3.5	4.3	5.2	6.1	6.9	7.7	8.6
7	1.5	2.7	3.7	4.6	5.6	6.6	7.7	8.8	9.9	10.9
8	1.9	3.4	4.7	5.9	7.0	8.3	9.6	11.1	12.4	13.7
9	2.3	4.2	5.8	7.2	8.6	10.2	11.8	13.5	15.2	16.8
10	2.8	5.1	7.0	8.8	10.5	12.3	14.2	16.3	18.4	20.3
11	3.3	6.0	8.3	10.4	12.5	14.7	16.9	19.3	21.9	24.2
12	3.9	7.1	9.8	12.3	14.7	17.2	19.9	22.7	25.7	28.5
13	4.5	8.2	11.3	14.2	17.0	20.0	23.1	26.3	29.9	33.1
14	---	9.3	13.0	16.3	19.6	23.0	26.6	30.2	34.4	38.1
15	---	10.6	14.8	18.6	22.3	26.2	30.3	34.4	39.2	43.4
16	---	12.0	16.7	21.0	25.2	29.6	34.3	39.0	44.3	49.1
17	---	13.4	18.7	23.5	28.2	33.2	38.5	43.8	49.7	55.2
18	---	14.9	20.8	26.2	31.5	37.0	43.0	48.9	55.5	61.7
19	---	16.5	23.0	29.0	34.9	41.1	47.7	54.2	61.6	68.5
20	---	18.2	25.4	31.9	38.4	45.3	52.7	59.9	68.0	75.6
21	---	20.0	27.8	35.0	42.2	49.8	57.9	65.9	74.7	83.2
22	---	21.8	30.4	38.3	46.1	54.4	63.4	72.1	81.7	91.1
23	---	23.7	33.1	41.7	50.2	59.3	69.1	78.6	89.1	99.3
24	---	25.7	35.9	45.2	54.5	64.5	75.1	85.4	96.8	107.9
25	---	27.8	38.8	48.9	58.9	69.8	81.3	92.5	104.8	116.9
26	---	30.0	41.8	52.7	63.6	75.4	87.8	99.9	113.1	126.2
27	---	32.3	45.0	56.7	68.5	81.2	94.6	107.6	121.8	135.8
28	---	34.6	48.2	60.8	73.6	87.2	101.6	115.6	130.7	145.9
29	---	37.0	51.6	65.1	78.8	93.4	108.8	123.8	140.0	156.2
30	---	39.5	55.1	69.5	84.2	99.8	116.3	132.3	149.6	167.0

Table D-2.

Composite table: gross volume in rough cords per square foot of basal area from a 6 inch stump to a 3 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME BASAL AREA RATIO WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.084	.151	.221	.288	.360	----	----	----	----	----
5	.078	.140	.192	.248	.308	.370	.428	.490	.552	.614
6	.074	.133	.181	.228	.279	.332	.391	.444	.499	.555
7	.071	.128	.175	.219	.264	.312	.365	.418	.467	.518
8	.068	.124	.170	.213	.254	.300	.347	.401	.448	.495
9	.066	.121	.166	.208	.248	.292	.337	.387	.436	.481
10	.065	.118	.163	.204	.243	.286	.330	.378	.427	.471
11	.064	.116	.160	.200	.240	.281	.325	.371	.420	.464
12	.063	.114	.158	.198	.237	.278	.321	.366	.415	.459
13	.062	.112	.156	.195	.234	.275	.318	.361	.411	.454
14	----	.111	.154	.193	.232	.272	.315	.358	.407	.451
15	----	.110	.153	.192	.230	.270	.313	.355	.404	.448
16	----	.109	.151	.190	.228	.268	.311	.353	.401	.446
17	----	.108	.150	.189	.227	.267	.309	.351	.399	.444
18	----	.107	.149	.187	.225	.265	.308	.350	.397	.442
19	----	.106	.148	.186	.224	.264	.307	.349	.396	.440
20	----	.106	.147	.185	.223	.263	.306	.348	.394	.439
21	----	.105	.146	.184	.222	.262	.305	.347	.393	.438
22	----	.105	.146	.184	.221	.261	.304	.346	.392	.437
23	----	.104	.145	.183	.220	.260	.303	.345	.391	.436
24	----	.104	.145	.182	.220	.260	.303	.344	.390	.435
25	----	.103	.144	.182	.219	.259	.302	.344	.389	.434
26	----	.103	.144	.181	.219	.259	.302	.343	.388	.433
27	----	.103	.143	.180	.218	.258	.301	.343	.388	.432
28	----	.102	.143	.180	.218	.258	.301	.342	.387	.432
29	----	.102	.142	.180	.217	.258	.300	.342	.386	.431
30	----	.102	.142	.179	.217	.257	.300	.341	.386	.431

Table D-3.

Composite table: gross volume in rough cords from a 6 inch stump to a 3 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.007	.013	.019	.025	.031	----	----	----	----	----
5	.011	.019	.026	.034	.042	.050	.058	.067	.075	.084
6	.014	.026	.036	.045	.055	.065	.077	.087	.098	.109
7	.019	.034	.047	.059	.071	.083	.097	.112	.125	.139
8	.024	.043	.059	.074	.089	.105	.121	.140	.157	.173
9	.029	.053	.073	.092	.109	.129	.149	.171	.192	.213
10	.035	.064	.089	.111	.133	.156	.180	.206	.233	.257
11	.042	.076	.106	.132	.158	.186	.214	.245	.277	.306
12	.049	.089	.124	.155	.186	.218	.252	.287	.326	.360
13	.057	.103	.144	.180	.216	.253	.293	.333	.379	.419
14	----	.118	.165	.207	.248	.291	.337	.383	.435	.482
15	----	.134	.187	.235	.282	.331	.384	.436	.496	.550
16	----	.152	.211	.265	.319	.374	.434	.493	.560	.622
17	----	.170	.237	.297	.357	.420	.488	.554	.629	.699
18	----	.189	.263	.331	.398	.469	.544	.619	.702	.781
19	----	.209	.292	.367	.441	.520	.604	.687	.779	.867
20	----	.230	.321	.404	.486	.573	.667	.758	.860	.957
21	----	.253	.352	.443	.534	.630	.732	.834	.945	1.053
22	----	.276	.385	.485	.584	.689	.802	.913	1.035	1.153
23	----	.300	.419	.527	.636	.751	.875	.995	1.128	1.257
24	----	.326	.454	.572	.690	.816	.951	1.082	1.225	1.366
25	----	.352	.491	.619	.746	.884	1.030	1.171	1.327	1.479
26	----	.380	.529	.667	.806	.954	1.112	1.265	1.432	1.597
27	----	.408	.569	.718	.867	1.028	1.197	1.362	1.541	1.720
28	----	.438	.610	.770	.931	1.104	1.286	1.463	1.655	1.846
29	----	.468	.653	.824	.997	1.182	1.377	1.567	1.772	1.978
30	----	.500	.697	.879	1.066	1.263	1.472	1.675	1.894	2.114

Table D-4.

Composite table: gross volume in cubic feet from a 6 inch stump to a 4 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
6	1.3	2.2	3.1	4.1	5.1	6.1	7.1	8.2	---	---
7	1.6	2.9	4.0	5.1	6.3	7.6	8.8	10.0	11.3	12.6
8	2.0	3.7	5.0	6.3	7.7	9.2	10.8	12.3	13.8	15.3
9	2.5	4.5	6.2	7.7	9.3	11.0	12.9	14.8	16.5	18.4
10	3.0	5.4	7.4	9.3	11.1	13.2	15.3	17.6	19.7	21.8
11	3.5	6.4	8.8	11.0	13.2	15.5	17.9	20.7	23.2	25.6
12	4.1	7.5	10.3	12.9	15.4	18.1	20.9	24.0	27.0	29.9
13	4.8	8.6	11.9	14.9	17.8	20.9	24.2	27.7	31.2	34.5
14	5.4	9.9	13.6	17.1	20.4	23.9	27.7	31.6	35.7	39.5
15	6.2	11.2	15.5	19.4	23.2	27.2	31.4	35.8	40.6	44.9
16	6.9	12.5	17.4	21.8	26.1	30.6	35.4	40.3	45.8	50.6
17	7.7	14.0	19.5	24.4	29.2	34.3	39.7	45.1	51.3	56.7
18	---	15.5	21.6	27.1	32.5	38.2	44.2	50.2	57.1	63.2
19	---	17.2	23.9	30.0	36.0	42.3	48.9	55.6	63.2	70.0
20	---	18.9	26.3	33.0	39.6	46.5	53.9	61.2	69.6	77.2
21	---	20.7	28.8	36.2	43.4	51.0	59.2	67.2	76.4	84.8
22	---	22.6	31.4	39.5	47.4	55.8	64.7	73.5	83.5	92.7
23	---	24.5	34.1	42.9	51.6	60.7	70.4	80.0	90.9	101.0
24	---	26.5	37.0	46.5	55.9	65.8	76.4	86.9	98.6	109.6
25	---	28.7	39.9	50.2	60.4	71.2	82.7	94.0	106.7	118.6
26	---	30.9	43.0	54.1	65.1	76.7	89.1	101.4	115.0	128.0
27	---	33.1	46.2	58.1	70.0	82.5	95.9	109.1	123.8	137.8
28	---	35.5	49.5	62.3	75.0	88.5	102.9	117.1	132.8	147.9
29	---	37.9	52.9	66.6	80.2	94.6	110.1	125.3	142.1	158.3
30	---	40.5	56.4	71.0	85.6	101.1	117.7	133.9	151.8	169.1

Table D-5.

Composite table: gross volume in rough cords per square foot of basal area from a 6 inch stump to a 4 inch top diameter inside bark by number of bolts.

DBH	VOLUME BASAL AREA RATIO WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
6	.081	.144	.202	.265	.331	.393	.460	.526	----	----
7	.077	.138	.188	.241	.297	.360	.417	.476	.536	.596
8	.074	.133	.181	.228	.279	.332	.391	.444	.499	.555
9	.071	.129	.176	.221	.267	.316	.371	.424	.473	.526
10	.069	.126	.172	.216	.259	.305	.355	.409	.457	.506
11	.068	.123	.169	.211	.252	.298	.344	.397	.445	.491
12	.066	.121	.166	.208	.248	.292	.337	.387	.436	.481
13	.065	.118	.164	.205	.244	.287	.332	.380	.429	.474
14	.064	.117	.161	.202	.241	.284	.327	.374	.423	.468
15	.063	.115	.159	.200	.239	.280	.324	.369	.419	.463
16	.063	.114	.158	.198	.237	.278	.321	.366	.415	.459
17	.062	.112	.156	.196	.235	.275	.318	.362	.412	.455
18	----	.111	.155	.194	.233	.273	.316	.360	.409	.453
19	----	.110	.154	.193	.231	.272	.314	.357	.406	.450
20	----	.110	.153	.192	.230	.270	.313	.355	.404	.448
21	----	.109	.152	.190	.229	.269	.311	.354	.402	.446
22	----	.108	.151	.189	.227	.267	.310	.352	.400	.444
23	----	.108	.150	.188	.226	.266	.309	.351	.399	.443
24	----	.107	.149	.187	.225	.265	.308	.350	.397	.442
25	----	.106	.148	.187	.224	.264	.307	.349	.396	.441
26	----	.106	.148	.186	.224	.263	.306	.348	.395	.440
27	----	.105	.147	.185	.223	.263	.305	.347	.394	.439
28	----	.105	.146	.184	.222	.262	.305	.347	.393	.438
29	----	.105	.146	.184	.221	.261	.304	.346	.392	.437
30	----	.104	.145	.183	.221	.261	.303	.345	.391	.436

Table D-6.

Composite table: gross volume in rough cords from a 6 inch stump to a 4 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
6	.016	.028	.040	.052	.065	.077	.090	.103	----	----
7	.020	.037	.050	.064	.079	.096	.111	.127	.143	.159
8	.026	.046	.063	.079	.097	.116	.137	.155	.174	.194
9	.032	.057	.078	.098	.118	.140	.164	.187	.209	.232
10	.038	.069	.094	.118	.141	.167	.194	.223	.249	.276
11	.045	.081	.112	.139	.167	.196	.227	.262	.294	.324
12	.052	.095	.130	.163	.195	.229	.265	.304	.342	.378
13	.060	.109	.151	.189	.225	.265	.306	.350	.395	.437
14	.069	.125	.173	.216	.258	.303	.350	.400	.452	.500
15	.078	.141	.196	.245	.293	.344	.397	.453	.514	.568
16	.088	.159	.220	.276	.330	.388	.448	.510	.579	.640
17	.098	.177	.246	.309	.370	.434	.502	.571	.649	.718
18	----	.197	.274	.344	.412	.483	.559	.635	.723	.800
19	----	.217	.303	.380	.455	.535	.619	.703	.800	.886
20	----	.239	.333	.418	.502	.589	.682	.775	.881	.977
21	----	.262	.365	.458	.550	.646	.749	.851	.967	1.073
22	----	.285	.398	.500	.600	.706	.819	.930	1.057	1.173
23	----	.310	.432	.543	.653	.769	.891	1.013	1.150	1.278
24	----	.336	.468	.589	.708	.833	.967	1.100	1.248	1.388
25	----	.363	.506	.636	.765	.901	1.046	1.190	1.350	1.502
26	----	.391	.544	.685	.824	.971	1.128	1.284	1.456	1.620
27	----	.419	.585	.736	.886	1.044	1.214	1.381	1.566	1.744
28	----	.449	.626	.788	.949	1.120	1.302	1.482	1.681	1.872
29	----	.480	.669	.843	1.015	1.198	1.394	1.587	1.799	2.004
30	----	.512	.714	.899	1.083	1.279	1.490	1.695	1.921	2.141

Table D-7.

Composite table: gross volume in cubic feet from a 6 inch stump to a 6 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	2.3	4.2	6.1	7.9	9.9	----	----	----	----	----
9	2.8	5.0	7.0	9.3	11.5	13.7	16.0	18.3	----	----
10	3.4	6.0	8.3	10.7	13.3	15.9	18.5	21.1	23.8	26.4
11	3.9	7.1	9.7	12.3	15.1	18.3	21.2	24.2	27.2	30.3
12	4.6	8.2	11.2	14.1	17.3	20.6	24.3	27.6	30.9	34.4
13	5.2	9.5	13.0	16.2	19.7	23.3	27.5	31.3	35.0	38.9
14	6.0	10.8	14.8	18.5	22.3	26.4	30.8	35.3	39.5	43.8
15	6.7	12.2	16.7	20.9	25.1	29.6	34.4	39.6	44.3	49.0
16	7.5	13.7	18.8	23.4	28.0	33.1	38.3	44.2	49.5	54.6
17	8.4	15.2	20.9	26.1	31.2	36.8	42.5	49.0	55.0	60.7
18	9.3	16.8	23.2	29.0	34.6	40.7	47.1	54.1	60.8	67.2
19	10.2	18.5	25.6	32.0	38.2	44.9	51.9	59.5	67.0	74.0
20	11.2	20.3	28.1	35.1	41.9	49.3	56.9	65.1	73.5	81.3
21	12.2	22.2	30.7	38.4	45.9	53.9	62.2	71.1	80.4	89.8
22	13.3	24.1	33.4	41.8	50.0	58.7	67.8	77.4	87.6	96.8
23	14.4	26.1	36.2	45.4	54.3	63.7	73.6	83.9	95.1	105.1
24	15.6	28.2	39.1	49.1	58.7	68.9	79.7	90.7	102.9	113.8
25	16.8	30.4	42.2	52.9	63.4	74.4	86.0	97.9	111.1	122.9
26	18.0	32.6	45.4	56.9	68.2	80.0	92.5	105.3	119.6	132.3
27	----	35.0	48.7	61.1	73.2	85.9	99.3	113.0	128.4	142.1
28	----	37.4	52.0	65.3	78.3	92.0	106.4	120.9	137.5	152.3
29	----	39.9	55.6	69.8	83.6	98.2	113.7	129.2	146.9	162.8
30	----	42.5	59.2	74.3	89.1	104.7	121.3	137.8	156.7	173.7

Table D-8.

Composite table: gross volume in rough cords per square foot of basal area from a 6 inch stump to a 6 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME BASAL AREA RATIO WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	.084	.151	.221	.288	.360	----	----	----	----	----
9	.081	.144	.202	.265	.331	.393	.460	.526	----	----
10	.078	.140	.192	.248	.308	.370	.429	.490	.552	.614
11	.076	.136	.185	.235	.290	.351	.408	.464	.522	.580
12	.074	.133	.181	.228	.279	.332	.391	.444	.499	.555
13	.072	.130	.178	.223	.271	.321	.377	.430	.481	.534
14	.071	.128	.175	.219	.264	.312	.365	.418	.467	.518
15	.069	.126	.172	.216	.259	.305	.355	.409	.457	.506
16	.068	.124	.170	.213	.254	.300	.347	.401	.448	.495
17	.067	.122	.168	.210	.251	.295	.342	.394	.441	.488
18	.066	.121	.166	.208	.248	.292	.337	.387	.436	.481
19	.066	.119	.164	.205	.245	.289	.333	.382	.431	.476
20	.065	.118	.163	.204	.243	.286	.330	.378	.427	.471
21	.064	.117	.161	.202	.241	.284	.327	.374	.423	.468
22	.064	.116	.160	.200	.240	.281	.325	.371	.420	.464
23	.063	.115	.159	.199	.238	.280	.323	.368	.417	.461
24	.063	.114	.158	.198	.237	.278	.321	.366	.415	.459
25	.062	.113	.157	.197	.235	.276	.319	.363	.413	.456
26	.062	.112	.156	.195	.234	.275	.318	.361	.411	.454
27	----	.111	.155	.194	.233	.273	.316	.360	.409	.453
28	----	.111	.154	.193	.232	.272	.315	.358	.407	.451
29	----	.110	.153	.192	.231	.271	.314	.357	.405	.449
30	----	.110	.153	.192	.230	.270	.313	.355	.404	.448

Table D-9.

Composite table: gross volume in rough cords from a 6 inch stump to a 6 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	.029	.053	.077	.100	.126	----	----	----	----	----
9	.036	.064	.089	.117	.146	.174	.203	.232	----	----
10	.042	.076	.104	.135	.168	.202	.234	.267	.301	.335
11	.050	.090	.122	.155	.192	.231	.269	.306	.344	.383
12	.058	.104	.142	.179	.219	.261	.307	.349	.392	.436
13	.066	.120	.164	.205	.249	.296	.348	.396	.443	.493
14	.076	.137	.187	.234	.282	.334	.390	.447	.500	.554
15	.085	.154	.212	.264	.317	.375	.436	.502	.561	.620
16	.095	.173	.238	.297	.355	.419	.485	.560	.626	.691
17	.106	.192	.265	.331	.395	.466	.539	.620	.696	.769
18	.117	.213	.294	.367	.438	.516	.596	.685	.770	.850
19	.129	.235	.324	.405	.483	.569	.657	.753	.848	.937
20	.142	.257	.355	.444	.531	.624	.720	.824	.931	1.029
21	.155	.281	.388	.486	.581	.682	.788	.900	1.018	1.125
22	.168	.305	.423	.529	.633	.743	.858	.979	1.109	1.225
23	.182	.331	.458	.574	.687	.806	.931	1.062	1.204	1.331
24	.197	.357	.496	.621	.744	.873	1.008	1.149	1.303	1.441
25	.212	.385	.534	.670	.802	.941	1.088	1.239	1.407	1.556
26	.228	.413	.574	.721	.863	1.013	1.171	1.332	1.514	1.675
27	----	.443	.616	.773	.926	1.087	1.258	1.430	1.626	1.799
28	----	.473	.659	.827	.991	1.164	1.347	1.531	1.741	1.928
29	----	.505	.703	.883	1.059	1.243	1.440	1.635	1.860	2.061
30	----	.538	.749	.941	1.128	1.326	1.535	1.744	1.983	2.199

Table D-10.

Composite table: gross volume in board-feet (Scribner rule) from a 6 inch stump to a 6 inch top diameter inside bark by number of 8 foot logs.

DBH	SCRIBNER BOARD FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	6.	16.	25.	33.	42.	----	----	----	----	----
9	6.	19.	29.	40.	51.	62.	73.	85.	----	----
10	6.	23.	35.	47.	61.	76.	89.	103.	117.	131.
11	6.	28.	41.	56.	72.	90.	107.	123.	140.	157.
12	6.	32.	50.	66.	84.	105.	127.	146.	166.	186.
13	6.	38.	59.	79.	99.	122.	148.	171.	194.	217.
14	6.	43.	69.	92.	115.	141.	169.	198.	225.	252.
15	6.	49.	80.	106.	132.	161.	193.	228.	258.	289.
16	6.	55.	91.	120.	151.	183.	219.	259.	294.	329.
17	6.	62.	103.	136.	171.	207.	248.	293.	333.	372.
18	6.	69.	115.	153.	192.	233.	278.	328.	375.	419.
19	6.	76.	128.	171.	215.	261.	311.	365.	419.	469.
20	6.	84.	142.	189.	239.	290.	345.	405.	466.	521.
21	6.	91.	157.	209.	264.	321.	381.	447.	515.	577.
22	6.	100.	172.	230.	291.	353.	420.	492.	567.	635.
23	6.	108.	188.	252.	318.	387.	460.	538.	622.	697.
24	6.	117.	204.	275.	347.	422.	502.	587.	679.	761.
25	6.	126.	221.	298.	377.	459.	545.	638.	739.	828.
26	6.	136.	239.	323.	408.	497.	591.	691.	801.	899.
27	6.	146.	257.	348.	440.	537.	639.	747.	866.	972.
28	6.	157.	276.	375.	474.	578.	688.	804.	933.	1048.
29	6.	167.	295.	402.	509.	621.	739.	864.	1002.	1127.
30	6.	179.	315.	430.	545.	666.	793.	926.	1074.	1208.

Table D-11.

Composite table: gross volume in cubic feet from a 6 inch stump to an 8 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	3.7	----	----	----	----	----	----	----	----	----
11	4.3	7.7	11.2	14.7	18.3	22.0	----	----	----	----
12	5.0	8.9	12.5	16.5	20.5	24.4	28.5	32.6	----	----
13	5.7	10.2	14.1	18.3	22.9	27.3	31.7	36.3	40.8	----
14	6.5	11.6	15.9	20.4	25.1	30.4	35.2	40.2	45.3	50.3
15	7.3	13.1	17.8	22.6	27.9	33.5	39.1	44.4	50.0	55.6
16	8.1	14.7	20.0	25.1	30.8	36.7	43.2	49.0	55.0	61.2
17	9.0	16.3	22.3	27.9	33.9	40.2	47.5	53.9	60.4	67.1
18	10.0	18.0	24.6	30.8	37.3	44.1	51.7	59.1	66.1	73.4
19	10.9	19.8	27.1	33.9	40.8	48.3	56.3	64.6	72.3	80.1
20	12.0	21.7	29.7	37.1	44.6	52.6	61.2	70.4	78.8	87.1
21	13.0	23.6	32.4	40.5	48.5	57.2	66.3	76.5	85.6	94.5
22	14.1	25.6	35.3	44.0	52.6	62.0	71.8	82.8	92.8	102.4
23	15.3	27.7	38.2	47.7	56.9	67.1	77.6	89.3	100.3	110.8
24	16.5	29.9	41.2	51.5	61.5	72.4	83.7	96.2	108.1	119.4
25	17.7	32.2	44.4	55.5	66.3	78.0	90.0	103.3	116.3	128.5
26	19.0	34.5	47.7	59.6	71.2	83.7	96.6	110.7	124.8	137.9
27	20.4	36.9	51.0	63.8	76.3	89.6	103.5	118.4	133.7	147.8
28	21.7	39.4	54.5	68.2	81.6	95.8	110.6	126.4	142.9	157.9
29	23.2	42.0	58.1	72.8	87.0	102.2	118.0	134.7	152.4	168.5
30	24.6	44.6	61.8	77.4	92.7	108.8	125.6	143.3	162.3	179.4

Table D-12.

Composite table: gross volume in rough cords per square foot of basal area from a 6 inch stump to an 8 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME BASAL AREA RATIO WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	.086	----	----	----	----	----	----	----	----	----
11	.083	.148	.215	.283	.350	.421	----	----	----	----
12	.081	.144	.202	.265	.331	.393	.460	.526	----	----
13	.078	.141	.193	.251	.314	.375	.435	.498	.561	----
14	.077	.138	.188	.241	.297	.360	.417	.476	.536	.596
15	.075	.135	.184	.233	.287	.346	.403	.458	.516	.573
16	.074	.133	.181	.228	.279	.332	.391	.444	.499	.555
17	.072	.131	.179	.224	.272	.323	.381	.433	.485	.539
18	.071	.129	.176	.221	.267	.316	.371	.424	.473	.526
19	.070	.127	.174	.218	.263	.310	.362	.416	.465	.515
20	.069	.126	.172	.216	.259	.305	.355	.409	.457	.506
21	.069	.124	.171	.213	.255	.301	.349	.403	.450	.498
22	.068	.123	.169	.211	.252	.298	.344	.397	.445	.491
23	.067	.122	.168	.209	.250	.295	.340	.392	.440	.486
24	.066	.121	.166	.208	.248	.292	.337	.387	.436	.481
25	.066	.119	.165	.206	.246	.289	.334	.384	.432	.477
26	.065	.119	.164	.205	.244	.287	.332	.380	.429	.474
27	.065	.118	.162	.203	.243	.285	.329	.377	.426	.470
28	.064	.117	.161	.202	.241	.284	.327	.374	.423	.468
29	.064	.116	.160	.201	.240	.282	.326	.372	.421	.465
30	.063	.115	.159	.200	.239	.280	.324	.369	.419	.463

Table D-13.

Composite table: gross volume in rough cords from a 6 inch stump to an 8 inch top diameter inside bark by number of bolts.

DBH	CORD VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	.047	----	----	----	----	----	----	----	----	----
11	.055	.098	.142	.187	.231	.278	----	----	----	----
12	.063	.113	.159	.208	.260	.309	.361	.413	----	----
13	.072	.130	.178	.232	.289	.346	.401	.459	.517	----
14	.082	.147	.201	.258	.317	.385	.446	.509	.573	.637
15	.092	.166	.226	.286	.353	.424	.495	.562	.633	.704
16	.103	.186	.253	.318	.390	.464	.546	.620	.696	.775
17	.114	.206	.282	.353	.429	.509	.601	.683	.764	.850
18	.126	.228	.312	.390	.472	.559	.655	.748	.837	.929
19	.138	.251	.343	.429	.517	.611	.713	.818	.915	1.014
20	.151	.274	.376	.470	.564	.666	.774	.892	.997	1.103
21	.165	.299	.411	.513	.614	.724	.839	.969	1.083	1.197
22	.179	.325	.446	.557	.666	.785	.909	1.048	1.174	1.297
23	.194	.351	.483	.604	.721	.850	.982	1.131	1.269	1.402
24	.209	.379	.522	.652	.778	.917	1.059	1.217	1.369	1.512
25	.225	.407	.562	.702	.839	.987	1.140	1.307	1.472	1.627
26	.241	.437	.603	.754	.901	1.059	1.223	1.401	1.580	1.746
27	.258	.467	.646	.808	.966	1.135	1.310	1.499	1.692	1.870
28	.275	.499	.690	.863	1.033	1.213	1.400	1.600	1.809	1.999
29	.293	.532	.736	.921	1.102	1.293	1.493	1.705	1.930	2.133
30	.312	.565	.783	.980	1.173	1.377	1.590	1.814	2.054	2.271

Table D-14.

Composite table: gross volume in board-feet (Scribner rule) from a 6 inch stump to an 8 inch top diameter inside bark by number of 8 foot logs.

DBH	SCRIBNER BOARD FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	15.	----	----	----	----	----	----	----	----	----
11	15.	38.	59.	80.	100.	122.	----	----	----	----
12	15.	43.	65.	89.	114.	138.	163.	188.	----	----
13	15.	49.	73.	99.	129.	157.	185.	213.	242.	----
14	15.	55.	82.	111.	142.	177.	209.	241.	273.	306.
15	15.	61.	92.	124.	158.	197.	235.	270.	307.	344.
16	15.	68.	104.	139.	176.	217.	262.	302.	342.	384.
17	15.	75.	117.	155.	196.	240.	291.	336.	381.	427.
18	15.	82.	130.	173.	217.	266.	320.	373.	422.	473.
19	15.	90.	144.	191.	240.	293.	351.	411.	466.	521.
20	15.	98.	159.	211.	264.	321.	385.	452.	513.	573.
21	15.	107.	174.	231.	290.	351.	420.	496.	562.	627.
22	15.	115.	190.	252.	316.	384.	458.	540.	614.	686.
23	15.	125.	207.	275.	344.	418.	498.	587.	669.	747.
24	15.	134.	224.	298.	374.	454.	540.	635.	726.	811.
25	15.	144.	242.	322.	405.	491.	584.	687.	786.	879.
26	15.	154.	260.	347.	437.	530.	631.	740.	849.	949.
27	15.	165.	280.	373.	470.	571.	678.	795.	914.	1023.
28	15.	176.	299.	400.	505.	613.	728.	853.	982.	1099.
29	15.	187.	320.	428.	541.	657.	780.	913.	1052.	1178.
30	15.	198.	341.	458.	578.	702.	834.	976.	1125.	1260.

Table D-15.

Composite table: gross volume in cubic feet from a 1 foot stump to a 3 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.6	1.0	1.5	2.0	2.5	---	---	---	---	---
5	.8	1.5	2.0	2.6	3.3	3.9	4.6	5.2	---	---
6	1.1	2.0	2.8	3.5	4.3	5.1	6.0	6.8	7.7	8.5
7	1.4	2.6	3.6	4.5	5.5	6.5	7.6	8.7	9.8	10.9
8	1.8	3.3	4.6	5.8	6.9	8.2	9.5	11.0	12.3	13.5
9	2.2	4.1	5.7	7.1	8.5	10.0	11.6	13.4	15.1	16.7
10	2.7	4.9	6.9	8.6	10.3	12.1	14.1	16.1	18.2	20.1
11	3.2	5.9	8.2	10.2	12.3	14.5	16.7	19.1	21.7	24.0
12	3.7	6.8	9.6	12.0	14.4	17.0	19.7	22.5	25.5	28.2
13	4.3	7.9	11.1	13.9	16.7	19.7	22.8	26.0	29.6	32.8
14	4.9	9.1	12.7	16.0	19.2	22.7	26.3	29.9	34.1	37.7
15	5.6	10.3	14.4	18.2	21.9	25.8	29.9	34.1	38.8	43.0
16	6.3	11.6	16.3	20.5	24.7	29.1	33.8	38.5	43.9	48.7
17	7.0	12.9	18.2	23.0	27.7	32.7	38.0	43.2	49.2	54.7
18	7.8	14.4	20.3	25.6	30.9	36.5	42.4	48.3	54.9	61.1
19	---	15.9	22.5	28.4	34.2	40.4	47.0	53.6	61.0	67.8
20	---	17.6	24.7	31.2	37.7	44.6	51.9	59.2	67.3	74.9
21	---	19.2	27.1	34.3	41.4	49.0	57.1	65.1	73.9	82.4
22	---	21.0	29.6	37.5	45.3	53.6	62.5	71.2	80.9	90.2
23	---	22.9	32.2	40.8	49.3	58.4	68.2	77.7	88.2	98.3
24	---	24.8	35.0	44.2	53.5	63.5	74.1	84.4	95.8	106.8
25	---	26.8	37.8	47.8	57.9	68.8	80.2	91.4	103.8	115.7
26	---	28.9	40.7	51.6	62.5	74.3	86.6	98.7	112.0	124.9
27	---	31.0	43.8	55.4	67.3	80.0	93.3	106.3	120.6	134.5
28	---	33.3	47.0	59.5	72.2	85.9	100.2	114.1	129.4	144.4
29	---	35.6	50.2	63.6	77.4	92.0	107.3	122.3	138.6	154.7
30	---	38.0	53.6	68.0	82.7	98.3	114.7	130.7	148.1	165.3

Table D-16.

Composite table: gross volume in cubic feet from a 1 foot stump to a 4 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
5	.9	---	---	---	---	---	---	---	---	---
6	1.2	2.2	3.1	4.1	5.1	6.1	7.1	8.1	---	---
7	1.6	2.9	3.9	5.0	6.2	7.5	8.7	10.0	11.2	12.5
8	2.0	3.6	4.9	6.2	7.6	9.1	10.7	12.1	13.7	15.2
9	2.4	4.4	6.0	7.6	9.2	10.9	12.8	14.7	16.4	18.2
10	2.9	5.3	7.3	9.1	11.0	13.0	15.1	17.4	19.5	21.6
11	3.4	6.2	8.6	10.8	13.0	15.3	17.7	20.5	23.0	25.4
12	4.0	7.3	10.1	12.6	15.1	17.9	20.7	23.8	26.8	29.6
13	4.6	8.4	11.7	14.6	17.5	20.6	23.9	27.4	30.9	34.2
14	5.2	9.6	13.3	16.7	20.0	23.6	27.3	31.3	35.4	39.1
15	5.9	10.8	15.1	19.0	22.8	26.8	31.0	35.5	40.2	44.5
16	6.6	12.2	17.0	21.4	25.7	30.2	34.9	39.9	45.3	50.1
17	7.4	13.6	19.0	23.9	28.7	33.8	39.1	44.7	50.7	56.2
18	8.2	15.1	21.1	26.6	31.9	37.6	43.6	49.7	56.5	62.6
19	9.0	16.6	23.4	29.4	35.3	41.6	48.3	55.0	62.6	69.3
20	9.9	18.3	25.7	32.3	38.9	45.9	53.2	60.6	69.0	76.5
21	10.9	20.0	28.1	35.4	42.7	50.3	58.4	66.4	75.7	84.0
22	11.8	21.8	30.7	38.7	46.6	54.9	63.8	72.6	82.7	91.8
23	12.9	23.7	33.3	42.0	50.7	59.8	69.5	79.1	90.0	100.0
24	13.9	25.6	36.1	45.5	54.9	64.8	75.4	85.8	97.7	108.6
25	15.0	27.6	39.0	49.2	59.3	70.1	81.5	92.9	105.6	117.5
26	---	29.8	41.9	53.0	63.9	75.6	87.9	100.2	113.9	126.8
27	---	31.9	45.0	56.9	68.7	81.2	94.6	107.8	122.5	136.4
28	---	34.2	48.2	60.9	73.6	87.1	101.5	115.7	131.5	146.4
29	---	36.6	51.6	65.2	78.7	93.2	108.6	123.8	140.7	156.8
30	---	39.0	55.0	69.5	84.0	99.6	116.1	132.3	150.3	167.5

Table D-17.

Composite table: gross volume in cubic feet from a 1 foot stump to a 6 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	2.3	4.1	6.0	7.9	9.9	----	----	----	----	----
9	2.7	4.9	6.9	9.2	11.4	13.6	15.9	18.2	----	----
10	3.3	5.9	8.1	10.5	13.1	15.8	18.3	21.0	23.6	26.3
11	3.8	6.9	9.5	12.1	15.0	18.1	21.1	24.0	27.0	30.1
12	4.4	8.1	11.0	13.9	17.1	20.4	24.1	27.3	30.7	34.2
13	5.1	9.3	12.7	16.0	19.4	23.1	27.2	31.0	34.7	38.6
14	5.8	10.5	14.5	18.2	22.0	26.1	30.5	35.0	39.1	43.5
15	6.5	11.9	16.4	20.5	24.7	29.2	34.1	39.2	43.9	48.6
16	7.3	13.3	18.4	23.0	27.6	32.6	37.9	43.8	49.0	54.2
17	8.1	14.8	20.5	25.7	30.7	36.3	42.1	48.6	54.5	60.2
18	8.9	16.4	22.7	28.4	34.0	40.2	46.5	53.6	60.3	66.6
19	9.8	18.0	25.0	31.4	37.5	44.3	51.2	58.9	66.4	73.4
20	10.8	19.8	27.5	34.4	41.2	48.6	56.2	64.5	72.8	80.5
21	11.7	21.6	30.0	37.6	45.1	53.1	61.5	70.4	79.6	88.1
22	12.7	23.4	32.7	41.0	49.1	57.9	66.9	76.6	86.7	95.9
23	13.8	25.4	35.4	44.4	53.3	62.8	72.7	83.1	94.2	104.2
24	14.9	27.4	38.3	48.1	57.7	67.9	78.6	89.8	101.9	112.8
25	16.0	29.5	41.3	51.8	62.3	73.3	84.9	96.8	110.0	121.8
26	17.2	31.7	44.4	55.8	67.0	78.9	91.3	104.2	118.4	131.1
27	18.4	33.9	47.5	59.8	71.9	84.6	98.1	111.8	127.2	140.8
28	19.7	36.2	50.9	64.0	76.9	90.6	105.0	119.7	136.2	150.9
29	21.0	38.6	54.3	68.3	82.2	96.8	112.2	127.8	145.5	161.3
30	22.4	41.1	57.8	72.8	87.6	103.2	119.7	136.3	155.2	172.1

Table D-18.

Composite table: gross volume in cubic feet from a 1 foot stump to an 8 inch top diameter inside bark by number of bolts.

DBH	CUBIC FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	3.6	----	----	----	----	----	----	----	----	----
11	4.3	7.6	11.1	14.6	18.1	21.8	----	----	----	----
12	4.9	8.8	12.3	16.3	20.3	24.2	28.3	32.4	----	----
13	5.6	10.1	13.8	18.1	22.7	27.1	31.5	36.0	40.6	----
14	6.3	11.4	15.6	20.1	24.8	30.2	34.9	39.9	45.0	50.0
15	7.1	12.8	17.5	22.3	27.5	33.2	38.7	44.1	49.7	55.2
16	7.9	14.3	19.6	24.7	30.4	36.3	42.8	48.6	54.6	60.8
17	8.7	15.9	21.8	27.4	33.5	39.8	47.0	53.5	59.9	66.7
18	9.6	17.6	24.1	30.3	36.8	43.6	51.3	58.6	65.6	72.9
19	10.6	19.3	26.6	33.3	40.3	47.7	55.8	64.0	71.7	79.5
20	11.6	21.1	29.1	36.5	43.9	52.0	60.6	69.8	78.1	86.5
21	12.6	23.0	31.8	39.8	47.8	56.5	65.7	75.8	84.8	93.8
22	13.6	25.0	34.5	43.2	51.9	61.2	71.0	82.1	91.9	101.6
23	14.7	27.0	37.4	46.8	56.1	66.2	76.7	88.5	99.4	109.8
24	15.9	29.1	40.4	50.6	60.5	71.4	82.7	95.3	107.1	118.4
25	17.1	31.3	43.5	54.4	65.1	76.9	89.0	102.3	115.2	127.4
26	18.3	33.6	46.7	58.4	70.0	82.5	95.5	109.6	123.7	136.7
27	19.6	35.9	50.0	62.6	75.0	88.4	102.2	117.2	132.4	146.5
28	20.9	38.3	53.4	66.9	80.2	94.4	109.2	125.2	141.5	156.5
29	22.2	40.8	56.9	71.3	85.5	100.7	116.5	133.4	150.9	167.0
30	23.6	43.4	60.5	75.9	91.1	107.2	124.0	141.8	160.7	177.8

Table D-19.

Composite table: gross volume in board-feet (Scribner rule) from a 1 foot stump to a 6 inch top diameter inside bark by number of 8 foot logs.

DBH	SCRIBNER BOARD FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
8	6.	15.	24.	33.	42.	----	----	----	----	----
9	6.	19.	28.	40.	51.	62.	73.	84.	----	----
10	6.	23.	34.	46.	61.	75.	89.	103.	110.	117.
11	6.	27.	41.	55.	71.	90.	106.	123.	133.	142.
12	6.	31.	48.	65.	84.	104.	126.	145.	159.	170.
13	6.	36.	58.	77.	98.	120.	147.	170.	186.	201.
14	6.	42.	67.	90.	113.	139.	168.	197.	217.	234.
15	6.	47.	77.	104.	131.	159.	192.	226.	250.	270.
16	6.	53.	88.	118.	149.	181.	218.	257.	286.	309.
17	6.	60.	100.	134.	168.	205.	246.	291.	325.	351.
18	6.	66.	112.	150.	189.	231.	276.	326.	366.	397.
19	6.	73.	125.	167.	211.	258.	308.	363.	410.	445.
20	6.	80.	138.	186.	235.	287.	342.	402.	456.	496.
21	6.	88.	152.	205.	260.	317.	378.	444.	505.	550.
22	6.	96.	167.	225.	286.	349.	415.	488.	557.	607.
23	6.	104.	182.	246.	313.	382.	455.	534.	611.	666.
24	6.	112.	198.	268.	341.	417.	497.	583.	668.	729.
25	6.	121.	214.	291.	371.	453.	540.	633.	727.	794.
26	6.	130.	231.	315.	401.	491.	585.	686.	789.	862.
27	6.	140.	249.	340.	433.	530.	632.	741.	854.	933.
28	6.	149.	267.	366.	466.	571.	681.	798.	921.	1007.
29	6.	159.	286.	392.	500.	613.	732.	857.	990.	1084.
30	6.	169.	305.	420.	535.	657.	785.	919.	1061.	1164.

Table D-20.

Composite table: gross volume in board-feet (Scribner rule) from a 1 foot stump to an 8 inch top diameter inside bark by number of 8 foot logs.

DBH	SCRIBNER BOARD FOOT VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
10	15.	----	----	----	----	----	----	----	----	----
11	15.	37.	58.	79.	100.	122.	----	----	----	----
12	15.	42.	64.	89.	114.	138.	163.	188.	----	----
13	15.	48.	72.	98.	128.	156.	184.	213.	226.	----
14	15.	54.	81.	110.	141.	176.	207.	240.	257.	271.
15	15.	60.	90.	122.	157.	196.	233.	269.	290.	307.
16	15.	66.	102.	137.	174.	216.	260.	300.	326.	347.
17	15.	73.	114.	153.	194.	238.	289.	334.	363.	389.
18	15.	80.	127.	170.	215.	264.	318.	370.	404.	433.
19	15.	87.	140.	188.	237.	290.	349.	409.	448.	481.
20	15.	95.	155.	207.	261.	318.	382.	449.	494.	531.
21	15.	103.	170.	227.	286.	348.	417.	492.	543.	584.
22	15.	112.	185.	248.	312.	379.	454.	537.	595.	640.
23	15.	120.	201.	270.	339.	413.	494.	583.	649.	700.
24	15.	130.	218.	292.	368.	449.	536.	631.	706.	762.
25	15.	139.	235.	316.	399.	486.	579.	682.	765.	820.
26	15.	149.	253.	340.	430.	524.	625.	735.	827.	896.
27	15.	159.	272.	365.	463.	564.	672.	790.	892.	967.
28	15.	169.	291.	392.	497.	606.	722.	847.	960.	1041.
29	15.	180.	311.	419.	532.	649.	773.	907.	1030.	1118.
30	15.	191.	331.	447.	569.	693.	826.	969.	1102.	1198.

APPENDIX E

Comparison of Stone's equation and the
expanded tree taper table

Table E-1.

Composite table: gross volume in rough cords
to a 4.0 inch top diameter inside bark by number
of bolts.*

DBH	CORD VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.007	.013	----	----	----	----	----	----	----	----
5	.012	.019	.026	----	----	----	----	----	----	----
6	.015	.028	.039	.052	----	----	----	----	----	----
7	.020	.036	.049	.064	.078	----	----	----	----	----
8	.025	.045	.062	.078	.096	.115	----	----	----	----
9	.031	.056	.076	.096	.116	.138	.162	----	----	----
10	.037	.067	.092	.115	.139	.165	.192	----	----	----
11	.043	.079	.109	.137	.164	.194	.225	.260	.291	.321
12	.050	.092	.128	.160	.191	.226	.262	.301	.339	.375
13	.058	.106	.148	.185	.221	.261	.302	.347	.391	.433
14	.066	.121	.169	.212	.254	.299	.346	.396	.448	.495
15	.075	.137	.192	.240	.288	.339	.392	.449	.509	.563
16	.084	.154	.215	.270	.325	.382	.442	.505	.573	.635
17	.094	.172	.241	.303	.363	.428	.495	.565	.642	.711
18	.104	.191	.267	.336	.404	.476	.552	.629	.715	.792
19	.115	.210	.296	.372	.447	.527	.611	.696	.792	.878
20	.126	.231	.325	.409	.493	.581	.673	.767	.873	.968
21	.138	.253	.356	.448	.540	.637	.739	.841	.958	1.063
22	.150	.276	.388	.489	.590	.695	.808	.919	1.047	1.162
23	.163	.299	.422	.532	.641	.757	.879	1.001	1.139	1.266
24	.176	.324	.457	.576	.695	.821	.954	1.086	1.236	1.374
25	.190	.350	.493	.622	.751	.887	1.032	1.176	1.337	1.487
26	----	.377	.531	.670	.809	.957	1.113	1.268	1.442	1.605
27	----	.404	.570	.720	.870	1.028	1.197	1.364	1.551	1.727
28	----	.433	.611	.771	.932	1.103	1.284	1.464	1.664	1.853
29	----	.463	.653	.825	.997	1.180	1.375	1.567	1.781	1.984
30	----	.494	.696	.880	1.064	1.260	1.469	1.674	1.902	2.120

*The bold type values are from a 1 foot stump to a 3.0 inch top diameter inside bark. All other top diameters are 4.0 inches inside bark.

This table was constructed by interpolation of Table 8 of Bulletin 1104.

Table E-2.

Stone's equation volume: gross volume in rough cords from a 1 foot stump to a 4 inch top diameter inside bark by number of bolts.

DBH	STONE'S VOLUME WHEN NUMBER OF BOLTS IS--									
	1	2	3	4	5	6	7	8	9	10
4	.009	.016	----	----	----	----	----	----	----	----
5	.013	.022	.031	----	----	----	----	----	----	----
6	.019	.030	.041	.051	----	----	----	----	----	----
7	.024	.038	.052	.065	.077	----	----	----	----	----
8	.031	.048	.065	.081	.097	.112	----	----	----	----
9	.038	.059	.079	.099	.118	.138	.158	----	----	----
10	.045	.070	.094	.118	.142	.167	.192	----	----	----
11	.054	.083	.111	.140	.169	.198	.228	.260	.292	.327
12	.062	.096	.130	.163	.197	.232	.268	.306	.345	.387
13	.072	.111	.150	.189	.229	.269	.312	.356	.403	.452
14	.082	.126	.171	.216	.262	.309	.358	.410	.464	.522
15	.092	.143	.194	.245	.297	.352	.408	.468	.531	.597
16	.103	.161	.218	.276	.335	.397	.462	.529	.601	.678
17	.115	.179	.243	.309	.376	.445	.518	.595	.676	.763
18	.128	.199	.270	.343	.418	.496	.578	.664	.756	.853
19	.140	.219	.299	.380	.463	.550	.641	.737	.840	.949
20	.154	.241	.329	.418	.510	.607	.708	.814	.928	1.049
21	.168	.263	.360	.458	.560	.666	.777	.895	1.021	1.155
22	.183	.287	.392	.500	.612	.728	.850	.980	1.118	1.265
23	.198	.312	.427	.544	.666	.793	.927	1.068	1.219	1.381
24	.214	.337	.462	.590	.722	.861	1.006	1.161	1.325	1.502
25	.230	.364	.499	.638	.781	.931	1.089	1.257	1.436	1.627
26	.247	.391	.537	.687	.842	1.005	1.176	1.357	1.551	1.758
27	.265	.420	.577	.739	.906	1.081	1.265	1.461	1.670	1.894
28	.283	.449	.618	.792	.972	1.160	1.358	1.569	1.794	2.035
29	.302	.480	.661	.847	1.040	1.241	1.454	1.680	1.922	2.180
30	.321	.512	.705	.904	1.110	1.326	1.554	1.796	2.054	2.331

Table E-3.

Percent difference between Stone's cord volume to a 4 inch top diameter inside bark and the revised table 6 composite table cord volume to a 4 inch top diameter inside bark.

(Stone's volume - revised table 6 volume)

		revised table 6 volume									
		Number of 8 foot bolts									
DBH		1	2	3	4	5	6	7	8	9	10
5.	8.	16.	---	---	---	---	---	---	---	---	---
6.	27.	7.	5.	-2.	---	---	---	---	---	---	---
7.	20.	6.	6.	2.	-1.	---	---	---	---	---	---
8.	24.	7.	5.	4.	1.	-3.	---	---	---	---	---
9.	23.	5.	4.	3.	2.	0.	-2.	---	---	---	---
10.	22.	4.	2.	3.	2.	1.	0.	---	---	---	---
11.	26.	5.	2.	2.	3.	2.	1.	0.	0.	2.	
12.	24.	4.	2.	2.	3.	3.	2.	2.	2.	3.	
13.	24.	5.	1.	2.	4.	3.	3.	3.	3.	4.	
14.	24.	4.	1.	2.	3.	3.	3.	4.	4.	5.	
15.	23.	4.	1.	2.	3.	4.	4.	4.	4.	6.	
16.	23.	5.	1.	2.	3.	4.	5.	5.	5.	7.	
17.	22.	4.	1.	2.	4.	4.	5.	5.	5.	7.	
18.	23.	4.	1.	2.	3.	4.	5.	6.	6.	8.	
19.	22.	4.	1.	2.	4.	4.	5.	6.	6.	8.	
20.	22.	4.	1.	2.	3.	4.	5.	6.	6.	8.	
21.	22.	4.	1.	2.	4.	5.	5.	6.	7.	9.	
22.	22.	4.	1.	2.	4.	5.	5.	7.	7.	9.	
23.	21.	4.	1.	2.	4.	5.	5.	7.	7.	9.	
24.	22.	4.	1.	2.	4.	5.	5.	7.	7.	9.	
25.	21.	4.	1.	3.	4.	5.	6.	7.	7.	9.	
26.	---	4.	1.	3.	4.	5.	6.	7.	8.	10.	
27.	---	4.	1.	3.	4.	5.	6.	7.	8.	10.	
28.	---	4.	1.	3.	4.	5.	6.	7.	8.	10.	
29.	---	4.	1.	3.	4.	5.	6.	7.	8.	10.	
30.	---	4.	1.	3.	4.	5.	6.	7.	8.	10.	