**Volume Estimator Library**

**Equations**

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# Volume Equation Numbers

What are Volume Equation Numbers and how are they used? A volume equation number is a 10 digit code which identifies a specific mathematical model developed to produce the volume for a specific species in a specific area. These models can be direct volume estimators or profile models**.**

A direct volume estimator is a regression equation developed to predict a specific volume for a tree, whether it be a total cubic volume or a board foot volume for the merchantable portion of the tree. A profile model is developed to predict the diameter at any height up the bole of a tree. With this capability, a set of rules can be applied to a profile model to calculate a specific volume, whether it be a total cubic volume or a board foot volume for the merchantable portion of the tree.

The 10 digit volume equation number is made up of several different parts to help identify the volume equation or model. The first character is a geographic code to reference where the model was developed. The current geographic codes are as follows:

1 = Region 1 9 = Region 9

2 = Region 2 A = Region 10 (Alaska)

3 = Region 3 H = Hawaii

4 = Region 4 B = BLM Washington Oregon

5 = Region 5 I = INGY model

6 = Region 6 F = Flewelling Westside models

8 = Region 8 N= National-scale

The second and third character is a Subregional Code based on a Forest number, a log length, or some other numerical code.

**Examples of Subregional Codes**

00 = No Subregional Code - Region Wide Application

VB = Equation for both volume and biomass

INGY Subregional Codes (Both Taper and Bark Models)

11 = East Cascade

12 = Okanogan

13 = Blue Mountains

14 = Kootenai

15 = Central Idaho

21,22,23 = Canada Model

Region 1 Subregional Code is used to identify model types

01 = FVS Behre’s Hyperbola

02 = Kemp Direct Volume Estimators Table 1

03 = Kemp Direct Volume Estimators Table 2

04 = Kemp Direct Volume Estimators Table 3

05 = Kemp Direct Volume Estimators Table 5

Region 2 Subregional Codes are based on Forest Number or Estimator Type

03 = Black Hills

13 = San Juan (Flewelling model)

Region 3 Subregional Codes are group of forests

01 = Lincoln, Coconino, Tonto, Apache - Sitgreaves, Coronado, Gila, Prescott

02 = Carson, Santa Fe, Cibola, Kaibab

Region 4 Subregional Codes are based on Forest Number when applicable or some numerical code when more than one forest is involved.

01 = Forest subset

05 = Caribou Forest only

07 = Dixie Forest only

Region 6 and Region 10 Subregional Codes based on Log Length

16 = Sixteen foot log length

32 = Thirty two foot log length

28 = Sixteen foot log length for cubic, thirty two foot log length for board foot

Flewelling equation subregion code:

I##FW2W\*\*\* and I##FW3W\*\*\* subregion as

00 – INGY regional wide

11 - East Cascade

12 – Okanogan

13 - Blue Mountains

F##FW2W\*\*\* and F##FW3W\*\*\* subregion as

00 – west coast regional wide

01 – CO OR 02 – EV OR 03 – NO WA

04 – RS WA 05 – So WA 06 – WE WA

07 – WV OR 08 – WC WA

Region 7 (BLM of Washington and Oregon) Subregional Codes

01 = Coastal

02 = eastern

Region 8 Subregional codes for profile models are based on R8 Definitions. The first number is a geographic code and the second is a reference height.

First Number (Geo. Code) Second Number (Ref. Ht)

1\_ = Coastal Plain \_0 = Height to tip

2\_ = Piedmont \_4 = Height to a 4 inch dob

3\_ = Appalachian Mtns \_7 = Height to a 7 inch dob

4\_ = Upper Coastal Plain \_9 = Height to a 9 inch dob

5\_ = Deep South

6\_ = Arkansas

7\_ = Delta / St. Francis

9\_ = Southwide

Region 9 Subregional Codes are Gevorkiantz Board Foot Equation (DVE) Table number.

01 = Gevorkiantz Board Foot Equation – Table A

02 = Gevorkiantz Board Foot Equation – Table B

03 = Gevorkiantz Board Foot Equation – Table C

04 = Gevorkiantz Board Foot Equation – Table D

05 = Gevorkiantz Board Foot Equation – Table E

06 = Gevorkiantz Board Foot Equation – Table F

11 = Gevorkiantz Cubic Pulpwood Equation

12 = Gevorkiantz Merchantable Cubic Equation

21 = Gevorkiantz Cordwood Equation

Region 10 Subregional Codes are

Direct Volume Equation( DVE):

01 = Interior Alaska

00 = Region wide

Fleweling Equation:

F3 = 32 foot log length

FW = 16 foot log length

Demars Equation:

01 = 16 foot log length

02 = 16 foot for cubic and 32 foot for board foot

16 = 16 foot log length

32 = 32 foot log length

The fourth, fifth, and sixth characters define the model as follows:

DVE = Direct Volume Estimators (regression models usually)

BEH = Behre's Hyperbola

(Bell & Dilworth, 1988).

CLK = Alexander Clark et.al. profile model

(Clark et al. 1991. Southeastern For Exper Station. Research Paper SE-282).

CZ2 = Czaplewski's 2 point profile model

Czaplewski et al 1989. Research Paper RM-284)

CZ3 = Czaplewski's 3 point profile model

(Unpublished. Based on work presented in Czaplewski & McClure. 1988. Forest Science, Vol. 34, pp. 512 – 522)

DEM = DeMars and Bruce profile models

(Donald Demars. 1996. Pacific Northwest Res. Station Research Note. PNW-RN-517) &

(Bruce, D., 1984. Volume estimators for Sitka spruce and western hemlock in coastal Alaska. In Inventorying forest and other vegetation of the high latitude and high altitude regions. SAF pub 84-11. Bethesada, MD. pp. 96-102).

FW2 = Flewelling's 2 point profile model

(Unpublished. Based on work presented by Flewelling and Raynes. 1993 Canadian Journal of Forest Research Vol 23. Part I and Part II).

FW3 = Flewelling's 3 point profile model

(Unpublished. Based on work presented by Flewelling and Raynes. 1993 Canadian Journal of Forest Research Vol 23. Part I and Part II).

MAT = Mathis (Rastagi and Loveless profile model)

(Rustagi, K.R. and Loveless, R.S.,Jr., 1991. Compatible variable-form volume and stem-profile equations for Douglas-fir. Can. J. For. Res. 21:143-151).

SN2 = Sharpnack's 2 point profile model

(Sharpnack, David A. 1966. Predicting Volumes in Four Hawaii Hardwoods. Southwest Forest and Range Research Station Research Note SW-121)

WO2 = Wensel and Olsen 2 point profile model

(Wensel, L. C. and C. M. Olson. 1993. Tree Taper Models for Major Commercial California Conifers. Research Note No. 33. Northern Calif. Forest Yield Cooperative. Dept. of Forestry and Mgmt., Univ. of Calif., Berkeley. 28 pp.)

The seventh character defines Western or Eastern U.S

W = Regions 1,2,3,4,5,6

E = Region 8,9

The eighth, ninth, and tenth character defines species (Forest Survey Handbook)

Examples of species codes:

017 = Grand Fir

122 = Ponderosa Pine

242 = Western Red Cedar

1. = White oak

The National-scale Volume and Biomass (NSVB) equations (Westfall etal 2023) were also added to the NVEL. The NSVB equation number is different from the regular NVEL equation number. The NSVB equation starts with NVB and then followed by EcoRegion Division code, such as M210 or 0210 etc. The last three characters are FIA species code. So the equation looks like:

**NVBM210202 or NVB0210202**

The list of NSVB equations is shown in Appendixes 9.5.

# National Volume Estimator Library Call List

|  |  |  |  |
| --- | --- | --- | --- |
| **Type** | **Variable Name** | **Variable Type** | **Variable Description** |
| Tree | REGN | INTEGER | Region number used to set Regional Merchandizing Rules |
| Tree | FORST | CHARACTER\*2 | Two digit forest number |
| Tree | PROD | CHARACTER\*2 | Product code:  01 = Sawtimber tree  02 = Pulpwood tree  06 = Roundwood tree. |
| Tree | VOLEQ | CHARACTER\*10 | The 10 character volume equation number for this tree |
| Tree | DBHOB | REAL | Diameter Breast Height outside bark |
| Tree | DRCOB | REAL | Diameter Root Collar outside bark (ground level diameter) |
| Tree | HTTOT[[1]](#footnote-1) | REAL | Total tree height measured from ground to tip |
| Tree | HT1PRD1 | REAL | Height to the minimum top diameter inside bark for primary product. Can be in feet or number of logs.  If in logs: R6 & BLM use number of logs times 10.  All other regions use number of logs.  If in logs, HTTYPE variable MUST be set to L. |
| Tree | HT2PRD | REAL | Height to the minimum top diameter inside bark for secondary product. Can be in feet or number of logs. If in logs, HTTYPE variable MUST be set to L and HT1PRD variable MUST also have height in logs. |
| Tree | HTTYPE | CHARACTER\*1 | Height type for HT1PRD and HT2PRD variables:  F = Height in feet (default value)  L = Height in number of logs |
| Tree | HTLOG | INTEGER | If HTTYPE is set to L, this is the length of the logs recorded in the HT1PRD field (8,16, or 32). 16 is the default value. |
| Tree | UPSHT1[[2]](#footnote-2) | REAL | Upper stem height in feet where upper stem diameter was measured or where AVG1 is to be applied.  OR  For Region 8 the upper stem reference height defined by their profile model (ht0, ht4, ht7, ht9).  OR  For region 9 the UPSHT1 is the height to 7.6/9.6 top diameter when HT1PRD is not the height to 7.6/9.6 top diameter. |
| Tree | UPSHT2 | REAL | Second upper stem height in feet where a second upper stem diameter was measured. |
| Tree | UPSD1 | REAL | Upper stem diameter measured at UPSHT1 |
| Tree | UPSD2 | REAL | Second upper stem diameter measured at UPSHT2 |
| Tree | HTREF2 | INTEGER | Reference height. Percent of total height where UPSD1 was measured or where AVGZ1 is to be applied. |
| Tree | AVGZ1 | REAL | Flewelling’s Average Z-Score value to be applied at either UPSHT1 or HTREF. |
| Tree | AVGZ2 | REAL | Second average Z-Score value to be applied at UPSHT2. |
| Tree | FCLASS | INTEGER | Girard’s form class. Diameter at the top of the first log given as a percent of DBH. |
| Tree | DBTBH | REAL | Double bark thickness at breast height in inches |
| Tree | BTR | REAL | Bark thickness ratio given as the percent of diameter inside bark to diameter outside bark. (dib/dob \*100). |
| Tree | CONSPEC | CHARACTER\*4 | Contract species. (used by BLM profile models. Currently is not in use) |
| Tree | HTTFLL | INTEGER | Height to first live limb in feet (used by Region 3 volume equation for ponderosa pine). |
| Tree | BRKHT | REAL | Height to broken top or missing top |
| Tree | BRKHTD | REAL | Broken top diameter |
| Tree | CR | REAL | The percent of the tree bole supporting live, healthy foliage |
| Tree | CULL | REAL | The percent of the cubic-foot volume in a live or dead tally tree that is rotten or missing. |
| Tree | DECAYCD | INTEGER | A code indicating the stage of decay in a standing dead tree:   1. All limbs and branches are present; the top of the crown is still present; all bark remains; sapwood is intact, with minimal decay; heartwood is sound and hard. 2. There are few limbs and no fine branches; the top may be broken; a variable amount of bark remains; sapwood is sloughing with advanced decay; heartwood is sound at base but beginning to decay in the outer part of the upper bole. 3. Only limb stubs exist; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay in upper bole and is beginning at the base. 4. Few or no limb stubs remain; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay at the base and is sloughing in the upper bole. 5. No evidence of branches remains; the top is broken; |
| Merch | MTOPP | REAL | Minimum top diameter inside bark for primary product |
| Merch | MTOPS | REAL | Minimum top diameter inside bark for secondary product |
| Merch | STUMP | REAL | Stump height in feet |
| Merch | CUTFLG | INTEGER | Total cubic volume flag:   1. If set to 0, will not calculate the total cubic foot volume. 2. If set to 1, will calculate the total cubic foot volume. |
| Merch | BFPFLG | INTEGER | Board foot volume flag:   1. If set to 0, will not calculate the board foot volume for primary product. 2. If set to 1, will calculate the Scribner and International ¼ board foot volumes for primary product. |
| Merch | CUPFLG | INTEGER | Cubic foot volume flag:   1. If set to 0, will not calculate the merchantable cubic foot volume for primary product. 2. If set to 1, will calculate the merchantable cubic foot volume for primary product. |
| Merch | CDPFLG | INTEGER | Cordwood volume flag:   1. If set to 0, will not calculate the merchantable cordwood volume for primary product. 2. If set to 1, will calculate the cordwood volume for primary product. |
| Merch | CUSFLG | INTEGER | Cubic foot volume flag for secondary product:   1. If set to 0, will not calculate the cubic foot volume for secondary product. 2. If set to 1, will calculate the cubic foot volume for secondary product.. |
| Merch | CDSFLG | INTEGER | Cordwood volume flag for secondary product:   1. If set to 0, will not calculate the cordwood volume for secondary product. 2. If set to 1, will calculate the cordwood volume for secondary product. |
| Merch | SPFLG | INTEGER | Volume flag for secondary product:   1. If set to 0, will not calculate volume for secondary product. 2. If set to 1, will calculate the volume for secondary product in same units as primary product flags. 3. This variable replaces CDSFLG and CUSFLG. |
| Output | VOL (15) | REAL | Array of 15 tree volumes   1. Total Cubic Volume from ground to tip 2. Gross Scribner board foot volume.   **Note: The VOL(2) is International ¼ board foot volume for Region 8 Forest 8, 9, 10, and 12 (except Andrew Pickens district); and Region 9 Forest 4,5,8,11,12,14,19,20,21,22,24, and 30 when using Clark profile equation.**   1. Net Scribner board foot volume. 2. Gross merchantable cubic foot volume 3. Net merchantable cubic foot volume 4. Merchantable cordwood volume 5. Gross secondary product volume in cubic feet 6. Net secondary product volume in cubic feet 7. Secondary product in cordwood 8. Gross International ¼ board foot volume 9. Net International ¼ board foot volume 10. Gross secondary product in Scribner board feet 11. Net secondary product in Scribner board feet 12. Stump volume 13. Tip volume |
| Output | LOGVOL (7.20) | REAL | The volume of up to 20 logs in a tree.   1. Gross Scribner board foot log volume (20 logs) 2. Gross removed Scribner board foot log volume (20 logs) 3. Net Scribner board foot log volume (20 logs) 4. Gross cubic foot log volume (20 logs) 5. Gross removed cubic foot log volume (20 logs) 6. Net cubic foot log volume (20 logs) 7. Gross International ¼ board foot log volume (20 logs) |
| Output | LOGDIA (21,3) | REAL | Log end diameters for up to 20 logs.   1. Scaling diameter inside bark (rounded or truncated value). 2. Actual predicted diameter inside bark. 3. Actual predicted diameter outside bark.   First number is large end diameter butt log, second number is small end diameter of butt log and also large end diameter of second log and so on. | |
| Output | LOGLEN (20) | REAL | Log lengths in feet for up to 20 logs. | |
| Output | BOLHT(21) | REAL | The actual heights up the tree where the corresponding LOGDIA values were predicted. | |
| Output | TLOGS | INTEGER | Total number of logs in a tree. | |
| Output | LOGST | INTEGER | Total number of logs in a tree. | |
| Output | NOLOGP | REAL | Number of 16 foot logs in the merchantable part of a tree, from stump to minimum top diameter for primary product. | |
| Output | NOLOGS | REAL | Number of 16 foot logs in the topwood part or the tree, from the minimum top diameter for the primary product to the minimum top diameter for the secondary product. | |
| Output | ERRFLAG | INTEGER | Returned Error Code:   1. No volume equation match 2. No form class 3. DBH less than one 4. Tree height less than 4.5 5. D2H is out of bounds 6. No species match 7. Illegal primary product log height (Ht1prd) 8. Illegal secondary product log height (Ht2prd) 9. Upper stem measurements required 10. Illegal upper stem height (UPSHT1) 11. Unable to fit profile given dbh, merch ht and top dia 12. Tree has more than 20 logs 13. Top diameter greater than DBH inside bark 14. The bark equation for the VOLEQ does not exist or yields a negative DBHIB. 15. Invalid BIOEQ 16. Primary prod height(HT1PRD) required for biomass calculation 17. Secondary prod height(HT2PRD) required for biomass calculation 18. Stem cubic volume required for the select BIOEQ | |
| Output | DRYBIO(15) | REAL | Dry biomass, array of 15 biomass elements:  1) above ground biomass (no foliage)  2) total stem wood  3) total stem bark  4) stump wood  5) stump bark  6) sawtimber wood (primary)  7) sawtimber bark  8) topwood wood (secondary)  9) topwood bark  10) tip wood  11) tip bark  12) branches  13) foliage  14) top and limb  15) carbon content | |
| Output | GRNBIO(15) | REAL | Green biomass (elements same as DRYBIO) | |
| Input | BA | INTEGER | Basal Area of the stand. Optional variable used when calculating the merchantable heights required with the current Region 8 and Region 9 volume models. | |
| Input | SI | INTEGER | Site Index of the stand. Optional variable used when calculating the merchantable heights required with the current Region 8 and Region 9 volume models. | |
| Input | CTYPE | STRING | Cruise Type: Flag to set some special volume criteria.  ‘C’ or blank = Cruise volumes. Will return zero volumes if required fields are missing.  ‘F’ = FVS volumes. Missing merchantable heights and form class variables will be calculated if they are required.  ‘V’ = Variable log length cruise. Requires the TLOGS variable to contain the number of logs and the LOGLEN variable to contain the variable log lengths.  ‘I” = FIA. This flag to let NSVB equation to calculate merchantable volume as the total volume from stump to merchantable height without removing trims. The log volumes will ne be calculated | |

# Merchandizing Rules Applied to Profile Models by Region

When Profile models (or taper equations) are used to estimate the volume of a tree, the main stem of the tree needs to be segmented into logs. Several merchandizing rules, determined by each Region, are applied to determine these log lengths.

Region 1:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 8 feet (16 feet for Prod 08)

Minimum log length for topwood logs is 16 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.

At least one 8 foot (16 feet for Prod 08) log must be present for the tree to be considered merchantable.

Region 2:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 2 feet

Minimum log length for topwood logs is 2 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 3:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 2 feet

Minimum log length for topwood logs is 2 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 4:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 2 feet

Minimum log length for topwood logs is 2 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 5:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 2 feet

Minimum log length for topwood logs is 2 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 6:

Scribner factor volume reported to nearest board foot.

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 2 feet

Minimum log length for topwood logs is 2 feet

Segmentation logic:

Logs are divided into 16 foot logs with the top log standing on it’s own. (ie: A 16 and an 8 foot log stay 16 and 8 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, no stump height will be accounted for.

At least one 8 foot log must be present for the tree to be considered merchantable.

To calculate board foot volumes for 32 foot logs, the first two logs are added together, the volume computed using the small end diameter for the top log using the total log length, then the volume is prorated back to the two 16 foot log segments. The next two logs are added together and so on up the tree.

Region 8:

Scribner Decimal C

Only even log lengths

Maximum log length is 8 feet

Minimum log length is 4 feet

Minimum log length for topwood logs is 4 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 4 feet and less than 8 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 8 and an 4 foot log become two 6 foot logs).

A 4 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump for sawtimber and 0.5 foot for pulp.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 9:

Scribner Decimal C

Only even log lengths

Maximum log length is 8 feet

Minimum log length is 4 feet

Minimum log length for topwood logs is 4 feet

Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 4 feet and less than 8 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 8 and an 4 foot log become two 6 foot logs).

A 4 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump for sawtimber and 0.5 foot for pulp.

At least one 8 foot log must be present for the tree to be considered merchantable.

Region 10:

Scribner Decimal C

Only even log lengths

Maximum log length is 16 feet

Minimum log length is 8 feet

Minimum log length for topwood logs is 8 feet

Segmentation logic:

Logs are divided into 16 foot logs with the top log standing on it’s own. (ie: A 16 and an 8 foot log stay 16 and 8 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, a 1.0 stump height will be used.

At least one 8 foot log must be present for the tree to be considered merchantable.

To calculate board foot volumes for 32 foot logs, the first two logs are added together, the volume computed using the small end diameter for the top log using the total log length, then the volume is prorated back to the two 16 foot log segments. The next two logs are added together and so on up the tree.

# Volume Equation Numbers By Region.

**A Forest Number of zero represents a Region-wide volume model.**

**A Forest Number other the zero means the volume model applies to this Forest.**

## Region 1

| **Region 1 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Balsam fir | 0 | I00FW3W012 | Flewelling Profile Model 3pt | 0 |
| Balsam fir | 0 | I00FW2W012 | Flewelling Profile Model | 1/0 |
| Blue spruce | 0 | 102DVEW090 | Kemp Equation | 1/0 |
| Blue spruce | 0 | 101DVEW090 | Allen Equation | 0 |
| Bristlecone pine | 0 | 101DVEW108 | Allen Equation | 0 |
| Bristlecone pine | 0 | 100JB2W108 | Byrne Equation | 0 |
| Bristlecone pine | 0 | 102DVEW108 | Kemp Equation | 1/0 |
| Cottonwood | 0 | 101DVEW740 | Edminster Equation | 0 |
| Cottonwood | 0 | 102DVEW740 | Kemp Equation | 1 |
| Douglas fir | 0 | 100JB2W202 | Byrne Equation | 0 |
| Douglas fir | 0 | 101DVEW202 | Allen Equation | 0 |
| Douglas fir | 0 | 102DVEW202 | Kemp Equation | 0 |
| Douglas fir | 0 | I00FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 0 | 103DVEW202 | Kemp Equation | 0 |
| Douglas fir | 0 | I00FW3W202 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 0 | I00FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 0 | 101DVEW090 | Allen Equation | 0 |
| Engelmann's spruce | 0 | I00FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 0 | 102DVEW090 | Kemp Equation | 0 |
| Grand fir | 0 | I00FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 0 | 101DVEW017 | Allen Equation | 0 |
| Grand fir | 0 | 100JB2W017 | Byrne Equation | 0 |
| Grand fir | 0 | I00FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 0 | 102DVEW017 | Kemp Equation | 0 |
| Juniper | 0 | 102DVEW060 | Kemp Equation | 0/1 |
| Larch | 0 | I00FW2W073 | Flewelling Profile Model | 1 |
| Limber pine | 0 | I00FW2W073 | Flewelling Profile Model | 1 |
| Limber pine | 0 | 101DVEW108 | Allen Equation | 0 |
| Limber pine | 0 | 102DVEW108 | Kemp Equation | 0 |
| Lodgepole pine | 0 | 104DVEW108 | Kemp Equation | 0 |
| Lodgepole pine | 0 | 102DVEW108 | Kemp Equation | 0 |
| Lodgepole pine | 0 | 101DVEW108 | Allen Equation | 0 |
| Lodgepole pine | 0 | 100JB2W108 | Byrne Equation | 0 |
| Lodgepole pine | 14 | 103DVEW108 | Kemp Equation | 0 |
| Lodgepole pine | 0 | I00FW3W108 | Flewelling Profile Model 3pt | 0 |
| Lodgepole pine | 0 | I00FW2W108 | Flewelling Profile Model | 1 |
| Mountain hemlock | 0 | 102DVEW260 | Kemp Equation | 0 |
| Mountain hemlock | 0 | I00FW2W260 | Flewelling Profile Model | 1 |
| Mountain hemlock | 0 | 101DVEW060 | Allen Equation | 0 |
| Other Softwoods | 0 | I00FW2W073 | Flewelling Profile Model | 0/1 |
| Pacific yew | 0 | 616BEHW231 | Behre's Hyperbola | 0/1 |
| Paper birch | 0 | 101DVEW375 | N. Central Station Equation | 0/1 |
| Pinyon Pine | 0 | 102DVEW106 | Kemp Equation | 0 |
| Ponderosa pine | 0 | 100JB2W122 | Byrne Equation | 0 |
| Ponderosa pine | 8 | 104DVEW122 | Kemp Equation | 0 |
| Ponderosa pine | 0 | 102DVEW122 | Kemp Equation | 0 |
| Ponderosa pine | 8 | 105DVEW122 | Kemp Equation | 0 |
| Ponderosa pine | 8 | 106DVEW122 | Kemp Equation | 0 |
| Ponderosa pine | 0 | I00FW3W122 | Flewelling Profile Model 3pt | 1 |
| Ponderosa pine | 8 | 203FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 0 | I00FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 14 | 103DVEW122 | Kemp Equation | 0 |
| Ponderosa pine | 0 | 101DVEW122 | Allen Equation | 0 |
| Quaking aspen | 0 | 200DVEW746 | Edminster Equation | 1 |
| Quaking aspen | 0 | 102DVEW746 | Kemp Equation | 0/1 |
| Rocky Mountain maple | 0 | 200DVEW746 | Edminster Equation | 0 |
| Subalpine fir | 0 | 102DVEW019 | Kemp Equation | 0 |
| Subalpine fir | 0 | 101DVEW019 | Allen Equation | 0 |
| Subalpine fir | 0 | 100JB2W019 | Byrne Equation | 0 |
| Subalpine fir | 0 | I00FW3W019 | Flewelling Profile Model 3pt | 1 |
| Subalpine fir | 0 | I00FW2W019 | Flewelling Profile Model | 1 |
| Subalpine larch | 0 | 100JB2W073 | Byrne Equation | 0 |
| Subalpine larch | 0 | 102DVEW073 | Kemp Equation | 0 |
| Subalpine larch | 0 | 101DVEW073 | Allen Equation | 0 |
| Unknown | 0 | 101DVEW999 | Allen Equation | 0 |
| Western hemlock | 0 | 101DVEW260 | Allen Equation | 1 |
| Western hemlock | 0 | I00FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | I00FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | 102DVEW260 | Kemp Equation | 0 |
| Western larch | 0 | I00FW3W073 | Flewelling Profile Model 3pt | 1 |
| Western larch | 0 | I00FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | 102DVEW070 | Kemp Equation | 0 |
| Western larch | 0 | 100JB2W073 | Byrne Equation | 0 |
| Western larch | 0 | 101DVEW073 | Allen Equation | 1 |
| Western redcedar | 0 | I00FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | 101DVEW240 | Allen Equation | 0 |
| Western redcedar | 0 | I00FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | 102DVEW240 | Kemp Equation | 1 |
| Western white pine | 0 | I00FW2W119 | Flewelling Profile Model | 0 |
| Western white pine | 0 | 102DVEW119 | Kemp Equation | 0 |
| Western white pine | 0 | 101DVEW119 | Allen Equation | 0 |
| Western white pine | 0 | I00FW3W119 | Flewelling Profile Model 3pt | 0 |
| White fir | 0 | 102DVEW017 | Kemp Equation | 0 |
| White fir | 0 | 100JB2W017 | Byrne Equation | 0 |
| White fir | 0 | 101DVEW017 | Allen Equation | 0 |
| White spruce | 0 | 101DVEW090 | Allen Equation | 0 |
| White spruce | 0 | 102DVEW090 | Kemp Equation | 0 |
| Whitebark pine | 0 | 100JB2W108 | Byrne Equation | 0 |
| Whitebark pine | 0 | 101DVEW108 | Allen Equation | 0 |
| Whitebark pine | 0 | 100JB2W108 | Byrne Equation | 0 |
| Whitebark pine | 0 | 102DVEW108 | Kemp Equation | 0 |
| Whitebark pine | 0 | 102DVEW101 | Kemp Equation | 0 |
| Whitebark pine | 0 | I00FW2W012 | Flewelling Profile Model | 1 |

## Region 2

| **Region 2 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Bur Oak | 0 | 200DVEW823 | Chojnacky Equation | 1 |
| Douglas fir | 0 | 200FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 0 | 200FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | 200CZ2W202 | Czaplewski Profile Model | 0 |
| Douglas fir | 0 | 200DVEW093 | Myers Equation | 0 |
| Douglas fir | 0 | 200CZ3W202 | Czaplewski Profile Model 3pt | 0 |
| Engelmann's spruce | 0 | 200CZ3W093 | Czaplewski Profile Model 3pt | 0 |
| Engelmann's spruce | 0 | 200CZ2W093 | Czaplewski Profile Model | 0 |
| Engelmann's spruce | 0 | 407FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 0 | 210DVEW093 | Myers Equation | 0 |
| Engelmann's spruce | 0 | 200DVEW093 | Myers Equation | 0 |
| Gambel Oak | 0 | 200DVEW814 | Chojnacky Equation | 1/0 |
| Mountain Mahogany | 0 | 200DVEW475 | Chojnacky Equation | 1/0 |
| Lodgepole pine | 0 | 200CZ3W108 | Czaplewski Profile Model 3pt | 0 |
| Lodgepole pine | 0 | 200DVEW108 | Myers Equation | 0 |
| Lodgepole pine | 0 | 210DVEW108 | Myers Equation | 0 |
| Lodgepole pine | 2 | 202FW3W108 | Flewelling Profile Model 3pt | 0 |
| Lodgepole pine | 0 | 200CZ2W108 | Czaplewski Profile Model | 0 |
| Lodgepole pine | 0 | 200FW3W108 | Flewelling Profile Model 3pt | 1 |
| Lodgepole pine | 0 | 200FW2W108 | Flewelling Profile Model | 1 |
| Lodgepole pine | 2,14 | 202FW2W108 | Flewelling Profile Model | 1 |
| Oneseed Juniper | 0 | 200DVEW069 | Chojnacky Equation | 1 |
| Other Hardwoods | 0 | 200DVEW998 | Chojnacky Equation | 1 |
| Pinyon Pine | 0 | 200DVEW106 | Chojnacky Equation | 1 |
| Ponderosa pine | 3 | 203FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | 200FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 0 | 200FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | 212DVEW122 | Edminster Equation 1 | 0 |
| Ponderosa pine | 13 | 213FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 0 | 213DVEW122 | Edminster Equation 1 | 0 |
| Ponderosa pine | 3 | 203FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 3 | 223DVEW122 | Direct Volume equation for small non-saw product trees | 1 |
| Ponderosa pine | 0 | 200CZ3W122 | Czaplewski Profile Model 3pt | 0 |
| Ponderosa pine | 3 | 203CZ3W122 | Czaplewski Profile Model 3pt | 0 |
| Ponderosa pine | 0 | 200CZ2W122 | Czaplewski Profile Model | 0 |
| Ponderosa pine | 3 | 203CZ2W122 | Czaplewski Profile Model | 0 |
| Ponderosa pine | 0 | 210DVEW122 | Edminster Equation 1 | 0 |
| Ponderosa pine | 0 | 200DVEW122 | Edminster Equation 1 | 0 |
| Ponderosa pine | 3 | 203DVEW122 | Myers Equation | 0 |
| Ponderosa pine | 13 | 213FW3W122 | Flewelling Profile Model 3pt | 0 |
| Quaking aspen | 0 | 200CZ2W746 | Czaplewski Profile Model | 0 |
| Quaking aspen | 0 | 200DVEW746 | Edminster Equation 2 | 0 |
| Quaking aspen | 0 | 200CZ3W746 | Czaplewski Profile Model 3pt | 0 |
| Quacking aspen | 0 | 200FW2W746 | Flewelling Profile Model | 1 |
| Quacking aspen | 0 | 200FW3W746 | Flewelling Profile Model 3pt | 0 |
| Quaking aspen | 0 | 210DVEW746 | Edminster Equation 2 | 0 |
| Rocky Mtn. Juniper | 0 | 200DVEW066 | Chojnacky Equation | 1/0 |
| Subalpine fir | 0 | I00FW2W019 | Flewelling Profile Model | 1 |
| Subalpine fir | 0 | 200CZ3W019 | Czaplewski Profile Model 3pt | 0 |
| Subalpine fir | 0 | 200CZ2W019 | Czaplewski Profile Model | 0 |
| Subalpine fir | 0 | 200DVEW093 | Myers Equation | 0 |
| Utah Juniper | 0 | 200DVEW065 | Chojnacky Equation | 1 |
| White fir | 0 | 200FW2W015 | Flewelling Profile Model | 1 |
| White fir | 0 | 200FW3W015 | Flewelling Profile Model 3pt | 0 |
| White fir | 0 | 200CZ2W015 | Czaplewski Profile Model | 0 |
| White fir | 0 | 200CZ3W015 | Czaplewski Profile Model 3pt | 0 |
| White fir | 0 | 200DVEW015 | Myers Equation | 0 |

## Region 3

| **Region 3 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Black maple | 0 | 300DVEW314 | Chojnacky Equation | 1/0 |
| Douglas fir | 0 | 301DVEW202 | Hann and Bare Equation | 1 |
| Douglas fir | 2 | 302DVEW202 | Hann and Bare Equation | 1 |
| Douglas fir | 3 | 302DVEW202 | Hann and Bare Equation | 1 |
| Douglas fir | 7 | 302DVEW202 | Hann and Bare Equation | 1 |
| Douglas fir | 10 | 302DVEW202 | Hann and Bare Equation | 1 |
| Douglas fir | 10 | 301FW2W202 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 0 | 300DVEW093 | Hann and Bare Equation | 1 |
| Juniper | 0 | 300DVEW060 | Chojnacky Equation | 1 |
| Limber pine | 0 | 300DVEW113 | Hann and Bare Equation | 1 |
| Maple | 0 | 300DVEW310 | Chojnacky Equation | 1 |
| Oak | 0 | 300DVEW800 | Chojnacky Equation | 1 |
| Pinyon Pine | 0 | 300DVEW106 | Chojnacky Equation | 1 |
| Ponderosa pine | 0 | 300FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 0 | 300FW3W122 | Flewelling Profile Model 3pt | 1 |
| Ponderosa pine | 0 | 300DVEW122 | Eager Mill Study Equation | 1 |
| Ponderosa pine | 10 | 301FW2W122 | Flewelling Profile Model | 0 |
| Quaking aspen | 0 | 300DVEW746 | Hann and Bare Equation | 1 |
| Unknown | 0 | 300DVEW999 | Chojnacky Equation | 1 |
| White fir | 2 | 302DVEW015 | Hann and Bare Equation | 1 |
| White fir | 7 | 302DVEW015 | Hann and Bare Equation | 1 |
| White fir | 3 | 302DVEW015 | Hann and Bare Equation | 1 |
| White fir | 10 | 302DVEW015 | Hann and Bare Equation | 1 |
| White fir | 10 | 301FW2W015 | Flewelling Profile Model | 1 |
| White fir | 0 | 301DVEW015 | Hann and Bare Equation | 1 |
| White pine | 10 | 301FW2W108 | Flewelling Profile Model | 1 |

## Region 4

| **Region 4 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Blue spruce | 7 | 407FW2W093 | Flewelling Profile Model | 1 |
| Blue spruce | 0 | 400MATW093 | Rustagi Profile Model | 1 |
| Blue spruce | 12 | I15FW2W093 | Flewelling Profile Model | 1 |
| Blue spruce | 13 | I15FW2W093 | Flewelling Profile Model | 1 |
| Blue spruce | 8 | 407MATW093 | Rustagi Profile Model | 1 |
| Blue spruce | 2 | I15FW2W093 | Flewelling Profile Model | 1 |
| California red fir | 9 | 400MATW020 | Rustagi Profile Model | 1/0 |
| California red fir | 17 | 400MATW020 | Rustagi Profile Model | 1/0 |
| Douglas fir | 12 | I15FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 12 | I15FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 2 | I15FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 2 | I15FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 5 | 405MATW202 | Rustagi Profile Model | 1 |
| Douglas fir | 0 | 400MATW202 | Rustagi Profile Model | 1 |
| Douglas fir | 2 | 401MATW202 | Rustagi Profile Model | 0 |
| Douglas fir | 12 | 401MATW202 | Rustagi Profile Model | 0 |
| Douglas fir | 13 | I15FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 13 | I15FW2W202 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 12 | I15FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 13 | I15FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 7 | 407FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 12 | I15FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 7 | 407FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 2 | I15FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 8 | 407MATW093 | Rustagi Profile Model | 1 |
| Engelmann's spruce | 2 | I15FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 7 | 407MATW093 | Rustagi Profile Model | 0 |
| Engelmann's spruce | 13 | I15FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 0 | 400MATW093 | Rustagi Profile Model | 1 |
| Grand fir | 2 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 0 | 400MATW015 | Rustagi Profile Model | 1 |
| Grand fir | 2 | I15FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 13 | I15FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 12 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 13 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 12 | I15FW2W017 | Flewelling Profile Model | 1 |
| Incense cedar | 9 | 400MATW081 | Rustagi Profile Model | 1 |
| Incense cedar | 17 | 400MATW081 | Rustagi Profile Model | 1 |
| Limber pine | 17 | 401MATW108 | Rustagi Profile Model | 1 |
| Limber pine | 9 | 401MATW108 | Rustagi Profile Model | 1 |
| Limber pine | 0 | 400MATW108 | Rustagi Profile Model | 1 |
| Lodgepole pine | 17 | 401MATW108 | Rustagi Profile Model | 1 |
| Lodgepole pine | 9 | 401MATW108 | Rustagi Profile Model | 1 |
| Lodgepole pine | 0 | 400MATW108 | Rustagi Profile Model | 1 |
| Mountain hemlock | 9 | 401MATW015 | Rustagi Profile Model | 1/0 |
| Mountain hemlock | 17 | 401MATW015 | Rustagi Profile Model | 1/0 |
| Mountain Mahogany | 0 | 400DVEW475 | Chojnacky Equation | 1 |
| Other Hardwoods | 0 | 400DVEW998 | Chojnacky Equation | 1 |
| Pinyon Pine | 0 | 400DVEW106 | Chojnacky Equation | 1 |
| Pinyon Pine Single Leaf | 0 | 400DVEW133 | Chojnacky Equation | 1 |
| Ponderosa pine | 2 | I15FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 9 | 403MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 0 | 400MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 19 | 402MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 18 | 402MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 10 | 402MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 8 | 402MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 7 | 402MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 1 | 401MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 13 | I15FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 17 | 403MATW122 | Rustagi Profile Model | 1 |
| Ponderosa pine | 12 | I15FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 13 | I15FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 2 | I15FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 12 | I15FW2W122 | Flewelling Profile Model | 1 |
| Quaking aspen | 0 | 400MATW746 | Rustagi Profile Model | 1 |
| Rocky Mtn. Juniper | 0 | 400DVEW066 | Chojnacky Equation | 1 |
| Subalpine fir | 0 | 400MATW019 | Rustagi Profile Model | 1 |
| Subalpine fir | 5 | 405MATW019 | Rustagi Profile Model | 1 |
| Sugar pine | 17 | 400MATW117 | Rustagi Profile Model | 1/0 |
| Sugar pine | 9 | 400MATW117 | Rustagi Profile Model | 1/0 |
| Utah Juniper | 0 | 400DVEW065 | Chojnacky Equation | 1 |
| Utah Juniper | 1 | 401DVEW065 | Chojnacky Equation | 1 |
| Utah Juniper | 10 | 401DVEW065 | Chojnacky Equation | 1 |
| Western Juniper | 0 | 400DVEW064 | Chojnacky Equation | 1 |
| Western larch | 14 | 400MATW073 | Rustagi Profile Model | 1 |
| Western larch | 13 | 400MATW073 | Rustagi Profile Model | 1 |
| Western larch | 6 | 400MATW073 | Rustagi Profile Model | 1 |
| Western larch | 2 | 400MATW073 | Rustagi Profile Model | 1 |
| Western larch | 12 | 400MATW073 | Rustagi Profile Model | 1 |
| Western white pine | 17 | 400MATW117 | Rustagi Profile Model | 1 |
| Western white pine | 9 | 400MATW117 | Rustagi Profile Model | 1 |
| White fir | 0 | 400MATW015 | Rustagi Profile Model | 1 |
| White fir | 9 | 401MATW015 | Rustagi Profile Model | 1 |
| White fir | 17 | 401MATW015 | Rustagi Profile Model | 1 |
| White fir | 2 | I15FW2W017 | Flewelling Profile Model | 1 |
| White fir | 12 | I15FW2W017 | Flewelling Profile Model | 1 |
| White fir | 13 | I15FW2W017 | Flewelling Profile Model | 1 |
| White fir | 12 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| White fir | 13 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| White fir | 2 | I15FW3W017 | Flewelling Profile Model 3pt | 0 |
| Whitebark pine | 0 | 400MATW108 | Rustagi Profile Model | 1 |
| Whitebark pine | 9 | 401MATW108 | Rustagi Profile Model | 1 |
| Whitebark pine | 17 | 401MATW108 | Rustagi Profile Model | 1 |

## Region 5

| **Region 5 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Bigleaf maple | 0 | 500DVEW312 | Pillsbury & Kirkley Equation | 1 |
| Blue oak | 0 | 500DVEW807 | Pillsbury & Kirkley Equation | 1 |
| California black oak | 0 | 500DVEW818 | Pillsbury & Kirkley Equation | 1 |
| California laurel | 0 | 500DVEW981 | Pillsbury & Kirkley Equation | 1 |
| California live oak | 0 | 500DVEW801 | Pillsbury & Kirkley Equation | 1 |
| California red fir | 0 | 500WO2W020 | Wensel &Olsen Profile Model | 1 |
| California red fir | 5,6,8,9,10,14 | 532WO2W020 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| California white oak | 0 | 500DVEW821 | Pillsbury & Kirkley Equation | 1 |
| Canyon live oak | 0 | 500DVEW805 | Pillsbury & Kirkley Equation | 1 |
| Douglas fir | 0 | 500WO2W202 | Wensel &Olsen Profile Model | 1 |
| Douglas fir | 5,6,8,9,10,14 | 532WO2W202 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Engelmann's oak | 0 | 500DVEW811 | Pillsbury & Kirkley Equation | 1 |
| Engelmann spruce | 0 | 500WO2W015 | Wensel &Olsen Profile Model | 1 |
| Eucalyptus | 0 | H01SN2W510 | Sharpnack Profile Model | 1/0 |
| Eucalyptus | 0 | H00SN2W510 | Sharpnack Profile Model | 1/0 |
| Giant sequoia | 0 | 500DVEW212 | Pillsbury & Kirkley Equation | 1 |
| Golden chinkapin | 0 | 500DVEW431 | Pillsbury & Kirkley Equation | 1 |
| Incense cedar | 0 | 500WO2W081 | Wensel &Olsen Profile Model | 1 |
| Incense cedar | 5,6,8,9,10,14 | 532WO2W081 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Interior live oak | 0 | 500DVEW839 | Pillsbury & Kirkley Equation | 1 |
| Jeffrey pine | 0 | 500WO2W116 | Wensel &Olsen Profile Model | 1 |
| Jeffrey pine | 5,6,8,9,10,14 | 532WO2W116 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Juniper | 0 | 500DVEW060 | Pillsbury & Kirkley Equation | 1 |
| Koa | 0 | H00SN2W301 | Sharpnack Profile Model | 0 |
| Koa | 0 | 616BEHW000 | Behre’s Hyperbola | 1/0 |
| Lodgepole pine | 0 | 500WO2W108 | Wensel &Olsen Profile Model | 1 |
| Lodgepole pine | 5,6,8,9,10,14 | 532WO2W108 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Ohia | 0 | H00SN2W671 | Sharpnack Profile Model | 1/0 |
| Oregon white oak | 0 | 500DVEW815 | Pillsbury & Kirkley Equation | 1 |
| Pacific madrone | 0 | 500DVEW361 | Pillsbury & Kirkley Equation | 1 |
| Ponderosa pine | 0 | 500WO2W122 | Wensel &Olsen Profile Model | 1 |
| Ponderosa pine | 5,6,8,9,10,14 | 532WO2W122 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Red alder | 0 | 500DVEW351 | Pillsbury & Kirkley Equation | 1 |
| Redwood | 0 | 500WO2W211 | Wensel &Olsen Profile Model | 1 |
| Redwood | 5,6,8,9,10,14 | 532WO2W211 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Sugar pine | 0 | 500WO2W117 | Wensel &Olsen Profile Model | 1 |
| Sugar pine | 5,6,8,9,10,14 | 532WO2W117 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| Tanoak | 0 | 500DVEW631 | Pillsbury & Kirkley Equation | 1 |
| White fir | 0 | 500WO2W015 | Wensel &Olsen Profile Model | 1 |
| White fir | 5,6,8,9,10,14 | 532WO2W015 | Wensel &Olsen Profile Model – Scribner 32 | 0 |
| White fir | 0 | 516TRFW015 | PNW tariff Equation | 0 |
| White fir | 0 | 532TRFW015 | PNW tariff Equation | 0 |
| California red fir | 0 | 516TRFW021 | PNW tariff Equation | 0 |
| California red fir | 0 | 532TRFW021 | PNW tariff Equation | 0 |
| Juniper | 0 | 516TRFW060 | PNW tariff Equation | 0 |
| Juniper | 0 | 532TRFW060 | PNW tariff Equation | 0 |
| Incense cedar | 0 | 516TRFW081 | PNW tariff Equation | 0 |
| Incense cedar | 0 | 532TRFW081 | PNW tariff Equation | 0 |
| Lodgepole pine | 0 | 516TRFW108 | PNW tariff Equation | 0 |
| Lodgepole pine | 0 | 532TRFW108 | PNW tariff Equation | 0 |
| Sugar pine | 0 | 516TRFW117 | PNW tariff Equation | 0 |
| Sugar pine | 0 | 532TRFW117 | PNW tariff Equation | 0 |
| Ponderosa pine | 0 | 516TRFW122 | PNW tariff Equation | 0 |
| Ponderosa pine | 0 | 532TRFW122 | PNW tariff Equation | 0 |
| Douglas-fir | 0 | 516TRFW202 | PNW tariff Equation | 0 |
| Redwood | 0 | 616TRFW211 | PNW tariff Equation | 0 |
| Redwood | 0 | 632TRFW211 | PNW tariff Equation | 0 |
|  |  |  |  |  |

## 

## Region 6

| **Region 6 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Balsam fir | 10 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 6 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 15 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 0 | 628BEHW012 | Behres Hyperbola | 0 |
| Balsam fir | 18 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 9 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 12 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 0 | 616BEHW012 | Behres Hyperbola | 1 |
| Balsam fir | 11 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 0 | I00FW3W012 | Flewelling Profile Model 3pt | 0 |
| Balsam fir | 5 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 3 | 632BEHW012 | Behres Hyperbola | 0/1 |
| Balsam fir | 0 | I00FW2W012 | Flewelling Profile Model | 0 |
| Douglas fir | 18 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 0 | F02FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | 602DVEW204 | Direct Volume Equation | 0 |
| Douglas fir | 14 | I13FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 9 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 15 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 0 | F03FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | 628BEHW202 | Behres Hyperbola | 0 |
| Douglas fir | 0 | F01FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F02FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 16 | I11FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 0 | I00FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 7 | I12FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 0 | F03FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | I00FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 10 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 0 | F00FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F04FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 5 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 4 | I12FW2W202 | Flewelling Profile Model | 1 |
| Douglas fir | 12 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 3 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 6 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 0 | F04FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | 601DVEW205 | Direct Volume Equation | 0 |
| Douglas fir | 0 | I12FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F00FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | F01FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 11 | 632BEHW202 | Behres Hyperbola | 0/1 |
| Douglas fir | 0 | F08FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | F07FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | F06FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | F05FW3W202 | Flewelling Profile Model 3pt | 0 |
| Douglas fir | 0 | F08FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F07FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F06FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | F05FW2W202 | Flewelling Profile Model | 0 |
| Douglas fir | 0 | 616BEHW202 | Behres Hyperbola | 1 |
| Engelmann's spruce | 18 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 6 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 3 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 9 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 0 | 616BEHW093 | Behres Hyperbola | 1 |
| Engelmann's spruce | 11 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 0 | I00FW3W093 | Flewelling Profile Model 3pt | 0 |
| Engelmann's spruce | 14 | I00FW2W093 | Flewelling Profile Model | 1 |
| Engelmann's spruce | 0 | 628BEHW093 | Behres Hyperbola | 0 |
| Engelmann's spruce | 0 | I00FW2W093 | Flewelling Profile Model | 0 |
| Engelmann's spruce | 15 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 10 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 12 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Engelmann's spruce | 5 | 632BEHW093 | Behres Hyperbola | 0/1 |
| Grand fir | 12 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 0 | I13FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 0 | I12FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 15 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 0 | I11FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 0 | I14FW2W017 | Flewelling Profile Model | 0 |
| Grand fir | 0 | I11FW2W017 | Flewelling Profile Model | 0 |
| Grand fir | 0 | I00FW2W017 | Flewelling Profile Model | 0 |
| Grand fir | 0 | I13FW2W017 | Flewelling Profile Model | 0 |
| Grand fir | 0 | I12FW2W017 | Flewelling Profile Model | 0 |
| Grand fir | 0 | I00FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 18 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 5 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 0 | 616BEHW017 | Behres Hyperbola | 1 |
| Grand fir | 6 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 3 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 7 | I12FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 14 | I13FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 16 | I11FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 9 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 10 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 0 | I14FW3W017 | Flewelling Profile Model 3pt | 0 |
| Grand fir | 11 | 632BEHW017 | Behres Hyperbola | 0/1 |
| Grand fir | 4 | I12FW2W017 | Flewelling Profile Model | 1 |
| Grand fir | 0 | 628BEHW017 | Behres Hyperbola | 0 |
| Lodgepole pine | 4 | I00FW2W108 | Flewelling Profile Model | 1 |
| Lodgepole pine | 0 | I00FW2W108 | Flewelling Profile Model | 0 |
| Lodgepole pine | 15 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 6 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 3 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 14 | I00FW2W108 | Flewelling Profile Model | 1 |
| Lodgepole pine | 0 | 628BEHW108 | Behres Hyperbola | 0 |
| Lodgepole pine | 12 | 632BEHW108 | Behres Hyperbola | 0 |
| Lodgepole pine | 10 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 0 | I00FW3W108 | Flewelling Profile Model 3pt | 0 |
| Lodgepole pine | 0 | 616BEHW108 | Behres Hyperbola | 1 |
| Lodgepole pine | 9 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 11 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 5 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 0 | 602DVEW108 | Direct Volume Equation | 0 |
| Lodgepole pine | 18 | 632BEHW108 | Behres Hyperbola | 0/1 |
| Lodgepole pine | 7 | I00FW2W108 | Flewelling Profile Model | 1 |
| Mountain hemlock | 3 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 10 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 0 | F02FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 18 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 0 | F03FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | 628BEHW000 | Behres Hyperbola | 0 |
| Mountain hemlock | 0 | F00FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | F04FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | F08FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 9 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 11 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 12 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 15 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 0 | F06FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F01FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | 616BEHW264 | Behres Hyperbola | 1 |
| Mountain hemlock | 0 | F07FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | F05FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 5 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 0 | I00FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | F01FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F02FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F03FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F08FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F00FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F04FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F05FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 0 | F06FW3W260 | Flewelling Profile Model 3pt | 0 |
| Mountain hemlock | 0 | F07FW2W260 | Flewelling Profile Model | 0 |
| Mountain hemlock | 6 | 632BEHW264 | Behres Hyperbola | 0/1 |
| Mountain hemlock | 0 | I00FW2W260 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I14FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | I00FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | I11FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 14 | I13FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 12 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 4 | I12FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 9 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | I21FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 3 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | I13FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | 600DVEW122 | Direct Volume Equation | 0 |
| Ponderosa pine | 15 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | 616BEHW122 | Behres Hyperbola | 1 |
| Ponderosa pine | 18 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 10 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | I00FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I22FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I12FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | I21FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 5 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | I14FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I22FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 6 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 0 | 628BEHW122 | Behres Hyperbola | 0 |
| Ponderosa pine | 0 | I23FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I23FW3W122 | Flewelling Profile Model 3pt | 0 |
| Ponderosa pine | 0 | I12FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 16 | I11FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 11 | 632BEHW122 | Behres Hyperbola | 0/1 |
| Ponderosa pine | 7 | I12FW2W122 | Flewelling Profile Model | 1 |
| Ponderosa pine | 0 | I13FW2W122 | Flewelling Profile Model | 0 |
| Ponderosa pine | 0 | I11FW2W122 | Flewelling Profile Model | 0 |
| Subalpine fir | 10 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 0 | 628BEHW019 | Behres Hyperbola | 0 |
| Subalpine fir | 9 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 0 | 616BEHW019 | Behres Hyperbola | 1 |
| Subalpine fir | 18 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Subalpine fir | 0 | I00FW3W019 | Flewelling Profile Model 3pt | 0 |
| Subalpine fir | 3 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 0 | I00FW2W019 | Flewelling Profile Model | 0 |
| Subalpine fir | 6 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 11 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 5 | 632BEHW019 | Behres Hyperbola | 0/1 |
| Subalpine fir | 14 | I00FW2W019 | Flewelling Profile Model | 1 |
| Subalpine fir | 12 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Subalpine fir | 15 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | F08FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | 616BEHW263 | Behres Hyperbola | 1 |
| Western hemlock | 3 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | F06FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 5 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | 628BEHW263 | Behres Hyperbola | 0 |
| Western hemlock | 9 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 6 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 12 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 10 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 15 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | 601DVEW263 | Direct Volume Equation | 0 |
| Western hemlock | 18 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | F07FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F03FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | F08FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 11 | 632BEHW263 | Behres Hyperbola | 0/1 |
| Western hemlock | 0 | F05FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | F01FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | F04FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | I00FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F05FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F02FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | F07FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | F06FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F04FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F03FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F02FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F01FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F00FW2W260 | Flewelling Profile Model | 0 |
| Western hemlock | 0 | F00FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western hemlock | 0 | I00FW3W260 | Flewelling Profile Model 3pt | 0 |
| Western larch | 3 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 0 | I00FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I21FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 7 | I12FW2W073 | Flewelling Profile Model | 1 |
| Western larch | 0 | I23FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I13FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I00FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 10 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 12 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 11 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 14 | I13FW2W073 | Flewelling Profile Model | 1 |
| Western larch | 15 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 0 | I11FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 6 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 0 | I12FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I22FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I11FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 0 | I12FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 0 | 616BEHW073 | Behres Hyperbola | 1 |
| Western larch | 18 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 5 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 0 | I14FW2W073 | Flewelling Profile Model | 0 |
| Western larch | 0 | I14FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 0 | I21FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 0 | I22FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 0 | 628BEHW073 | Behres Hyperbola | 0 |
| Western larch | 0 | I23FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western larch | 9 | 632BEHW073 | Behres Hyperbola | 0/1 |
| Western larch | 0 | I13FW3W073 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | 616BEHW242 | Behres Hyperbola | 1 |
| Western redcedar | 0 | F00FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | I00FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | I00FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | I11FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 10 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 9 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 6 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 18 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 0 | F02FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | F01FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 12 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 5 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 0 | F01FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | F00FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | F04FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 3 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 0 | F04FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | F03FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 11 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 0 | F03FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | F02FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 15 | 632BEHW242 | Behres Hyperbola | 0/1 |
| Western redcedar | 0 | 628BEHW242 | Behres Hyperbola | 0 |
| Western white pine | 15 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 18 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 0 | 628BEHW119 | Behres Hyperbola | 0 |
| Western white pine | 0 | 616BEHW119 | Behres Hyperbola | 1 |
| Western white pine | 3 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 5 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 9 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 0 | I00FW3W119 | Flewelling Profile Model 3pt | 0 |
| Western white pine | 12 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 0 | I00FW2W119 | Flewelling Profile Model | 0 |
| Western white pine | 11 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 6 | 632BEHW119 | Behres Hyperbola | 0/1 |
| Western white pine | 10 | 632BEHW119 | Behres Hyperbola | 0/1 |
| White fir | 0 | 601DVEW015 | Direct Volume Equation | 0 |
| White fir | 7 | I12FW2W017 | Flewelling Profile Model | 1 |
| White fir | 16 | I11FW2W017 | Flewelling Profile Model | 1 |
| White fir | 0 | 602DVEW015 | Direct Volume Equation | 0 |
| Subalpine fir | 0 | 616TRFW019 | PNW tariff Equation | 0 |
| Western larch | 0 | 616TRFW073 | PNW tariff Equation | 0 |
| Western larch | 0 | 632TRFW073 | PNW tariff Equation | 0 |
| White spruce | 0 | 616TRFW094 | PNW tariff Equation | 0 |
| Sitka spruce | 0 | 616TRFW098 | PNW tariff Equation | 0 |
| Sitka spruce | 0 | 632TRFW098 | PNW tariff Equation | 0 |
| Lodgepole pine | 0 | 616TRFW108 | PNW tariff Equation | 0 |
| Lodgepole pine | 0 | 632TRFW108 | PNW tariff Equation | 0 |
| Ponderosa pine | 0 | 616TRFW122 | PNW tariff Equation | 0 |
| Ponderosa pine | 0 | 632TRFW122 | PNW tariff Equation | 0 |
| Douglas-fir | 0 | 616TRFW202 | PNW tariff Equation | 0 |
| Douglas-fir | 0 | 632TRFW202 | PNW tariff Equation | 0 |
| Western redcedar | 0 | 616TRFW242 | PNW tariff Equation | 0 |
| Western redcedar | 0 | 632TRFW242 | PNW tariff Equation | 0 |
| Western hemlock | 0 | 616TRFW263 | PNW tariff Equation | 0 |
| Western hemlock | 0 | 632TRFW263 | PNW tariff Equation | 0 |
| Mountain hemlock | 0 | 616TRFW264 | PNW tariff Equation | 0 |
| Mountain hemlock | 0 | 632TRFW264 | PNW tariff Equation | 0 |
| Red alder | 0 | 616TRFW351 | PNW tariff Equation | 0 |
| Quacking aspen | 0 | 616TRFW746 | PNW tariff Equation | 0 |
| Black cottonwood | 0 | 616TRFW747 | PNW tariff Equation | 0 |
| Unknown hardwood | 0 | 616TRFW998 | PNW tariff Equation | 0 |
| Pacific silver fir | 0 | 632TRFW011 | PNW tariff Equation | 0 |

## Region 7 (BLM)

| **(BLM) Total Tree Height or Height in 16 Foot Logs** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Species Name** | **Code** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Douglas fir/Cascade | PSME | ALL | B01BEHW202 | Behre’s Hyperbola | 1 |
| Douglas fir/Coast | PSME | ALL | B02BEHW202 | Behre’s Hyperbola | 1 |
| Douglas fir/Southwest | PSME | ALL | B03BEHW202 | Behre’s Hyperbola | 1/0 |
| Redwood | SESE3 | ALL | B00BEHW211 | Behre’s Hyperbola | 1 |
| Pond. pine/Yellow | PIPO | ALL | B00BEHW122 | Behre’s Hyperbola | 1 |
| Jeffery pine | PIJE | ALL | B00BEHW116 | Behre’s Hyperbola | 1 |
| Sugar pine | PILA | ALL | B00BEHW117 | Behre’s Hyperbola | 1 |
| Western white pine | PIMO3 | ALL | B00BEHW119 | Behre’s Hyperbola | 1 |
| Lodgepole pine | PICO | ALL | B00BEHW108 | Behre’s Hyperbola | 1 |
| Pacific yew | TABR2 | ALL | B00BEHW231 | Behre’s Hyperbola | 1 |
| Tan oak | LIDE3 | ALL | B00BEHW631 | Behre’s Hyperbola | 1 |
| Red alder | ALRU2 | ALL | B00BEHW351 | Behre’s Hyperbola | 1 |
| Oregon myrtle |  | ALL | B00BEHW998 | Behre’s Hyperbola | 1/0 |
| Big leaf maple | ACMA3 | ALL | B00BEHW312 | Behre’s Hyperbola | 1 |
| Pacific madrone | ARME | ALL | B00BEHW361 | Behre’s Hyperbola | 1 |
| Golden chinquapin | CHCHC4 | ALL | B00BEHW431 | Behre’s Hyperbola | 1 |
| Oregon ash | FRLA | ALL | B00BEHW542 | Behre’s Hyperbola | 1 |
| Black cottonwood | POBAT | ALL | B00BEHW747 | Behre’s Hyperbola | 1 |
| Oak species | QUESPP | ALL | B00BEHW800 | Behre’s Hyperbola | 1 |
| White fir/Westside | ABCO | ALL | B00BEHW015 | Behre’s Hyperbola | 1 |
| Shasta red fir | ABSH | ALL | B00BEHW021 | Behre’s Hyperbola | 1 |
| Grand fir | ABGR | ALL | B00BEHW017 | Behre’s Hyperbola | 1 |
| Pacific. silver fir | ABAM | ALL | B00BEHW011 | Behre’s Hyperbola | 1 |
| Noble fir | ABPR | ALL | B00BEHW022 | Behre’s Hyperbola | 1 |
| Engelmann spruce | PIEN | ALL | B00BEHW093 | Behre’s Hyperbola | 1 |
| Sitka spruce | PISI | ALL | B00BEHW098 | Behre’s Hyperbola | 1 |
| Hemlock | TSHE | ALL | B00BEHW260 | Behre’s Hyperbola | 1 |
| Incense cedar | CADE27 | ALL | B00BEHW081 | Behre’s Hyperbola | 1 |
| Alaska cedar | CHNO | ALL | B00BEHW042 | Behre’s Hyperbola | 1 |
| Port Orford cedar | CHLA | ALL | B00BEHW041 | Behre’s Hyperbola | 1 |
| Western red cedar | THPL | ALL | B00BEHW242 | Behre’s Hyperbola | 1 |
| Western larch | LAOC | ALL | B00BEHW073 | Behre’s Hyperbola | 1/0 |
| Misc. species | UNLSPP | ALL | B00BEHW999 | Behre’s Hyperbola | 1 |

All = Equation good for all Forest or Districts.

| **(BLM) Total Tree Height or Height in 32 Foot Logs** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Species Name** | **Code** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Douglas fir/Cascade | PSME | ALL | B01B32W202 | Behre’s Hyperbola | 1/0 |
| Douglas fir/Coast | PSME | ALL | B02B32W202 | Behre’s Hyperbola | 1/0 |
| Douglas fir/Southwest | PSME | ALL | B03B32W202 | Behre’s Hyperbola | 1/0 |
| Redwood | SESE3 | ALL | B00B32W211 | Behre’s Hyperbola | 1/0 |
| Pond. pine/Yellow | PIPO | ALL | B00B32W122 | Behre’s Hyperbola | 1/0 |
| Jeffery pine | PIJE | ALL | B00B32W116 | Behre’s Hyperbola | 1/0 |
| Sugar pine | PILA | ALL | B00B32W117 | Behre’s Hyperbola | 1/0 |
| Western white pine | PIMO3 | ALL | B00B32W119 | Behre’s Hyperbola | 1/0 |
| Lodgepole pine | PICO | ALL | B00B32W108 | Behre’s Hyperbola | 1/0 |
| Pacific yew | TABR2 | ALL | B00B32W231 | Behre’s Hyperbola | 1/0 |
| Tan oak | LIDE3 | ALL | B00B32W631 | Behre’s Hyperbola | 1/0 |
| Red alder | ALRU2 | ALL | B00B32W351 | Behre’s Hyperbola | 1/0 |
| Oregon myrtle |  | ALL | B00B32W998 | Behre’s Hyperbola | 1/0 |
| Big leaf maple | ACMA3 | ALL | B00B32W312 | Behre’s Hyperbola | 1/0 |
| Pacific madrone | ARME | ALL | B00B32W361 | Behre’s Hyperbola | 1/0 |
| Golden chinquapin | CHCHC4 | ALL | B00B32W431 | Behre’s Hyperbola | 1/0 |
| Oregon ash | FRLA | ALL | B00B32W542 | Behre’s Hyperbola | 1/0 |
| Black cottonwood | POBAT | ALL | B00B32W747 | Behre’s Hyperbola | 1/0 |
| Oak species | QUESPP | ALL | B00B32W800 | Behre’s Hyperbola | 1/0 |
| White fir/Westside | ABCO | ALL | B00B32W015 | Behre’s Hyperbola | 1/0 |
| Shasta red fir | ABSH | ALL | B00B32W021 | Behre’s Hyperbola | 1/0 |
| Grand fir | ABGR | ALL | B00B32W017 | Behre’s Hyperbola | 1/0 |
| Pacific. silver fir | ABAM | ALL | B00B32W011 | Behre’s Hyperbola | 1/0 |
| Noble fir | ABPR | ALL | B00B32W022 | Behre’s Hyperbola | 1/0 |
| Engelmann spruce | PIEN | ALL | B00B32W093 | Behre’s Hyperbola | 1/0 |
| Sitka spruce | PISI | ALL | B00B32W098 | Behre’s Hyperbola | 1/0 |
| Hemlock | TSHE | ALL | B00B32W260 | Behre’s Hyperbola | 1/0 |
| Incense cedar | CADE27 | ALL | B00B32W081 | Behre’s Hyperbola | 1/0 |
| Alaska cedar | CHNO | ALL | B00B32W042 | Behre’s Hyperbola | 1/0 |
| Port Orford cedar | CHLA | ALL | B00B32W041 | Behre’s Hyperbola | 1/0 |
| Western red cedar | THPL | ALL | B00B32W242 | Behre’s Hyperbola | 1/0 |
| Western larch | LAOC | ALL | B00B32W073 | Behre’s Hyperbola | 1/0 |
| Misc. species | UNLSPP | ALL | B00B32W999 | Behre’s Hyperbola | 1/0 |

All = Equation good for all Forest or Districts.

## Region 8

| **Region 8 Volume Equation Numbers By Forest and District Number** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Replace the \*\*\* with the Species Code from the Species Table Below** | | | | | |
| **Species Name** | **Forest**  **Number** | **District**  **Number** | **Equation Number**  **(Cubic and Board Foot Volume)** | **Volume Model Name** | **Used By Cruise/FVS**  **1 = Yes** |
| All | 0 | 0 | 891CLKE\*\*\* | Clark Profile Model | 1 |
| All | 1 | 0 | 841CLKE\*\*\* | Clark Profile Model | 1 |
| All | 1 | 3 | 811CLKE\*\*\* | Clark Profile Model | 1 |
| All | 2 | 0 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 3 | 0 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 3 | 8 | 821CLKE\*\*\* | Clark Profile Model | 1 |
| All | 4 | 0 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 5 | 0 | 811CLKE\*\*\* | Clark Profile Model | 1 |
| All | 6 | 0 | 851CLKE\*\*\* | Clark Profile Model | 1 |
| All | 7 | 0 | 851CLKE\*\*\* | Clark Profile Model | 1 |
| All | 7 | 6 | 871CLKE\*\*\* | Clark Profile Model | 1 |
| All | 7 | 7,17 | 841CLKE\*\*\* | Clark Profile Model | 1 |
| All | 8 | 0 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 9 | 0 | 861CLKE\*\*\* | Clark Profile Model | 1 |
| All | 10 | 0 | 861CLKE\*\*\* | Clark Profile Model | 1 |
| All | 10 | 3 | 811CLKE\*\*\* | Clark Profile Model | 1 |
| All | 10 | 10 | 821CLKE\*\*\* | Clark Profile Model | 1 |
| All | 11 | 0 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 12 | 0 | 821CLKE\*\*\* | Clark Profile Model | 1 |
| All | 12 | 2 | 831CLKE\*\*\* | Clark Profile Model | 1 |
| All | 12 | 5 | 811CLKE\*\*\* | Clark Profile Model | 1 |
| All | 13 | 0 | 851CLKE\*\*\* | Clark Profile Model | 1 |

| **Region 8 Volume Equation Numbers By Forest and District Number** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Replace the \*\*\* with the Species Code from the Species Table Below** | | | | | |
| **Species Name** | **Forest**  **Number** | **District**  **Number** | **Equation Number**  **(Board Foot Volume)** | **Volume Model Name** | **Used By Cruise/FVS**  **1 = Yes** |
| All | 0 | 0 | 825DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 1 | 813DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 3 | 815DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 4 | 816DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 5,6 | 814DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 7 | 817DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 1 | 8 | 806DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 2 | 11,12,13,14,15,16,17 | 810DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 3 | 1,2,3,4,5,6,7 | 801DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 4 | 1,2,3,4,5,6 | 801DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 5 | 1,2,4,5,6 | 803DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 6 | 1,2,3,4,5 | 802DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 6 | 6 | 809DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 1,10 | 819DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 2,3 | 820DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 4,8 | 821DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 5 | 822DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 6 | 818DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 7 | 7,17 | 823DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 8 | 1,2,3,4,5,6 | 811DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 9 | 1,6 | 830DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 9 | 2,3,4,5,7,8,9,10,11 | 831DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 9 | 12 | 832DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 10 | 1,2,3,4,5,6 | 804DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 10 | 7 | 805DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 11 | 2,4,5,6,7,8,9,11 | 801DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 11 | 3 | 807DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 11 | 10 | 808DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 12 | 1,3,7,8 | 824DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 12 | 2 | 801DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 12 | 5,6 | 825DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 13 | 1 | 826DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 13 | 3,6 | 827DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 13 | 5,7 | 828DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 13 | 2,4 | 829DVEE\*\*\* | Lasher Equations – Bdft | 0 |
| All | 14 | 1,2,3,4,5,6 | 812DVEE\*\*\* | Lasher Equations – Bdft | 0 |

| **Region 8 Volume Equation Numbers By Forest and District Number** | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Replace the \*\*\* with the Species Code from the Species Table Below** | | | | | | | | |
|  | | | **Pulpwood Trees All Species** | | **Sawtimber**  **Softwoods** | **Sawtimber**  **Hardwoods** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| **Species** | **Forest**  **Number** | **District**  **Number** | **Total Height** | **Height**  **4” Top Diam** | **Height**  **7” Top Diam** | **Height**  **9” Top Diam** |
| All | 0 | 0 | 890CLKE\*\*\* | 894CLKE\*\*\* | 897CLKE\*\*\* | 899CLKE\*\*\* | Clark Profile Model | 0 |
| All | 1 | 0 | 840CLKE\*\*\* | 844CLKE\*\*\* | 847CLKE\*\*\* | 849CLKE\*\*\* | Clark Profile Model | 0 |
| All | 1 | 3 | 810CLKE\*\*\* | 814CLKE\*\*\* | 817CLKE\*\*\* | 819CLKE\*\*\* | Clark Profile Model | 0 |
| All | 2 | 0 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 3 | 0 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 3 | 8 | 820CLKE\*\*\* | 824CLKE\*\*\* | 827CLKE\*\*\* | 829CLKE\*\*\* | Clark Profile Model | 0 |
| All | 4 | 0 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 5 | 0 | 810CLKE\*\*\* | 814CLKE\*\*\* | 817CLKE\*\*\* | 819CLKE\*\*\* | Clark Profile Model | 0 |
| All | 6 | 0 | 850CLKE\*\*\* | 854CLKE\*\*\* | 857CLKE\*\*\* | 859CLKE\*\*\* | Clark Profile Model | 0 |
| All | 7 | 0 | 850CLKE\*\*\* | 854CLKE\*\*\* | 857CLKE\*\*\* | 859CLKE\*\*\* | Clark Profile Model | 0 |
| All | 7 | 6 | 870CLKE\*\*\* | 874CLKE\*\*\* | 877CLKE\*\*\* | 879CLKE\*\*\* | Clark Profile Model | 0 |
| All | 7 | 7,17 | 840CLKE\*\*\* | 844CLKE\*\*\* | 847CLKE\*\*\* | 849CLKE\*\*\* | Clark Profile Model | 0 |
| All | 8 | 0 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 9 | 0 | 860CLKE\*\*\* | 864CLKE\*\*\* | 867CLKE\*\*\* | 869CLKE\*\*\* | Clark Profile Model | 0 |
| All | 10 | 0 | 860CLKE\*\*\* | 864CLKE\*\*\* | 867CLKE\*\*\* | 869CLKE\*\*\* | Clark Profile Model | 0 |
| All | 10 | 3 | 810CLKE\*\*\* | 814CLKE\*\*\* | 817CLKE\*\*\* | 819CLKE\*\*\* | Clark Profile Model | 0 |
| All | 10 | 10 | 820CLKE\*\*\* | 824CLKE\*\*\* | 827CLKE\*\*\* | 829CLKE\*\*\* | Clark Profile Model | 0 |
| All | 11 | 0 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 12 | 0 | 820CLKE\*\*\* | 824CLKE\*\*\* | 827CLKE\*\*\* | 829CLKE\*\*\* | Clark Profile Model | 0 |
| All | 12 | 2 | 830CLKE\*\*\* | 834CLKE\*\*\* | 837CLKE\*\*\* | 839CLKE\*\*\* | Clark Profile Model | 0 |
| All | 12 | 5 | 810CLKE\*\*\* | 814CLKE\*\*\* | 817CLKE\*\*\* | 819CLKE\*\*\* | Clark Profile Model | 0 |
| All | 13 | 0 | 850CLKE\*\*\* | 854CLKE\*\*\* | 857CLKE\*\*\* | 859CLKE\*\*\* | Clark Profile Model | 0 |

| **Region 8 Species List for Volume Equation Numbers** | | | |
| --- | --- | --- | --- |
| **Hardwood Species** | | **Softwood Species** | |
| **Species Name** | **Species Code** | **Species Name** | **Species Code** |
| Acacia | 300 | Baldcypress | 221 |
| American beech | 531 | Eastern hemlock | 261 |
| American sycamore | 731 | Eastern white pine | 129 |
| Basswood | 950 | Loblolly pine | 131 |
| Birch | 370 | Longleaf pine | 121 |
| Black cherry | 762 | Pine | 100 |
| Black locust | 901 | Pitch pine | 126 |
| Black maple | 314 | Pond pine | 128 |
| Black oak | 837 | Pondcypress | 222 |
| Black tupelo | 693 | Sand pine | 107 |
| Black walnut | 602 | Shortleaf pine | 110 |
| Blue ash | 546 | Slash pine | 111 |
| Boxelder | 313 | Spruce | 197 |
| Bur oak | 823 | Spruce pine | 115 |
| Butternut | 601 | Table mountain pine | 123 |
| California buckeye | 330 | Virginia pine | 132 |
| Cherrybark oak | 813 |  |  |
| Chestnut oak | 832 |  |  |
| Chinkapin oak | 826 |  |  |
| Common persimmon | 521 |  |  |
| Cucumbertree | 651 |  |  |
| Eastern cottonwood | 742 |  |  |
| Elm | 970 |  |  |
| Green Ash | 544 |  |  |
| Hackberry | 460 |  |  |
| Hawthorn | 500 |  |  |
| Hickory | 400 |  |  |
| Honeylocust | 550 |  |  |
| Lauel oak | 820 |  |  |
| Magnolia | 650 |  |  |
| Northern red oak | 833 |  |  |
| Nuttall oak | 828 |  |  |
| Oak | 800 |  |  |
| Overcup oak | 822 |  |  |
| Pecan | 404 |  |  |
| Pin oak | 830 |  |  |
| Post oak | 835 |  |  |
| Pumpkin ash | 545 |  |  |
| Red maple | 316 |  |  |
| Sassafras | 930 |  |  |
| Scarlet oak | 806 |  |  |
| Shingle oak | 817 |  |  |
| Shumard oak | 834 |  |  |
| Silver maple | 317 |  |  |
| Silverbell | 580 |  |  |
| Sourwood | 711 |  |  |
| Southern magnolia | 652 |  |  |
| Southern red oak | 812 |  |  |
| Sugar maple | 318 |  |  |
| Swamp chestnut oak | 825 |  |  |
| Swamp tupelo | 694 |  |  |
| Swamp white oak | 804 |  |  |
| Sweetbay | 653 |  |  |
| Sweetgum | 611 |  |  |
| Water oak | 827 |  |  |
| Water tupelo | 691 |  |  |
| White ash | 541 |  |  |
| White oak | 802 |  |  |
| Whitethorn acacia | 300 |  |  |
| Willow | 920 |  |  |
| Willow oak | 831 |  |  |
| Yellow popular | 621 |  |  |

## Region 9

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Region 9 Volume Equation Numbers By Species and Forest Number** | | | | |
| **Replace the \*\*\* with the Species Code from the Species Table Below** | | | | |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used by Cruise/FVS** |
| All | ALL | 900CLKE\*\*\* | Region 9 Clark’s Profile Model | 1 |
| All | 2 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 3 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 4 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 5 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 6 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 7 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 8 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 9 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 10 | 901DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table A | 0 |
| All | 11 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 18 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 19 | 903DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table C | 0 |
| All | 20 | 904DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table D | 0 |
| All Hardwoods | 21 | 905DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table E | 0 |
| All Softwoods | 21 | 906DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table F | 0 |
| All | 22 | 904DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table D | 0 |
| All | 24 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 31 | 902DVEE\*\*\* | Gevorkiantz Board Foot Equation – Table B | 0 |
| All | 0 | 911DVEE\*\*\* | Gevorkiantz Cubic Pulpwood Equation | 0 |
| All | 0 | 912DVEE\*\*\* | Gevorkiantz Merchantable Cubic Equation | 0 |
| All | 0 | 921DVEE\*\*\* | Gevorkiantz Cordwood Equation | 0 |

| **Region 9 Species List for Volume Equation Numbers** | | | |
| --- | --- | --- | --- |
| **Hardwood Species** | | **Softwood Species** | |
| **Species Name** | **Species Code** | **Species Name** | **Species Code** |
| American basswood | 951 | Balsam fir | 012 |
| American beech | 531 | Black Spruce | 095 |
| American sycamore | 731 | Eastern hemlock | 261 |
| Balsam poplar | 741 | Eastern redcedar | 068 |
| Black ash | 543 | Eastern white pine | 129 |
| Black cherry | 762 | Jack pine | 105 |
| Black locust | 901 | Loblolly pine | 131 |
| Black oak | 837 | Red pine | 125 |
| Black walnut | 602 | Red spruce | 097 |
| Blackjack oak | 824 | Shortleaf pine | 110 |
| Bur oak | 823 | Tamarack | 071 |
| Butternut | 601 | White spruce | 094 |
| California buckeye | 330 |  |  |
| Cherrybark oak | 813 |  |  |
| Chestnut oak | 832 |  |  |
| Cucumbertree | 651 |  |  |
| Eastern cottonwood | 742 |  |  |
| Elm | 970 |  |  |
| Hackberry | 460 |  |  |
| Hickory | 400 |  |  |
| Northern red oak | 833 |  |  |
| Paper birch | 375 |  |  |
| Pecan | 404 |  |  |
| Pin oak | 830 |  |  |
| Post oak | 835 |  |  |
| Quaking aspen | 746 |  |  |
| Red maple | 316 |  |  |
| River birch | 373 |  |  |
| Scarlet oak | 806 |  |  |
| Sugar maple | 318 |  |  |
| Sweetgum | 611 |  |  |
| White ash | 541 |  |  |
| White oak | 802 |  |  |
| Willow | 920 |  |  |
| Yellow birch | 371 |  |  |
| Yellow popular | 621 |  |  |

## Region 10

| **Region 10 Volume Equation Numbers By Species and Forest Number** | | | | |
| --- | --- | --- | --- | --- |
| **Species Name** | **Forest**  **Number** | **Volume**  **Equation**  **Number** | **Volume Model Name** | **Used By**  **Cruise/FVS**  **1 = Yes** |
| Alaska yellow cedar | 0 | A00FW3W042 | Flewelling Profile Model 3pt | 0 |
| Alaska yellow cedar | 0 | A00F32W042 | Flewelling Profile Model  (32 foot log rule) | 1 |
| Alaska yellow cedar | 0 | A00FW2W042 | Flewelling Profile Model | 0 |
| Alaska yellow cedar | 0 | A61DEMW042 | Demars Profile Model | 0 |
| Alaska yellow cedar | 0 | A32DEMW042 | Demars Profile Model | 0 |
| Alaska yellow cedar | 0 | A02DEMW000 | Demars Profile Model | 0 |
| Alaska yellow cedar | 4 | A01DEMW000 | Demars Profile Model | 0 |
| Alaska yellow cedar | 4 | A16DEMW042 | Demars Profile Model | 0 |
| Alaska yellow cedar | 5 | A00F32W042 | Flewelling Profile Model | 1 |
| Lodgepole pine | 0 | A00F32W260 | Flewelling Profile Model | 1 |
| Lodgepole pine | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Mountain Hemlock | 0 | A00F32W260 | Flewelling Profile Model | 1 |
| Mountain Hemlock | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Other Hardwood | 0 | A00F32W260 | Flewelling Profile Model | 1 |
| Other Hardwood | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Other Softwood | 0 | A00F32W260 | Flewelling Profile Model | 1 |
| Other Softwood | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Pacific silver fir | 0 | A00F32W260 | Flewelling Profile Model | 1 |
| Pacific silver fir | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Red Alder | 0 | A16CURW260 | Curtis Profile Model | 1 |
| Red Alder | 4 | A32CURW000 | Curtis Profile Model (32 foot log rule) | 1 |
| Sitka spruce | 4 | A16DEMW098 | Demars Profile Model | 0 |
| Sitka spruce | 0 | A00F32W098 | Flewelling Profile Model  (32 foot log rule) | 1 |
| Sitka spruce | 0 | A00FW2W098 | Flewelling Profile Model | 0 |
| Sitka spruce (Second Growth) | 0 | A02F32W098 | Flewelling Profile Model  (32 foot log rule) | 1 |
| Sitka spruce (Second Growth) | 0 | A02FW2W098 | Flewelling Profile Model | 0 |
| Sitka spruce | 0 | A02DEMW000 | Demars Profile Model | 0 |
| Sitka spruce | 0 | A32DEMW098 | Demars Profile Model | 0 |
| Sitka spruce | 0 | A61DEMW098 | Demars Profile Model | 0 |
| Sitka spruce | 4 | A01DEMW000 | Demars Profile Model | 1/0 |
| Western hemlock | 4 | A01DEMW000 | Demars Profile Model | 1/0 |
| Western hemlock | 0 | A02DEMW000 | Demars Profile Model | 0 |
| Western hemlock | 0 | A32DEMW098 | Demars Profile Model | 0 |
| Western hemlock | 4 | A16DEMW098 | Demars Profile Model | 0 |
| Western hemlock | 0 | A61DEMW098 | Demars Profile Model | 0 |
| Western hemlock | 0 | A00F32W260 | Flewelling Profile Model  (32 foot log rule) | 1/0 |
| Western hemlock | 0 | A00FW2W260 | Flewelling Profile Model | 1 |
| Western hemlock (Second Growth) | 0 | A02F32W260 | Flewelling Profile Model  (32 foot log rule) | 1/0 |
| Western hemlock (Second Growth) | 0 | A02FW2W260 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | A32DEMW242 | Demars Profile Model | 0 |
| Western redcedar | 4 | A01DEMW000 | Demars Profile Model | 1 |
| Western redcedar | 0 | A02DEMW000 | Demars Profile Model | 0 |
| Western redcedar | 0 | A00FW2W242 | Flewelling Profile Model | 0 |
| Western redcedar | 0 | A00F32W242 | Flewelling Profile Model  (32 foot log rule) | 1 |
| Western redcedar | 0 | A00FW3W242 | Flewelling Profile Model 3pt | 0 |
| Western redcedar | 0 | A61DEMW242 | Demars Profile Model | 0 |
| Western redcedar | 4 | A16DEMW242 | Demars Profile Model | 0 |
| White spruce | 4 | A00DVEW094 | Larson Volume Equation | 1 |
| Paper birch | 4 | A00DVEW375 | Larson Volume Equation | 1/0 |
| Cottonwood | 4 | A00DVEW747 | Larson Volume Equation | 1 |
| White spruce | 4 | A01DVEW094 | Haack & Gregory Volume Equation | 0 |
| Paper birch | 4 | A01DVEW375 | Haack & Gregory Volume Equation | 0 |
| Cottonwood | 4 | A01DVEW747 | Haack & Gregory Volume Equation | 0 |
| White spruce | 4 | A00DVEW108 | Brackett Volume Equation | 0 |
| Paper birch | 4 | A00DVEW310 | Brackett Volume Equation | 0 |
| Cottonwood | 4 | A00DVEW351 | Brackett Volume Equation | 0 |

# Required and Optional Variables by Volume Model.

| **Model Name** | **Required Vairables** | **Optional Variables** | **Volume Types** | **Defaults** | **Equations** |
| --- | --- | --- | --- | --- | --- |
| Behres Hyperbola Profile Model  (Region 6 and BLM) | 6\*\*BEHW\*\*\*:  DBHOB  HTTOT  FCLASS1  (FORST\*)  \*use forest number to find Form Class)  DBTBH (needed to calculate DBHIB, this affect Total Cubic)  MTOPP  B\*\*BEHW\*\*\*:  DBHOB  HTTOT  FCLASS | 6\*\*BEHW\*\*\*:  HT1PRD (This height will only work when HTTOT is not provided)  B\*\*BEHW\*\*\*:  MTOPP | Merch Cubic  Board Foot  Total Cubic (ground to tip) | 6\*\*BEH:  MTOPP=6.0  STUMP=1.0  TRIM=0.3/0.6  MAXLEN=16/32  (32 for 632 EQ)  B\*\*BEH:  MTOPP=0.184\*DBH+2.24  STUMP=1  TRIM=0.3  MAXLEN=16  MINLEN=8  MERCHL=8  EVOD=2  OPT=23 | 616BEHW000  632BEHW000  628BEHW000  Note: 000 can be replaced with species code  B00BEHW011  B00BEHW015  B00BEHW017  B00BEHW021  B00BEHW022  B00BEHW081  B00BEHW093  B00BEHW098  B00BEHW108  B00BEHW116  B00BEHW117  B00BEHW119  B00BEHW122  B00BEHW231  B00BEHW260  B00BEHW263  B00BEHW312  B00BEHW351  B00BEHW361  B00BEHW431  B00BEHW542  B00BEHW631  B00BEHW747  B00BEHW800  B00BEHW998  B01BEHW202  B02BEHW202  B03BEHW202 |
| BIA Behres  Hyperbola equation | DBHOB  HTTOT  FCLASS | MTOPP | Boardfoot | STUMP=1  LOGLEN=16  TRIM=0.3 | I16BEHW000  Note 000 can be any species code |
| BIA Johnson Equation | DBHOB  HTTOT  FCLASS |  | Merch Cubic |  | I00DVEW000  Note 000 can be any species code |
| Brackett Volume Equation  (Region 10) | DBHOB  HTTOT | None | Total Cubic  Merch Cubic  Board Foot  Topwood | STUMP=1  MTOPP=6/8(hard/soft)  MTOPS=4 | TARIF Equation |
| Bruce Profile Model  (Region 10) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD | Total Cubic Merch Cubic  Board Foot (01 = 16 FT, 02 = 32 Ft)  Topwood |  | A01BRUW042  A01BRUW098  A01BRUW242  A01BRUW351  A02BRUW042  A02BRUW098  A02BRUW242  A02BRUW351 |
| Byrne Equation  (Region 1) | FORST  DBHOB  HTTOT  MTOPP | None | Total Cubic Merch Cubic  Board Foot  Topwood | none | 100JB2W017  100JB2W070  100JB2W073  100JB2W108  100JB2W119  100JB2W122  100JB2W202 |
| Chojnacky Equation  (Regions 2, 3, 4) | DBHOB/DRCOB  HTTOT | FCLASS:  0 = multi-stem model (default)  1 = single stem model | Total Cubic  Merch Cubic |  | 200DVEW065  200DVEW066  200DVEW069  200DVEW106  300DVEW060  301DVEW060  302DVEW060  301DVEW106  302DVEW106  400DVEW064  400DVEW066  400DVEW065  401DVEW065  402DVEW065  403DVEW065  400DVEW133  400DVEW106  400DVEW475  400DVEW998 |
| Clark Profile Model  (Region 8) | DBHOB  FORST  HTTOT  HT1PRD2  HT2PRD 2 |  | Total Cubic  Merch Cubic  Topwood | MTOPP=7/9 (DOB)  MTOPS=4 (DOB)  STMUP=0.5/1 | Listed in Table: R8 Clark Equations |
| Clark Profile Model  (Region 9) | DBHOB  HTTOT /  HT1PRD/HT2PRD2 | UPSHT1 2 | Total Cubic  Merch Cubic  Topwood  Boardfoot | MTOPP=7.6/9.6  MTOPS=4  TRIM=0.3  MAXLEN=8  MINLEN=4  STUMP=0.5/1 | Listed in R9 Clark and DVE equations |
| Curtis Profile Model  (Region 10) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD | Total Cubic  Merch Cubic  Board Foot  Topwood |  |  |
| Czaplewski Profile Model  (Region 2) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD  HT2PRD | Total Cubic Merch Cubic  Board Foot  Topwood  Cords | MTOPP=6  MTOPS=4  STUMP=1  TRIM=0.5  MAXLEN=16  MINLEN=2  MINLENT=2  OPT=22 | 200CZ2W015  200CZ2W019  200CZ2W093  200CZ2W108  200CZ2W122  200CZ2W202  200CZ2W746  203CZ2W122 |
| Czaplewski Profile Model 3pt  (Region 2) | REGN  DBHOB  HTTOT  MTOPP  UPSD1 + UPSHT1 | DBTBH  HT1PRD  HT2PRD | Total Cubic Merch Cubic  Board Foot  Topwood  Cords | MTOPP=6  MTOPS=4  STUMP=1  TRIM=0.5  MAXLEN=16  MINLEN=2  MINLENT=2  OPT=22 | 200CZ3W015  200CZ3W019  200CZ3W093  200CZ3W108  200CZ3W122  200CZ3W202  200CZ3W746  203CZ3W122 |
| Demars Profile Model  (Region 10) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD | Total Cubic MerchCubic  Board Foot  Topwood | MTOPP=6  MTOPS=4  STUMP=1  MAXLEN=16/32  MINLEN=8  MINLT=8  TRIM=0.5  OPT=23  EVOD=2 | A16DEMW042  A16DEMW098  A16DEMW242  A16DEMW351  A32DEMW042  A32DEMW098  A32DEMW242  A32DEMW351  A01DEMW000  A02DEMW000 |
| Direct Volume Equation  (Region 6) | DBHOB  HTTOT | None | Board Foot | none | 601DVEW205  601DVEW263  601DVEW015  602DVEW204  602DVEW015  602DVEW108  600DVEW122 |
| Eager Mill Study Equation  &  Hann and Bare Equation  (Region 3) | DBHOB/DRCOB  HTTOT  /HT1PRD | None | Total Cubic  MerchCubic  Board Foot | MTOPP=6  MTOPS=4 | 300DVEW122  301DVEW202  302DVEW202  301DVEW015  302DVEW015  300DVEW093  300DVEW113  300DVEW746  -pulpwood only  300DVEW060  300DVEW106  300DVEW310  300DVEW800  300DVEW999  300DVEW314 |
| Edminster Equation  (Region 1) | DBHOB  HTTOT | None | Merch Cubic |  |  |
| Edminster Equation  &  Myers Equation  (Region 2) | DBHOB/DRCOB  HTTOT | FCLASS  (=0 for multistems, =1 for single stem) | Total Cubic  MerchCubic  Board Foot | MTOPP=6 (8 for black hill PP)  MTOPS=4  STUMP=1 | 200DVEW746  200DVEW108  203DVEW122  200DVEW122  212DVEW122  200DVEW093  200DVEW069  200DVEW066  200DVEW065  200DVEW814  200DVEW823  200DVEW106  200DVEW475  200DVEW998  -total cubic only  210DVEW746  210DVEW108  210DVEW122  213DVEW122  210DVEW093 |
| Flewelling Profile Model  (Region 1, 2, 4, 6, 10) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD  UPSHT1  DBTBH  BTR | Total Cubic MerchCubic  Board Foot  Topwood  Cords | MTOPP=6 (R1=5.6, R6=2, R7=anint((0.184\*DBHOB)+2.24))  MTOPS=4  STUMP=1 (R6=0)  TRIM=0.5  MAXLEN=16  MINLEN=2  EVOD=2  OPT=22(R6/7/10=23)  MINLENT=2(R10=8) | Listed in Fleweling profile equations table (FW2) |
| Flewelling Profile Model 3pt  (Region 1, 2, 4, 6, 10) | REGN  DBHOB  HTTOT  MTOPP  AVGZ1 + HTREF  or  AVGZ1 +  UPSHT1  or  UPSD1 + UPSHT1  or  UPSD1 +  HTREF | HT1PRD  HT2PRD  DBTBH  BTR | Total Cubic Merch Cubic  Board Foot  Topwood  Cords |  | Listed in Fleweling profile equations table (FW3 and F3) |
| Gevorkiantz Equation  (Region 9) | REGN  DBHOB  HT1PRD2  HT2PRD2 | Total Height  Site Index  Basal Area | Merch Cubic  Board Foot  Topwood  Cords |  | Listed in table: R9 DVE equations |
| Haack and Gregory Volume Equation  &  Larson Volume Equation  (Region 10) | DBHOB  HTTOT | None | Total Cubic  Merch Cubic  Board Foot | none | A00DVEW094  A00DVEW095  A01DVEW094  A01DVEW095  A00DVEW375  A00DVEW746  A00DVEW920  A01DVEW375  A01DVEW746  A01DVEW920  A00DVEW747  A01DEVW747  A00DVEW108  A00DVEW310  A00DVEW351  A00DVEW660 |
| Hahn (NC-250) Equation (Region 9) | DBHOB  HTTOT | HT1PRD  HT2PRD  MTOPP  MTOPS  SI  BA | Total Cubic  Merch Cubic  Board Foot | MTOPP = 7 (soft)/9(hard)  MTOPS = 4  SI = 60  BA = 90 | 925DVEE\*\*\*  Species List:  12,68,71,94,95,  105,125,129,132,  241,261,299,313,  314,316,317,318,  371,373,375,400,  460,531,541,543,  544,601,602,611,  621,694,731,741,  742,743,746,762,  802,806,812,830,  833,834,837,920,  951,970,998,999 |
| Hann & Bare (BIA) | DBHOB  HTTOT | MTOPP | Total Cubic  Merch Cubic  Board Foot |  | blackjack  301HAB0122  302HAB0122  Yellow pine  300HAB1122 |
| Honer Equation (Canada, used by BIA) | DBHOB  HTTOT  MTOPP | MTOPS | Total cubic  Merch Cubic  Boardfoot |  | C00DVEE\*\*\*  Species List:  12,71,94,95,97,105,  125,129, 241,261,  315,316,317,318,  330, 371,375,379,  531,541,543,742,  743,746,762,833,  951,990,999 |
| Kemp Equation  (Region 1) | DBHOB  HTTOT | Live\_Dead  Prod | Merch Cubic  Board Foot | STUMP=1  MAXLEN=16  TRIM=0.5 | 101DVEW119  101DVEW073  101DVEW202  101DVEW017  101DVEW263  101DVEW242  101DVEW108  101DVEW093  101DVEW019  101DVEW122  101DVEW999  101DVEW375  101DVEW740  102DVEW746  102DVEW740  102DVEW017  102DVEW019  102DVEW070  102DVEW073  102DVEW090  102DVEW093  102DVEW101  102DVEW108  102DVEW119  102DVEW122  102DVEW202  102DVEW240  102DVEW242  102DVEW260  102DVEW263  102DVEW060  102DVEW106  103DVEW101  103DVEW108  103DVEW122  103DVEW202  104DVEW108  104DVEW122  105DVEW122  106DVEW122 |
| Lasher Equations – Bdft  (Region 8) | DBHOB  FORST  HT1PRD2  HTREF2 | Total Height  Site Index  Basal Area | Merch Cubic  Board Foot |  | Listed in R8 Clark and DVE equations |
| Malone, T. et al. (Region 10) | DBHOB, HTTOT | MTOPP | Total cubic  Merch cubic to 2, 4, 6 inch top |  | A02DVEW094 |
| Pillsbury and Kirkley Equation  (Region 5) | DBHOB  HTTOT  MTOPP | None | Total Cubic  Merch Cubic  Board Foot |  | 500DVEW060  500DVEW351  500DVEW312  500DVEW818  500DVEW807  500DVEW805  500DVEW431  500DVEW801  500DVEW839  500DVEW981  500DVEW361  500DVEW815  500DVEW631  500DVEW821  500DVEW212  500DVEW811 |
| PNW Tariff Equation  (Region 5, 6) | DBHOB  HTTOT  MTOPP | None | Total Cubic Merch Cubic  Board Foot |  | 500TRFW475  500TRFW312  500TRFW351  500TRFW361  500TRFW431  500TRFW631  500TRFW801  500TRFW805  500TRFW807  500TRFW811  500TRFW815  500TRFW818  500TRFW821  500TRFW839  500TRFW981  500TRFW015  500TRFW021  500TRFW060  500TRFW081  500TRFW108  500TRFW117  500TRFW122  500TRFW202   |  | | --- | | 616TRFW122 | | 616TRFW263 | | 616TRFW019 | | 616TRFW011 | | 616TRFW094 | | 616TRFW098 | | 616TRFW108 | | 616TRFW264 | | 616TRFW073 | | 616TRFW211 | | 616TRFW351 | | 616TRFW746 | | 616TRFW747 | | 616TRFW998 | | 616TRFW202 | | 616TRFW242 | | 632TRFW122 | | 632TRFW263 | | 632TRFW019 | | 632TRFW011 | | 632TRFW094 | | 632TRFW098 | | 632TRFW108 | | 632TRFW264 | | 632TRFW073 | | 632TRFW211 | | 632TRFW351 | | 632TRFW746 | | 632TRFW747 | | 632TRFW998 | | 632TRFW202 | | 632TRFW242 | |
| Rustagi Profile Model  (Region 4) | REGN  DBHOB  HTTOT  MTOPP | HT1PRD | Total Cubic Merch Cubic  Board Foot  Topwood(actually Tip)  Cords | STUMP=1  TRIM=0.5  MTOPP=6  MTOPS=1  MAXLEN=16 | 400MATW746  400MATW202  405MATW202  401MATW202  400MATW019  405MATW019  400MATW015  401MATW015  400MATW081  400MATW073  400MATW122  401MATW122  402MATW122  403MATW122  400MATW108  401MATW108  400MATW093  407MATW093  400MATW020  400MATW117 |
| Sharpnack Profile Model  (Region 5) | DBHOB  HT1PRD  FCLASS  MTOPP | None | Total Cubic  Merch Cubic  Board Foot | MAXLEN=8  TRIM=0.15 | H00SN2W301  H00SN2W510  H00SN2W671  H01SN2W510 |
| Wensel and Olsen Profile Model  (Region 5) | DBHOB  HTTOT | HT1PRD  HT2PRD  MTOPP  MTOPS | Total Cubic Merch Cubic  Board Foot  Topwood  Cords | MTOPP=6  MTOPS=4  STUMP=1  MAXLEN=16  MINLEN=2  MINLENT=2  TRIM=0.5  OPT=22 | 500WO2W015  500WO2W020  500WO2W081  500WO2W108  500WO2W116  500WO2W117  500WO2W122  500WO2W202  500WO2W211 |
| Westfall NSVB Equation  (Nation wide) | DBHOB  HTTOT | BRKHT  BRKHTD  CR  CULL  DECAYCD | Total Cubic Merch Cubic  Board Foot  Topwood  Stump  Dry biomass  Green biomass |  | NVB####\*\*\*  (#### = EcoRegion DIVISION code  \*\*\* = FIA species code) |

1 These variables will be estimated if left blank or set to zero.

2  These variables will be estimated from total height if left blank or set to zero.

# EXCEL ADDINS FUNCTIONS

## INTRODUCTION

The Volume Estimator Library is a collection of volume estimators in use by the Forest Management group of the USDA Forest Service. This library contains not only the currently used estimators, but also some estimators that were used historically and have been retired. It is not, however, the complete list of all of the volume estimators in use by all the functionaries of the Forest Service. The Volume Estimator Library, as presented in these functions, supports the National Cruise Program, the Forest Vegetation Simulator (FVS), and the Field Sampled Vegetation (FSVeg) group.

Due to the complexity and rigorous implementation process of many of the volume estimators, they cannot be easily added to a spreadsheet or simple program designed to calculate the volume of one or more trees. To help make the volume estimator library more accessible, the code was compiled into a Dynamic Link Library (DLL) which can be utilized in many different programs and functions without the programmer having to maintain the code directly. This also allows for the volume estimator library (written and maintained in FORTRAN) to be called by programs written in C, C++, and Visual Basic.

Using this volume estimator library DLL, a series of Excel Functions were developed using the Visual Basic language. Once these functions are linked into an Excel spreadsheet, they can be used to calculate the volumes of individual trees.

Due to the number of possible data input variables that are available across all the Regions, two different sets of Excel functions were developed: one using just the minimum data requirements and one containing the list of all available input variables, many of which are optional or used only for specific volume estimators.

Although these routines have been thoroughly tested, much of the error checking for missing or invalid data input has been historically done outside of the volume estimator library, either through the National Cruise Program, FVS, or other programs that call the volume library. Although some error checking has been incorporated into the volume estimator library, there is still a chance for the Excel functions to produce an error based on some specific combination of data input that will cause the program to crash. If you receive such an error, please fill out the Error Report document and email it to [yingfang.wang@usda.gov](mailto:yingfang.wang@usda.gov) so the error can be corrected.

## SETUP

***Warning:*** *When installing the Excel Volume Functions version 2022.12.01, the old version of Excel Volume Functions needs to be removed first. To remove the old version, first open Excel program, click on File. At the bottom of the newly displayed form, click the ‘Options’ button. From the next form, select the ‘Add-Ins’ option from the list displayed on the lefthand side.  Click the ‘Go…’ button at the bottom of the form. If the Add-ins list has Forest Service Tree Volume Calculations and Forest Service Advanced Tree Volume Calculations, uncheck the check boxes and then click OK button. Close Excel program. Then click on Windows -> Settings, from Apps to find the Excel Volume Functions to uninstall.*

Before the Excel volume functions can be used, they need to be ‘added’ into the Excel function library. This involves three simple steps.

Step 1: For Forest Service computers, go to Software Center and search Excel Volume Functions. For non-Forest Service computers, download the following files from the Forest Management Service Center web page (<https://www.fs.usda.gov/forestmanagement/products/measurement/volume/nvel/index.php>):

‘Excel (64-bit) Volume Functions’ or ‘Excel (32-bit) Volume Functions’

Step 2: Install the functions by running the program (**you will need admin privileges to install the functions)**:

The installation process will copy the files FSVolume.xla, FSVolumeAdv.xla, and VolLib.lib into the following directory C:\fsapps\FMSC Software\Excel Functions

Additional files (VolLib.dll) will be copied into your Windows system directory.

C:\Windows\System32 for 64-bit Excel or C:\Windows\SysWOW64 for 32-bit Excel

Step 3: Run the Excel program.

Open Excel program, click on File.  At the bottom of the newly displayed form, click the ‘Options’ button. From the next form, select the ‘Add-Ins’ option from the list displayed on the lefthand side.  Click the ‘Go…’ button at the bottom of the form.  From the next form, click on the Browse button to navigate to C:\fsapps\FMSC Software\Excel Functions to select FSVolume.xla and FSVolumeAdv.xla one by one. Click OK to add in the functions. Make sure the box next to the functions called Forest Service Tree Volume Calculations and Forest Service Advanced Tree Volume Calculations are checked.

You are now ready to use the volume library Excel functions.

## USING THE FUNCTIONS

Using the volume library functions in Excel is no different than using any Excel functions. You can type in the name of the function, use the Insert Function icon from the toolbar, or select *Insert | Function* from the main menu. If you use either of the Insert Function options, you will need to select *User Defined* from the category pull-down list.

As with other Excel functions, the input variables can be entered directly or can be references to cell locations that contain the data. For example, DBH can be entered as 11.5 or can be a cell reference, say C2, containing the value 11.5.

## Available Functions

There are seventeen separate functions available within each set. Some functions are designed to return a specific volume for the tree, some will return information based on profile models (height to a specific diameter or diameter to a specific height), others will return log level information (log lengths or log end diameters). There are also functions to return a full description of any error code that might be returned by a volume function, return the default volume equation number given species, region, and forest numbers, and the current version number of the Volume Library DLL.

The functions for biomass with name start with calcWt…or getWt… for advanced function.

*calcTotCubic(…)* & *getTotCubicAdv(…)* Functions

These two functions will calculate the total cubic volume of the main stem of a tree from ground to tip. This volume is calculated for trees of all sizes. However, not every volume equation has the ability to calculate this volume.

*calcBdft(…)* & *getBdftAdv(…)* Functions

These functions will calculate the volume of the merchantable portion of the tree in terms of board feet. For the most part, this is in terms of Scribner’s log rule. However, there are some volume equations that do not calculate a Scribner’s board foot volume, so an International ¼ inch log rule will be returned. This volume is returned for sawtimber sized trees only.

*calcBdft(…)* & *getBdftAdv(…)* Functions

These functions will calculate the volume of the merchantable portion of the tree in terms of International ¼ inch log rule board feet. This volume is returned for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

*calcMerchCubic(…)* & *getMerchCubicAdv(…)* Functions

These functions will calculate the merchantable cubic foot volume of the tree. This volume is calculated for both sawtimber and non-sawtimber sized trees.

*calcCords(…)* & *getCordsAdv(…)* Functions

These functions will calculate the volume of the merchantable portion of the tree in terms of cords. The number of cords does take into account bark and airspace existing in a stack of logs 4 feet deep by 4 feet high by 8 feet long. Not every volume equation has the ability to calculate this volume.

*calcCubicTW(…)* & g*etCubicTWAdv(…)* Functions

These functions will calculate the volume of the topwood, or the volume between the merchantable top diameter in a sawtimber sized tree to some secondary top diameter in terms of cubic feet. This is volume not acceptable by sawtimber standards, but can be utilized to make other products. This volume is calculated for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

*calcCordTW(…)* & *getCordTWAdv(…)* Functions

These functions also calculate the volume of the topwood, or the volume between the merchantable top diameter in a sawtimber sized tree to some secondary top diameter, but in terms of cords. This is volume not acceptable by sawtimber standards, but can be utilized to make other products. The number of cords does take into account bark and airspace existing in a stack of logs 4 feet deep by 4 feet high by 8 feet long. This volume is calculated for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

*calcLogVolCubic(…) & getLogVolCubicAdv(…)* Functions

These functions will return the cubic foot volume of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log. The sum of all log volumes should equal the merchantable cubic foot volume for the tree.

*calcLogVolBdft(…) & getLogVolBdftAdv(…)* Functions

These functions will return the board foot volume of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log. The sum of all log volumes should equal the merchantable cubic foot volume for the tree.

*calcLogLength(…) & getLogLengthAdv(…)* Functions

These functions will return the estimated length of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log.

*calcLogDiam(…) & getLogDiamAdv(…)* Functions

These functions will return the estimated inside diameter of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log.

*calcLogScalingDiam(…) & getLogScalingDiamAdv(…)* Functions

These functions will return the estimated scaling diameter of a single log, assuming a profile model has been selected. The scaling diameter is the diameter used in the calculation of the volume for the log. The last parameter of the function is the number of the log, with log one being the butt log.

*calcXHt(…) & getXHt*  Functions

These functions will return a height from the ground to the specified top diameter. This function will only work for profile models. If the function cannot return a height to the top diameter, a height of zero will be returned.

*calcDib(…)* & *calcDob(...) & getDibAdv(…) & getDobAdv(…)* Functions

These functions will return a diameter at a specific height. This functions will only work with profile models. Not all profile models can return a diameter outside bark (calcDob). If the function can not return a diameter to the specified height, a diameter of zero will be returned.

*ErrorMessages(…)* Function

This function will take an error message produced by the volume function and display a text message describing the error message.

*VersionNumber()* Function

This function will return the version number for the volume library DLL you are using.

*VolumeEquationNumber()* Function

This function will return the volume equation number used by the Forest Service given information like the species code, region number, and forest number.

*calcBiomassFromBioEq()* Functions

This function will return the dry and green biomass for the selected biomass equation. The convertion from dry to green or from green to dry is using the moisture content from Miles and Smith (2009).

*calcFiaVol() & getAdvFiaVol ()* Functions

These functions will return volume for the selected volume equation. The volume equation can be FIA volume equation number (such as CU\*\*\*\*\*\* or BD\*\*\*\*\*\*) or NVEL equation number. If using FIA volume equation number, the input for VolType is not required. However if using NVEL equation number, the input for VolType will be required.

*getFiaVolType ()* Function

This function will return the volume type for the selected volume equation. The volume type can be CV4, CVT, SV\*, IV\*, etc.

*getNSVB\_Eq ()* Function

This function will return the default NSVB equation for a given information like species code, region number, forest number and ranger district number.

*calcWtAGB() & getWtAGB()* Functions

These functions will return dry and green biomass for above ground total without foliage.

*calcWtTotStem()*  Functions

These functions will return dry and green biomass for total stem wood and bark.

*calcWtTotStemWood() & getWtTotStemWood ()* Functions

These functions will return dry and green biomass for total stem wood.

*calcWtTotStemBark() & getWtTotStemBark ()* Functions

These functions will return dry and green biomass for total stem bark.

*calcWtMerchStem()* Functions

These functions will return dry and green biomass for merchantable stem wood and bark from stump to merchantable top.

*calcWtMerchStemWood() & getWtMerchStemWood ()* Functions

These functions will return dry and green biomass for merchantable stem wood from stump to merchantable top.

*calcWtMerchStemBark() & getWtMerchStemBark()* Functions

These functions will return dry and green biomass for merchantable stem bark from stump to merchantable top.

*calcWtTW()*  Functions

These functions will return dry and green biomass for topwood wood and bark from primary top diameter to secondary top diameter.

*calcWtTWwood() & getWtTWwood()* Functions

These functions will return dry and green biomass for topwood wood from primary top diameter to secondary top diameter.

*calcWtTWbark() & getWtTWbark()* Functions

These functions will return dry and green biomass for topwood bark from primary top diameter to secondary top diameter.

*calcWtTip()* Functions

These functions will return dry and green biomass for tip wood and bark (from secondary top diameter to tip).

*calcWtTipWood() & getWtTipWood()* Functions

These functions will return dry and green biomass for tip wood (from secondary top diameter to tip).

*calcWtTipBark() & getWtTipBark()* Functions

These functions will return dry and green biomass for tip bark (from secondary top diameter to tip).

*calcWtBranch() & getWtBranch()* Functions

These functions will return dry and green biomass for branches wood and bark.

*calcWtFoliage() & getWtFoliage()* Functions

These functions will return dry and green biomass for foliage.

*calcWtStump()* Functions

These functions will return dry and green biomass for stump wood and bark

*calcWtStumpWood() & getWtStumpWood()* Functions

These functions will return dry and green biomass for stump wood

*calcWtStumpBark() & getWtStumpBark()* Functions

These functions will return dry and green biomass for stump bark.

*calcWtTopLimb() & getWtTopLimb()* Functions

These functions will return dry and green biomass for branches and stem tip.

*calcCarbonContent() & getCarbonContent()* Functions

These functions will return carbon content for above ground total (without foliage).

## Variables for the Basic Functions (calc…)

Each of the basic volume functions has a short list of required variables. These variables can be entered as values or as references to a cell that contains the value. The variable names and descriptions are listed below.

Region = Forest Service Region number (see Appendix: Region and Forest Numbers).

Forest = Forest Service Forest number (see Appendix: Region and Forest Numbers).

District = Forest Service District number (when in doubt, use 01).

VolEquNum = Volume Equation Number (see Volume Equation Numbers).

Dbh = Diameter at Breast Height (4.5 feet from the ground).

TotalHt = Total tree height measured from the ground to the tip.

TopDia = Minimum top diameter for calculating the main stem volume. Some volume equations use a set minimum top diameter that cannot be changed.

TopDiaTW = Minimum top diameter for calculating the topwood (or secondary) volume in a tree. Some volume equations use a set minimum top diameter for topwood that cannot be changed.

Height = Height to a point up the stem. Used by the *calcDib* and *calcDob* functions.

LogNum = The log number to display. Must be a value between 1 and 20. Used by the functions *calcLogVolCubic*, *calcLogVolBdft*, *calcLogDiam*, *calcLogScalingDiam*, and *calcLogLength*.

Product = Product code for the tree.

01 = Sawtimber tree

02 = Non-sawtimber tree or pulpwood

SpeciesCode = Three digit species code (see Appendix: Species Codes).

SPCD\_or\_NVBEQ = Three digit species code or NSVB equation number.

CalcType = Calculation type for volume. Valid type includes FVS, Cruise and FIA. The default is FVS.

## Variables for the Advanced Functions (get…Adv)

Each of the advanced volume functions has a list of input variables. Some of these variables are optional variables that can be set to a value or set to zero if no data is available. Note: All variables must have data (a zero or actual data). You may not leave a variable blank. This will cause the function to fail. The variable names and descriptions are listed below.

Region = Forest Service Region number (see Appendix: Region and Forest Numbers).

Forest = Forest Service Forest number (see Appendix: Region and Forest Numbers).

VolEquNum = Volume Equation Number (see Volume Equation Numbers).

Dbh = Diameter at Breast Height (4.5 feet from the ground).

TotalHt = Total tree height measured from the ground to the tip.

TopDia = Minimum top diameter for calculating the main stem volume. Some volume equations use a set minimum top diameter that cannot be changed.

TopDiaTW = Minimum top diameter for calculating the topwood (or secondary) volume in a tree. Some volume equations use a set minimum top diameter for topwood that cannot be changed.

MerchHt = The height in either feet or number of logs to the merchantable top diameter. This is useful if you have a tree with a broken top. If you enter the merchantable height in terms of logs, you will need to put an ‘L’ in the LogOrFeet variable. For more information on using the MerchHt field, see the section ‘Height Combinations’ below.

MerchHtTW = The height in either feet or number of logs to the topwood merchantable top diameter. This is measured from the stump and not from the sawtimber merchantable height point. If you enter the merchantable height in terms of logs, you will need to put an ‘L’ in the LogOrFeet variable. For more information on using the MerchHtTW field, see the section ‘Height Combinations’ below.

FormClass = Girard’s Form Class variable. This is defined as the diameter at the top of the first log expressed as a percentage of Dbh. This variable is only used when using a Behre’s hyperbola volume equation.

Product = Product code for the tree.

01 = Sawtimber tree

02 = Non-sawtimber tree or pulpwood

DblBarkBH = Double Bark Thickness at Breast Height.

BarkRatio = Bark thickness ratio. This is the inside bark to outside bark ratio at breast height. This is defined as the diameter inside bark at breast height divided by Dbh multiplied by 100.

LogOrFeet = This is a flag that tells the volume library if the MerchHt and MerchHtTW variables are measured in feet or logs. An ‘L’ indicates the merchantable height(s) are in terms of logs while an ‘F’ or blank indicates the merchantable height(s) are in feet.

LogLength = If the merchantable height is measured in logs, this variable tells the volume library the length of those logs. If left blank, the program defaults to 16 foot logs for the Western Regions and 8 foot logs for the Eastern Regions.

UpStemHt = The height up the stem where an upper stem diameter (UpStemDia) was measured. Part of a Height/Diameter pair required for multi-point profile modelsor can be used in conjunction with an Average Z-Score (AvgZ) variable. This variable is also used by Clark’s profile model to be the height up the stem to a 4, 7, or 9 inch diameter, depending on the volume equation used.

UpStemDia = An upper stem diameter measured at a point identified by the upper stem height variable (UpStemHt). Part of a Height/Diameter pair required for multi-point profile models.

AvgZ = Flewelling’s Average Z-Score variable. This is a standardized variable used to adjust the profile predicted by a Flewelling 2-point profile model. This variable requires either an upper stem height (UpStemHt) or reference height (RefHt) be given so the profile model knows where to apply the adjustment.

RefHt = The Reference Height variable has two uses based on the volume equation used. The first is in conjunction with a Flewelling’s Average Z-Score (AvgZ) variable. It is the height up the stem where the AvgZ variable is to be applied expressed as a percent of total height. The second is with the board foot model for ponderosa pine in Region 3 where the RefHt is the Height to the First Live Limb.

BasalArea = The basal area of the stand from where the tree came. This is used when a merchantable height is predicted for the Eastern Regions. If left blank, the program will use a default value. This variable is not need if a merchantable height (MerchHt) is input.

SiteIndex = The Site Index of the stand from where the tree came. This variable is also used when merchantable height is predicted for the Eastern Regions. If left blank, the program will calculate a default value based on Region, Forest, and species. This variable is not need if a merchantable height (MerchHt) is input.

Height = Height to a point up the stem. Used by the *getDibAdv* and *getDobAdv* functions.

LogNum = The log number to display. Must be a value between 1 and 20. Used by the functions *getLogVolCubic*, *getLogVolBdft*, *getLogDiam*, *getLogScalingDiam*, and *getLogLength*.

BrokenHt = Height to broken top or missing top

BrokenHtDia = Diameter at broken height

CR = Crown ratio (%)

CULL = The percent of the cubic-foot volume in a live or dead tree that is rotten or missing

DECAYCD = A code indicating the stage of decay in a standing dead tree

For more information about when an optional variable is used, see Appendix C, Variables Required for Volume Equations.

## Determining Merchantable Volumes

Profile models are being implemented as volume estimators, replacing direct volume estimators, because of the flexibility that comes with using profile models. There are several ways to define the merchantable volume in a tree when using profile models. These methods are tied to specific combinations of heights and top diameter. The following is a complete list of these heights and top diameters and the types of volumes returned.

For the Behre, Bruce, Czaplewski, DeMars, Flewelling, Rastigi & Loveless, and Wensel & Olsen profile models:

* Dbh and total height is required for total cubic volume.
* Dbh, total height, and a minimum top diameter can be used to determine the merchantable volume in cubic or board feet. The merchantable length is determined by the profile model.
* Dbh, total height, minimum top diameter, and minimum top diameter for topwood can be used to determine the merchantable volume of the main stem in cords, cubic or board feet and the merchantable volume of top wood in cords or cubic feet. The merchantable lengths are determined by the profile model.
* Dbh, total height and merchantable height (in feet) can be used to determine the merchantable volume of a tree to a certain height. The minimum top diameter is determined by the profile model.

Additonally, for Behre, Bruce, Czaplewski, DeMars, Flewelling, and Wensel & Olsen profile models:

* Total height, merchantable height (in feet), and merchantable height of topwood (in feet) can be used to determine the volume of the merchantable piece and the volume of the topwood piece. The minimum top diameters are determined by the profile model.

Additionally, for Behre, Bruce, DeMars, and Flewelling profile models,:

* Dbh, merchantable height (feet or logs), and a minimum top diameter can be used to determine the volume of trees with broken tops. Total tree height is estimated using the profile model. No topwood volume is assumed.

For Clark’s profile model, the following applies:

* Dbh and total height can be used to determine the volume of a tree to a 4 inch top diameter.
* Dbh and an upper stem height can be used to determine the merchantable volume to a 4 inch top (for product ‘02’ trees) or a merchantable volume to a 7 or 9 inch top (softwood or hardwood species respectively).
* Dbh, upper stem height, and merchantable height can be used to determine the volume to the height given as merchantable height assuming the upper stem height is the height to the 4, 7, or 9 inch top and the merchantable height is less then or equal to the upper stem height.

## Estimated Variables

Several of the volume estimators require one or more additional input variables then what is provided in the Basic Functions. To keep these functions simple, additional routines were added to the volume library for estimating these additional values. These routines were currently being used within the FVS program and were incorporated into the volume library to promote consistency between the FVS volumes and volumes produced by these Excel functions as well as simplify the Basic Functions input list of variables.

The volume estimators requiring additional variables and a description of the estimated variables are listed below.

Region 6: Behre’s Hyperbola. This volume estimator requires a Girard Form Class, or the diameter at the top of the first log expressed as a percent of Dbh. The volume library will estimate an average form class value based on Forest number, species, and Dbh.

Region 8: Clark Profile Model. For sawtimber sized trees, the Clark profile model requires a merchantable height measured to either a 9 inch (for hardwoods) or a 7 inch (softwood) top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

Region 8: Lasher Equations. The Lasher equations require a merchantable height measured to either a 4 inch (pulpwood trees), 9 inch (hardwoods sawtimber) or a 7 inch (softwood sawtimber) top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

Region 9: Gevorkiantz Equation. The requires Gevorkiantz equations require a merchantable height, measured in number of 8 foot logs, to the minimum top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

## ERROR MESSAGES

If the volume library function is unable to calculate the volume for a tree, and error message is returned. This might be due to incorrect data entry or a function of the tree size. Anytime an error message is returned, the volume is assumed to be zero. The error messages and their meanings are listed below.

#VOLEQ! = No volume equation match.

The volume equation number entered does not match any in the volume estimator library. Double check the equation number.

#FORMCL = No form class (FormClass)

Form class was not entered and the volume library was unable to estimate one.

#DBH<1! = DBH less than one

No volume can be computed for trees with a Dbh of less then one.

#HT<4.5! = Tree height less than 4.5

A tree with a height less then 4.5 has no Dbh by definition. No volume will be computed for trees with a height of less then 4.5 feet.

#D2H! = Dbh squared times total height is out of bounds

The value Dbh squared times total height is not valid. Check your values for Dbh and Total Height.

#SPECIES! = No Species match (last three digits of the Volume Equation Number)

The species code (the last three digits of the volume equation number) is sometimes used to determine other variables, such as form class or merchantable height. If the species code is not matched in the routine, this error will be returned. Check the volume equation number list for a species that can be used as a surrogate for the species entered.

#MERCH\_HT! = Illegal primary product log height (MerchHT & LogOrFeet = L)

There are two possible reasons for this error. Some Regions require the merchantable height entered as logs to be recorded in 10s of logs. For example, a 3 log tree would be input as 30 logs. If a tree had 4 ½ logs, it should be input as 45 logs. Check the volume equation list to determine which form the volume equation takes.

The other reason is the volume equation requires a merchantable height to be entered as number of 8 foot logs and not in feet.

#MERCH\_HTTW! = Illegal secondary product log height(MerchHT & LogOrFeet = L)

The volume equation requires the merchantable height to the top of the Topwood portion of the tree to be entered as number of 8 foot logs and not measured in feet.

#STEMDIA! = Upper stem measurement required (UpStemDia & UpStemHt)

The volume equation used is a three point model and requires an upper stem diameter (UpStemDia) and upper stem height (UpStemHt) be entered. This also means the volume equation requires the user to use the Advanced volume functions.

#STEMHT! = Illegal upper stem height value (UpStemHt > TotalHt or UpStemHt < 4.5)

For multi-point profile models where an upper stem height (UpStemHt) is given, the height needs to be greater then 4.5 and less then the total height of the tree.

#MERCH\_ERR! = Unable to fit profile given dbh, merch ht and top dia.

This error is returned on trees where a merchantable height is entered with no total height, and the profile model is unable to fit a total tree height to the measurement. This can happen on large diameter trees that have broken off fairly low to the ground.

# Use of VolLib.Dll

The National Volume Estimator Library DLL is a FORTRAN DLL compiled using Intel Visual Fortran. There are 32-bit and 64-bit DLL compiled The following files are the volume library files:

vollib.lib

vollib.dll

## C++ access to the volume library

Additionally, the following files are provided to aid the developer in linking the National Volume Estimator Library DLL into a C++ application:

DllVolume.cpp C++ class used to call the National Volume Estimator Library DLL

DllVolume.h Header file for DllVolume.cpp file.

f77matrx.h Class used to convert FORTRAN arrays into C++ arrays

f77char.h Class used to convert FORTRAN strings into C++ strings

The following instructions describe the procedure to link in and access the National Volume Estimator Library DLL using the provided DllVolume class. The example was run with Visual C++ version 6.

Run Visual C++ and start a new project. Once the C++ project is set up, add the files VolLib.lib, DllVolume.cpp, DllVolume.h, f77matrx.h, and f77char.h to your project. The file VolLib.dll will need to reside in the same directory as your project’s executable.

The values for the parameter list will need to be set using the ‘Set’ member function for each variable. Once the variables have been set, a call into the DllVolume routine will reconfigure the C++ variables into FORTRAN readable variables, call the National Volume Estimator Library DLL and return the volumes. The volume information can be retrieved using the ‘Get’ member functions.

C++ Program:

// call to FORTRAN VolLib.DLL. All non-character variables are passed as references.

VOLUMELIBRARY(&REGN,FORST,VOLEQ,&MTOPP,&MTOPS,&STUMP,&DBHOB,&DRCOB,HTTYPE,&HTTOT,

&HTLOG,&HT1PRD,&HT2PRD,&UPSHT1,&UPSHT2,&UPSD1,&UPSD2,&HTREF,&AVGZ1,

&AVGZ2,&FCLASS,&DBTBH,&BTR,I3,I7,I15,I20,I21,VOL,LOGVOL,LOGDIA,LOGLEN,

BOLHT,&TLOGS,&NOLOGP,&NOLOGS,&CUTFLG,&BFPFLG,&CUPFLG,&CDPFLG,&SPFLG,

CONSPEC,PROD,&HTTFLL,LIVE,&BA,&SI,CTYPE,&ERRFLAG,&DIST);

You can find the variable definitions starting on page 6 (National Volume Estimator Library Call List) with the following exceptions:

I3 = 3

I7 = 7

I11 = 11

I20 = 20

I21 = 21

These integer variables are used to define arrays and character arrays.

## C# and VB .net access to the volume library

Also included in this download is a C# application that can be used for testing the volume library on individual trees. This application also includes and an updated version of the Profile Model Tutorial originally developed by Ken Cormier. The new version allows users to display and compare up to 2 trees, change merchandizing rules and change models.

The PMT only works, however for a subset of profile models. These include Clark, Flewelling, Wenzel/Olsen, Demars and a few others. In addition to the PMT, for certain equations, you can also get the diameter inside bark (DIB) at a user defined height. Examples of how to access the volume library via C# .net are including in the files Form1.cs, MRules.cs and PMTForm.cs

C# program:

[DllImport("vollib.dll")]

static extern void VOLLIBCS(ref int regn, StringBuilder forst, StringBuilder voleq, ref float mtopp,

ref float mtops, ref float stump, ref float dbhob, ref float drcob, StringBuilder httype, ref float httot, ref int htlog, ref float ht1prd, ref float ht2prd, ref float upsht1, ref float upsht2, ref float upsd1, ref float upsd2, ref int htref, ref float avgz1, ref float avgz2, ref int fclass, ref float dbtbh,

ref float btr, ref int i3, ref int i7, ref int i15, ref int i20, ref int i21, float[] vol,

float[,] logvol, float[,] logdia, float[] loglen, float[] bohlt, ref int tlogs, ref float nologp,

ref float nologs, ref int cutflg, ref int bfpflg, ref int cupflg, ref int cdpflg, ref int spflg, StringBuilder conspec, StringBuilder prod, ref int httfll, StringBuilder live, ref int ba, ref int si, StringBuilder ctype, ref int errflg, ref int indeb, ref int pmtflg, ref MRules mRules, ref int dist, int ll1, int ll2, int ll3, int ll4, int ll5, int ll6, int ll7, int charLen);

VOLLIBCS(ref REGN, FORST, VOLEQ, ref MTOPP, ref MTOPS, ref STUMP, ref DBHOB, ref DRCOB,

HTTYPE, ref HTTOT, ref HTLOG, ref HT1PRD, ref HT2PRD, ref UPSHT1, ref UPSHT2,

ref UPSD1, ref UPSD2,ref HTREF, ref AVGZ1, ref AVGZ2, ref FCLASS, ref DBTBH,

ref BTR, ref I3, ref I7, ref I15, ref I20, ref I21, VOL, LOGVOL, LOGDIA, LOGLEN,

BOLHT, ref TLOGS, ref NOLOGP, ref NOLOGS, ref CUTFLG, ref BFPFLG, ref CUPFLG,

ref CDPFLG, ref SPFLG, CONSPEC, PROD, ref HTTFLL, LIVE, ref BA, ref SI, CTYPE,

ref ERRFLAG, ref INDEB, ref PMTFLG, ref mRules, strlen, strlen, strlen, strlen,

strlen, strlen, strlen, charLen);

The **VOLLIBCSNVB** makes the new Nation-scale Volume and Biomass (NSVB) equation available to use.

[DllImport("vollib.dll")]

static extern void VOLLIBCSNVB(ref int regn, StringBuilder forst, StringBuilder voleq, ref float mtopp, ref float mtops, ref float stump, ref float dbhob, ref float drcob, StringBuilder httype, ref float httot, ref int htlog, ref float ht1prd, ref float ht2prd, ref float upsht1, ref float upsht2, ref float upsd1, ref float upsd2, ref int htref, ref float avgz1, ref float avgz2, ref int fclass, ref float dbtbh,

ref float btr, float[] vol, float[,] logvol, float[,] logdia, float[] loglen, float[] bohlt,

ref int tlogs, ref float nologp, ref float nologs, ref int cutflg, ref int bfpflg, ref int cupflg,

ref int cdpflg, ref int spflg, StringBuilder conspec, StringBuilder prod, ref int httfll,

StringBuilder live, ref int ba, ref int si, StringBuilder ctype, ref int errflg, ref int pmtflg,

ref MRules mRules, ref int dist, ref float brkht, ref float brkhtd, ref int fiaspcd, float[] drybio, float[] grnbio, ref float cr, ref float cull, ref int decaycd, int ll1, int ll2, int ll3, int ll4,

int ll5, int ll6, int ll7, int charLen);

VOLLIBCSNVB(ref REGN, FORST, VOLEQ, ref MTOPP, ref MTOPS, ref STUMP, ref DBHOB, ref DRCOB,

HTTYPE, ref HTTOT, ref HTLOG, ref HT1PRD, ref HT2PRD, ref UPSHT1, ref UPSHT2, ref UPSD1, ref UPSD2,

ref HTREF, ref AVGZ1, ref AVGZ2, ref FCLASS, ref DBTBH, ref BTR, VOL, LOGVOL,

LOGDIA, LOGLEN, BOLHT, ref TLOGS, ref NOLOGP, ref NOLOGS, ref CUTFLG, ref BFPFLG, ref CUPFLG,

ref CDPFLG, ref SPFLG, CONSPEC, PROD, ref HTTFLL, LIVE, ref BA, ref SI, CTYPE, ref ERRFLAG, ref PMTFLG,

ref mRules, ref IDIST, ref BRKHT, ref BRKHTD, ref FIASPCD, DRYBIO, GRNBIO, ref CR, ref CULL, ref DECAYCD,

strlen, strlen, strlen, strlen, strlen, strlen, strlen, charLen);

VB.net program:

Declare Sub VOLUMELIBRARY Lib "vollib.dll" (ByRef REGN As Integer, ByVal FORST As String, \_

ByVal FORST\_LEN As Integer, ByVal VOLEQ As String, ByVal VOLEQ\_LEN As Integer, \_

ByRef MTOPP As Single, ByRef MTOPS As Single, ByRef STUMP As Single, ByRef DBHOB As Single, \_

ByRef DRCOB As Single, ByVal HTTYPE As String, ByVal HTTYPE\_LEN As Integer, \_

ByRef HTTOT As Single, ByRef HTLOG As Integer, ByRef HT1PRD As Single, ByRef HT2PRD As Single, \_ ByRef UPSHT1 As Single, ByRef UPSHT2 As Single, ByRef UPSD1 As Single, ByRef UPSD2 As Single, \_

ByRef HTREF As Integer, ByRef AVGZ1 As Single, ByRef AVGZ2 As Single, ByRef FCLASS As Single, \_ ByRef DBTBH As Single, ByRef BTR As Single, ByRef I3 As Integer, ByRef I7 As Integer, \_

ByRef I15 As Integer, ByRef I20 As Integer, ByRef I21 As Integer, ByRef VOL As Single, \_

ByRef LOGVOL As Single, ByRef LOGDIA As Single, ByRef LOGLEN As Single, ByRef BOLHT As Single, \_

ByRef TLOGS As Integer, ByRef NOLOGP As Single, ByRef NOLOGS As Single, \_

ByRef CUTFLG As Integer, ByRef BFPFLG As Integer, ByRef CUPFLG As Integer, \_

ByRef CDPFLG As Integer, ByRef SPFLG As Integer, ByVal CONSPEC As String, \_

ByVal CONSPEC\_LEN As Integer, ByVal PROD As String, ByVal PROD\_LEN As Integer, \_

ByRef HTTFLL As Integer, ByVal LIVE As String, ByVal LIVE\_LEN As Integer, \_

ByRef BA As Integer, ByRef SI As Integer, ByVal CLTYPE As String, ByVal CLTYPE\_LEN As Integer, \_ ByRef ERRFLAG As Integer, ByRef DIST As Integer)

Declare PtrSafe Sub VOLUMELIBRARY2 Lib "vollib.dll" \_

(REGN As Long, ByVal FORST As String, ByVal FORST\_LEN As Long, \_

ByVal VOLEQ As String, ByVal VOLEQ\_LEN As Long, MTOPP As Single, \_

MTOPS As Single, STUMP As Single, DBHOB As Single, DRCOB As Single, \_

ByVal HTTYPE As String, ByVal HTTYPE\_LEN As Long, HTTOT As Single, \_

HTLOG As Long, HT1PRD As Single, HT2PRD As Single, UPSHT1 As Single, \_

UPSHT2 As Single, UPSD1 As Single, UPSD2 As Single, HTREF As Long, \_

AVGZ1 As Single, AVGZ2 As Single, FCLASS As Long, DBTBH As Single, \_

BTR As Single, VOL As Single, LOGVOL As Single, LOGDIA As Single, \_

LOGLEN As Single, BOLHT As Single, TLOGS As Long, NOLOGP As Single, \_

NOLOGS As Single, CUTFLG As Long, BFPFLG As Long, CUPFLG As Long, \_

CDPFLG As Long, SPGLG As Long, ByVal CONSPEC As String, \_

ByVal CONSPEC\_LEN As Long, ByVal Prod As String, ByVal PROD\_LEN As Long, \_

HTTFLL As Long, ByVal LIVE As String, ByVal LIVE\_LEN As Long, BA As Long, \_

SI As Long, ByVal CTYPE As String, ByVal CTYPE\_LEN As Long, ERRFLAG As Long, Dist As Long, \_

BRKHT As Single, BRKHTD As Single, FIASPCD As Long, DRYBIO As Single, GRNBIO As Single, \_

CR As Single, CULL As Single, DECAYCD As Long)

and the following has very few input parameters

Declare Sub VOLLIBVB8 Lib "vollib.dll" (ByVal VOLEQ As String, ByRef REGN As Long, \_

ByRef DBHOB As Single, ByRef HTTOT As Single, ByRef TOPD As Single, ByRef TOTCU As Single, \_

ByRef MERCHCU As Single, ByRef BDFT As Single, ByRef XINT As Single)

## Python 3 access to the volume library

Included in this download is also an example (vollibTestPython3.py) of how to access the volume library via python version 3.

## R Program access to the library

1. **The NVEL has the following subroutines for R program. They are:**

vernum\_r(VERNUM)

vernum\_r returns the version number for vollib.dll.

getvoleq\_r(REGN,FORST,DIST,SPEC,VOLEQ,ERRFLAG)

getvoleq\_r returns the NVEL default VOLEQ for the given REGN, FORST and DIST. The default VOLEQ is used by National Cruise Processing program or FVS.

vollib\_r(VOLEQ,REGN,FORST,DIST,SPEC,DBHOB,HTTOT,MTOPP,MTOPS,HT1PRD,HT2PRD,

UPSHT1,UPSD1,STUMP,FCLASS,DBTBH,BTR,VOL,ERRFLAG)

vollib\_r calculates the volume for a given tree. The calculated volumes are saved in the variable VOL. Please see the List of Variables for the VOL definition.

vollib2\_r(VOLEQ,REGN,FORST,DIST,SPEC,DBHOB,HTTOT,MTOPP,MTOPS,HT1PRD,HT2PRD,

UPSHT1,UPSD1,STUMP,FCLASS,DBTBH,BTR,VOL,LOGVOL,LOGDIA,LOGLEN,BOLHT, TLOGS,NOLOGP,NOLOGS, ERRFLAG)

vollib2\_r calculates the volume for a given tree. The calculated volumes are saved in the variable VOL. It also has output variables for logs volumes, diameters, length, etc. Please see the List of Variables for the VOL definition.

getnvbeq\_r(REGN,FORST,DIST,SPEC,VOLEQ,ERRFLAG)

getnvbeq\_r returns the default NSVB equation for a given species, region, forest and district.

vollibnew\_r(VOLEQ,REGN,FORST,DIST,SPEC,DBHOB,HTTOT,

MTOPP,MTOPS,HT1PRD,HT2PRD,UPSHT1,UPSD1,STUMP,

FCLASS,DBTBH,BTR,VOL,LOGVOL,LOGDIA,LOGLEN,BOLHT,

TLOGS,NOLOGP,NOLOGS,ERRFLAG,BRKHT,BRKHTD,

DRYBIO,GRNBIO,CR,CULL,DECAYCD)

vollibnvb\_r calculates the volume and dry and green biomass for a given tree. If the National-scale Volume and Biomass (NSVB) equation is used, the volume and biomass will be calculated with the NSVB equation. When a non NSVB equation is used, the volume will be calculated with the provided equation, but the biomass will be calculated with the NSVB default equation for the given SPEC, REGN, FORST and DIST.

ht2topd\_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMDIB,STEMHT,ERRFLAG,UPSHT1,UPSD1)

ht2topd\_r calculates stem height to a particular top diameter inside bark.

calcdib\_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMHT,STEMDIB,ERRFLAG,UPSHT1,UPSD1)

calcdib\_r calculates diameter inside bark at a given height on stem

calcdob\_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMHT,STEMDOB,ERRFLAG,UPSHT1,UPSD1)

calcdob\_r calculates diameter outside bark at a given height on stem if the profile model has the coefficient for outside bark diameter. Currently only Flewelling profile model calculates DOB.

fiavoltype\_r(FIAVOLEQ,FIAVOLTYPE,ERRFLAG)

fiavoltype\_r returns the FIA volume type (FIAVOLTYPE) for a given FIA volume equation (FIAVOLEQ). The list of FIA volume equation is documented in the Excel spreadsheet List\_of\_FIA\_Volume\_Equations.

fiavol\_r(VOLEQ,SPN,DBHOB,HTTOT,MTOPP,VOLTYPE,FIAVOL,ERRFLAG)

This is the simple function with the minimum input variable. VOLEQ can be FIA equation number or NVEL equation number. When VOLEQ is FIA equation number (CU\*\*\*\*\*\* or BD\*\*\*\*\*\*), the VOLTYPE is not required. Merch top diameter (MTOPP) is only required for some equations (with \* in VOLTYPE, such as CV\*). FIAVOL = volume calculated from the FIA volume equation number or NVEL equation number with VOLTYPE.

advfiavol\_r(VOLEQ,SPN,DBHOB,HTTOT,HT1PRD,HT2PRD,MTOPP,UPSTEMHT,UPSTEMDIA,BROKENHT,

CENTROIDHT,CENTROIDHTDIA,STANDBA,SI,GEOSUB,VOLTYPE,FIAVOL,ERRFLAG)

This is the advanced function to calculate FIA volume (FIAVOL). It has options for other variables. When the variable is not measured, input as zero (0).

HT1PRD = height for saw timber.

HT2PRD = pulp height (height to 4” top).

MTOPP = merch top diameter.

UPSTEMHT = upper stem height.

UPSTEMDIA = upper stem diameter.

BROKENHT = height to top broken.

CENTROIDHT = centroid height.

CENTROIDHTDIA = centroid height diameter.

STANDBA = stand basual area.

SI = site index.

GEOSUB = geographic area code.

VOLTYPE = FIA volume type (CVT, CV4, SV6, etc).

biomasslib\_r(BIOEQ,DBHOB,HTTOT,CROWNL,HT1PRD,HT2PRD,CV4,TOPD,STEMS,

DRYBIOM,GRNBIOM,ERRFLAG,SPN,GEOSUB)

This function calculates dry and green biomass (DRYBIOM and GRNBIOM). All units are in English.

BIOEQ = biomass equation number (12 characters, such as AFF019BRL01D),

DBHOB = outside diameter at breast height (inches),

HTTOT = total height (ft),

CROWNL = crown length (ft),

HT1PRD = height for saw timber,

HT2PRD = height for pulp (to 4” top),

CV4 = cubic volume from stump to 4” top,

TOPD = merch top diameter,

STEMS = number of stems (woodland species),

DRYBIOM = dry biomass (lb),

GRNBIOM = green biomass (lb),

SPN = FIA species code,

GEOSUB = geographic subcode (use 0 if unknown).

biomasslib\_r(REGN,FORST,SPN,GRMWF,DRYWF)

This function returns the species default green and dry weight factor (weight (lb) of wood and bark per cubicfoot of wood) in a specified region and forest. If the region/forest does not setup the default weight factor, the national default vales will be returned.

REGN = National Forest Region number,

FORST = National Forest administration number,

SPN = species FIA number,

GRNWF = green weight factor (lb/cuft),

DRYWF = dry weight factor (lb/cuft),

1. **How to use vollib.dll**

Save the vollib.dll to a directory on your PC, such as C:/NVEL/32 for the 32-Bits library and C:/NVEL/64 for the 64-Bits library. Then load the library with:

dyn.load("C:/NVEL/32/vollib.dll")

**Note: If you use 64-bit R program, you need to load the 64-bit dll, such as** dyn.load("C:/NVEL/64/vollib.dll")

1. **Example call to the library**
   1. **To get the NVEL version number:**

.Fortran("vernum\_r",vernum=integer(1))

Result:

$vernum

[1] 20170413

* 1. **To get the default VOLEQ for a species in a given site:**

REGN=2

FORST="01"

DIST="01"

SPEC=122

VOLEQ=" "

ERRFLAG=0

.Fortran("getvoleq\_r",as.integer(regn),as.character(forst),as.character(dist),as.integer(spec),as.character(voleq),as.integer(errflg))

Result:

[[1]]

[1] 2

[[2]]

[1] "01"

[[3]]

[1] "01"

[[4]]

[1] 122

$ VOLEQ

[1] "200FW2W122"

[[6]]

[1] 0

* 1. **To calculate the volume for a tree, you need to provide values for the input variables. If any unknown, just use 0 (zero) (For FORST and DIST use “01”):**

voleq="200FW2W122"

regn=2

forst="01"

dist="01"

spec=122

dbhob=19.6

httot=76.4

mtopp=0

mtops=0

ht1prd=0

ht2prd=0

upsht1=0

upsd1=0

stump=1

fclass=0

dbtbh=0

btr=0

vol=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

.Fortran("vollib\_r",as.character(voleq),as.integer(regn),as.character(forst),

as.character(dist),as.integer(spec),as.double(dbhob),as.double(httot),as.double(mtopp),

as.double(mtops),as.double(ht1prd),as.double(ht2prd),as.double(upsht1),as.double(upsd1),

as.double(stump),as.integer(fclass),as.double(dbtbh),as.double(btr),as.double(vol),

as.integer(errflg))

Result:

[[1]]

[1] "200FW2W122"

[[2]]

[1] 2

[[3]]

[1] "01"

[[4]]

[1] "01"

[[5]]

[1] 122

[[6]]

[1] 19.6

[[7]]

[1] 76.4

[[8]]

[1] 6

[[9]]

[1] 4

[[10]]

[1] 61.8001

[[11]]

[1] 0

[[12]]

[1] 0

[[13]]

[1] 0

[[14]]

[1] 1

[[15]]

[1] 0

[[16]]

[1] 2.322811

[[17]]

[1] 0

[[18]]

[1] 62.6000023 290.0000000 0.0000000 54.3999977 0.0000000 0.0000000 0.9000000 0.0000000 0.0000000 335.0000000 0.0000000 0.0000000

[13] 0.0000000 2.0732925 0.2637756

[[19]]

[1] 0

To get log volumes and diameters, please use vollib2\_r. The following is an example to call vollib2\_r.

voleq="200FW2W122"

regn=2

forst="01"

dist="01"

spec=122

dbhob=19.6

httot=76.4

mtopp=6.0

mtops=4.0

ht1prd=0

ht2prd=0

upsht1=0

upsd1=0

stump=1

fclass=0

dbtbh=0

btr=0

vol=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

logvol=matrix(0,7,20)

logdia=matrix(0,21,3)

loglen=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

bolht=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

tlogs=0

nologp=0

nologs=0

errflag=0

> .Fortran("vollib2\_r",as.character(voleq),as.integer(regn),as.character(forst),

as.character(dist),as.integer(spec),as.double(dbhob),as.double(httot),as.double(mtopp),

as.double(mtops),as.double(ht1prd),as.double(ht2prd),as.double(upsht1),

as.double(upsd1),as.double(stump),as.integer(fclass),as.double(dbtbh),as.double(btr),

as.double(vol),as.double(logvol),as.double(logdia),as.double(loglen),as.double(bolht),

as.integer(tlogs),as.double(nologp),as.double(nologs),as.integer(errflag))

The Results are as below:

[[1]]

[1] "200FW2W122"

[[2]]

[1] 2

[[3]]

[1] "01"

[[4]]

[1] "01"

[[5]]

[1] 122

[[6]]

[1] 19.6

[[7]]

[1] 76.4

[[8]]

[1] 6

[[9]]

[1] 4

[[10]]

[1] 61.8001

[[11]]

[1] 66.62714

[[12]]

[1] 0

[[13]]

[1] 0

[[14]]

[1] 1

[[15]]

[1] 0

[[16]]

[1] 2.322811

[[17]]

[1] 0

[[18]]

[1] 62.6000023 290.0000000 0.0000000 54.3999977 0.0000000 0.0000000 0.9000000

[8] 0.0000000 0.0000000 335.0000000 0.0000000 0.0000000 0.0000000 2.0732872

[15] 0.3883249

[[19]]

[1] 140.0 0.0 0.0 22.4 0.0 0.0 155.0

[8] 100.0 0.0 0.0 17.2 0.0 0.0 115.0

[15] 40.0 0.0 0.0 10.3 0.0 0.0 50.0

[22] 10.0 0.0 0.0 4.5 0.0 0.0 15.0

[29] 0.0 0.0 0.0 0.9 0.0 0.0 0.0

[36] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[43] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[50] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[57] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[64] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[71] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[78] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[85] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[92] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[99] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[106] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[113] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[120] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[127] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[134] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[20]]

[1] 17.000000 15.000000 13.000000 10.000000 6.000000 4.000000 0.000000

[8] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[15] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[22] 17.277189 15.391918 13.020892 10.189163 6.307143 4.000000 0.000000

[29] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[36] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[43] 19.600000 17.306204 14.636779 11.470787 7.139086 4.145066 0.000000

[50] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[57] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[[21]]

[1] 16 16 14 12 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

[[22]]

[1] 4.5 17.5 34.0 48.5 61.0 67.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[15] 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[23]]

[1] 5

[[24]]

[1] 4

[[25]]

[1] 0.375

[[26]]

[1] 0

Note: The row in LOGVOL is the log sequence and the column in LOGVOL is the different type of volume. The log boardfoot volumes are in LOGVOL(1,i) and the log cubic volumes are in LOGVOL(4,i), where i is 1 to 20. The row in LOGDIA is the different type of diameter and the column in LOGDIA is the log sequence. The log scaled diameters are in LOGDIA(i,1) and the log actual predicted inside bark diameters are in LOGDIA(i,2), where i is 1 to 21.

If errflag > 0, some error returned from the volume library. Please check the error message for detail.

* 1. **To calculate stem height to a given diameter inside bark (stemdib):**

> dyn.load("c:/development/NVEL/32/vollib.dll")

> voleq="I11FW3W202"

> regn=6

> forst="01"

> dbhob=19

> httot=76

> stemdib=9

> stemht=0

> errflg=0

> upsht1=40

> upsd1=12

> .Fortran("ht2topd\_r",as.character(voleq),as.integer(regn),as.character(forst), as.double(dbhob),as.double(httot),as.double(stemdib),as.double(stemht),as.integer(errflg),as.double(upsht1),as.double(upsd1))

Results:

[[1]]

[1] "I11FW3W202"

[[2]]

[1] 6

[[3]]

[1] "01"

[[4]]

[1] 19

[[5]]

[1] 76

[[6]]

[1] 9

[[7]]

[1] 50.76356

[[8]]

[1] 0

[[9]]

[1] 40

[[10]]

[1] 12

* 1. **To calculate stem diameter inside bark (stemdib) at a given height (stemht):**

> dyn.load("c:/development/NVEL/32/vollib.dll")

> voleq="I11FW3W202"

> regn=6

> forst="01"

> dbhob=19

> httot=76

> stemdib=0

> stemht=50

> errflg=0

> upsht1=40

> upsd1=12

> .Fortran("calcdib\_r",as.character(voleq),as.integer(regn),as.character(forst),

as.double(dbhob),as.double(httot),as.double(stemht),as.double(stemdib),as.integer(errflg),as.double(upsht1),as.double(upsd1))

Results:

[[1]]

[1] "I11FW3W202"

[[2]]

[1] 6

[[3]]

[1] "01"

[[4]]

[1] 19

[[5]]

[1] 76

[[6]]

[1] 50

[[7]]

[1] 9.234578

[[8]]

[1] 0

[[9]]

[1] 40

[[10]]

[1] 12

* 1. **To get the FIA volume type for a given FIA equation number**

> dyn.load("c:/development/NVEL/32/vollib.dll")

> VOLEQ="CU000055"

> VOLTYPE=""

> ERRFLAG=0

> .Fortran("fiavoltype\_r",as.character(VOLEQ),as.character(VOLTYPE),as.integer(ERRFLAG))

Results:

[[1]]

[1] "CU000055"

[[2]]

[1] "CV4 "

[[3]]

[1] 0

* 1. **To calculate FIA volume using the simple function using the inputs below and CV4 = 32.9):**

> VOLEQ="CU000055"

> VOLTYPE=""

> ERRFLAG=0

> DBHOB=15.6

> HTTOT=78.9

> FIAVOL=0

> SPN=316

> .Fortran("fiavol\_r",as.character(VOLEQ),as.integer(SPN),as.double(DBHOB),as.double(HTTOT),as.double(MTOPP),as.character(VOLTYPE),as.double(FIAVOL),as.integer(ERRFLAG))

Results:

[[1]]

[1] "CU000055"

[[2]]

[1] 316

[[3]]

[1] 15.6

[[4]]

[1] 78.9

[[5]]

[1] 4

[[6]]

[1] "CV4 "

[[7]]

[1] **32.91642**

[[8]]

[1] 0

* 1. **To calculate FIA volume using the advanced function for equation BD000031 with given saw height =50 with no total height:**

> voleq="BD000031"

> dbhob=15.6

> httot=0

> spn=129

> ht1prd=50

> ht2prd=0

> mtopp=0

> upstemht=0

> upstemdia=0

> brokenht=0

> centroidht=0

> centroidhtdia=0

> standba=0

> si=0

> geosub="0"

> voltype=""

> fiavol=0

> errflag=0

> .Fortran("advfiavol\_r",as.character(voleq),as.integer(spn),as.double(dbhob),as.double(httot),as.double(ht1prd),as.double(ht2prd),as.double(mtopp),as.double(upstemht),as.double(upstemdia),as.double(brokenht),as.double(centroidht),as.double(centroidhtdia),as.integer(standba),as.integer(si),as.character(geosub),as.character(voltype),as.double(fiavol),as.integer(errflag))

And get the result for Scribner boardfoot volume (SV7) = 196

[[1]]

[1] "BD000031"

[[2]]

[1] 129

[[3]]

[1] 15.6

[[4]]

[1] 0

[[5]]

[1] 50

[[6]]

[1] 0

[[7]]

[1] 0

[[8]]

[1] 0

[[9]]

[1] 0

[[10]]

[1] 0

[[11]]

[1] 0

[[12]]

[1] 0

[[13]]

[1] 0

[[14]]

[1] 0

[[15]]

[1] "0"

[[16]]

[1] "SV7 "

[[17]]

[1] **196**

[[18]]

[1] 0

* 1. **To calculate biomass using biomass equation in the National Biomass Estimator Library (NBEL)**

> BIOEQ="AFF019AST01D"

> DBHOB=15

> HTTOT=65

> CROWNL=30

> HT1PRD=0

> HT2PRD=0

> CV4=0

> TOPD=0

> STEMS=0

> DRYBIOM=0

> GRNBIOM=0

> ERRFLSG=0

> SPN=999

> GEOSUB="0"

> .Fortran("biomasslib\_r",as.character(BIOEQ),as.double(DBHOB),as.double(HTTOT),as.double(CROWNL),as.double(HT1PRD),as.double(HT2PRD),as.double(CV4),as.double(TOPD),as.integer(STEMS),as.double(DRYBIOM),as.double(GRNBIOM),as.integer(ERRFLAG),as.integer(SPN),as.character(GEOSUB))

And the calculated dry biomass = 859.5227 and green biomass = 1510.468

[[1]]

[1] "AFF019AST01D"

[[2]]

[1] 15

[[3]]

[1] 65

[[4]]

[1] 30

[[5]]

[1] 0

[[6]]

[1] 0

[[7]]

[1] 0

[[8]]

[1] 0

[[9]]

[1] 0

[[10]]

[1] 859.5227

[[11]]

[1] 1510.468

[[12]]

[1] 0

[[13]]

[1] 999

[[14]]

[1] "0"

* 1. **To get the species default weight factor**

> REGN=6

> FORST="01"

> SPN=202

> GRNWF=0

> DRYWF=0

> .Fortran("getwtfactor\_r",as.integer(REGN),as.character(FORST),as.integer(SPN), as.double(GRNWF),as.double(DRYWF))

[[1]]

[1] 6

[[2]]

[1] "01"

[[3]]

[1] 202

[[4]]

[1] 60

[[5]]

[1] 32.8

The weight factor for Douglas-fir in Region 6 Forest 01 is green weight factor = 60 lb/cuft and dry weight factor = 32.8 lb/cuft.

* 1. **Calculate volume and biomass with** vollibnvb\_r

When regular VOLEQ is used, the default NSVB equation for the Region, forest and district will be used for biomass calculation.

voleq="200FW2W122"

regn=2

forst="01"

dist="01"

spec=122

dbhob=19.6

httot=76.4

mtopp=6.0

mtops=4.0

ht1prd=0

ht2prd=0

upsht1=0

upsd1=0

stump=1

fclass=0

dbtbh=0

btr=0

vol=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

logvol=matrix(0,7,20)

logdia=matrix(0,21,3)

loglen=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

bolht=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

tlogs=0

nologp=0

nologs=0

errflag=0

brkht=0

brkhtd=0

cr=0

cull=0

decaycd=0

drybio=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

grnbio=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)

.Fortran("vollibnvb\_r",as.character(voleq),as.integer(regn),as.character(forst),

as.character(dist),as.integer(spec),as.double(dbhob),as.double(httot),as.double(mtopp),

as.double(mtops),as.double(ht1prd),as.double(ht2prd),as.double(upsht1),

as.double(upsd1),as.double(stump),as.integer(fclass),as.double(dbtbh),as.double(btr),

as.double(vol),as.double(logvol),as.double(logdia),as.double(loglen),as.double(bolht),

as.integer(tlogs),as.double(nologp),as.double(nologs),as.integer(errflag),

as.double(brkht),as.double(brkhtd),as.double(drybio),as.double(grnbio),as.double(cr),

as.double(cull),as.integer(decaycd))

The result:

[[1]]

[1] "200FW2W122"

[[2]]

[1] 2

[[3]]

[1] "01"

[[4]]

[1] "01"

[[5]]

[1] 122

[[6]]

[1] 19.6

[[7]]

[1] 76.4

[[8]]

[1] 6

[[9]]

[1] 4

[[10]]

[1] 61.8001

[[11]]

[1] 66.62714

[[12]]

[1] 0

[[13]]

[1] 0

[[14]]

[1] 1

[[15]]

[1] 0

[[16]]

[1] 0

[[17]]

[1] 0

[[18]]

[1] 62.6000023 290.0000000 0.0000000 54.3999977 0.0000000 0.0000000 0.9000000 0.0000000 0.0000000 335.0000000 0.0000000 0.0000000 0.0000000 2.0732872 0.3883249

[[19]]

[1] 140.0 0.0 0.0 22.4 0.0 0.0 155.0 100.0 0.0 0.0 17.2 0.0 0.0 115.0 40.0 0.0 0.0 10.3 0.0 0.0 50.0 10.0 0.0 0.0 4.5 0.0 0.0 15.0 0.0 0.0

[31] 0.0 0.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[61] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[91] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[121] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[20]]

[1] 17.000000 15.000000 13.000000 10.000000 6.000000 4.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[19] 0.000000 0.000000 0.000000 17.277189 15.391918 13.020892 10.189163 6.307143 4.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[37] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 19.600000 17.306204 14.636779 11.470787 7.139086 4.145066 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[55] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[[21]]

[1] 16 16 14 12 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

[[22]]

[1] 4.5 17.5 34.0 48.5 61.0 67.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[23]]

[1] 5

[[24]]

[1] 4

[[25]]

[1] 1

[[26]]

[1] 0

[[27]]

[1] 0

[[28]]

[1] 0

[[29]]

[1] 2283.224365 1508.791382 262.044922 50.119205 8.704638 1416.918457 246.088547 29.358860 5.098987 12.394827 2.152717 512.388000 0.000000 526.935730 1172.055176

[[30]]

[1] 5749.541504 3799.389404 659.872986 126.208557 21.919735 3568.038086 619.692200 73.930527 12.840102 31.212250 5.420903 1290.278809 0.000000 1326.912476 2951.431152

[[31]]

[1] 0

[[32]]

[1] 0

[[33]]

[1] 0

**Using NSVB equation NVBM210122.**

Both volume and biomass will be calculated using the NSVB equation.

> voleq="NVBM210122"

> .Fortran("vollibnvb\_r",as.character(voleq),as.integer(regn),as.character(forst),

+ as.character(dist),as.integer(spec),as.double(dbhob),as.double(httot),as.double(mtopp),

+ as.double(mtops),as.double(ht1prd),as.double(ht2prd),as.double(upsht1),

+ as.double(upsd1),as.double(stump),as.integer(fclass),as.double(dbtbh),as.double(btr),

+ as.double(vol),as.double(logvol),as.double(logdia),as.double(loglen),as.double(bolht),

+ as.integer(tlogs),as.double(nologp),as.double(nologs),as.integer(errflag),

+ as.double(brkht),as.double(brkhtd),as.double(drybio),as.double(grnbio),as.double(cr),

+ as.double(cull),as.integer(decaycd))

[[1]]

[1] "NVBM210122"

[[2]]

[1] 2

[[3]]

[1] "01"

[[4]]

[1] "01"

[[5]]

[1] 122

[[6]]

[1] 19.6

[[7]]

[1] 76.4

[[8]]

[1] 6

[[9]]

[1] 4

[[10]]

[1] 63.86563

[[11]]

[1] 70.43125

[[12]]

[1] 0

[[13]]

[1] 0

[[14]]

[1] 1

[[15]]

[1] 0

[[16]]

[1] 0

[[17]]

[1] 0

[[18]]

[1] 59.2832451 270.0000000 0.0000000 54.5999985 0.0000000 0.0000000 0.9000000 0.0000000 0.0000000 315.0000000 0.0000000 0.0000000 0.0000000 2.2005467 0.3321649

[[19]]

[1] 140.0 0.0 0.0 24.0 0.0 0.0 155.0 80.0 0.0 0.0 16.1 0.0 0.0 95.0 40.0 0.0 0.0 9.3 0.0 0.0 50.0 10.0 0.0 0.0 5.2 0.0 0.0 15.0 0.0 0.0

[31] 0.0 0.9 0.0 0.0 5.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[61] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[91] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[121] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[20]]

[1] 18.000000 15.000000 12.000000 10.000000 6.000000 4.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[19] 0.000000 0.000000 0.000000 17.549633 14.897626 12.127937 9.509294 6.279702 4.326492 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[37] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[55] 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

[[21]]

[1] 16 16 14 14 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

[[22]]

[1] 4.5 17.5 34.0 48.5 63.0 69.5 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

[[23]]

[1] 5

[[24]]

[1] 4

[[25]]

[1] 1

[[26]]

[1] 0

[[27]]

[1] 0

[[28]]

[1] 0

[[29]]

[1] 2283.224365 1478.978149 272.132874 54.898487 10.101354 1390.203369 255.798187 25.589565 4.708590 8.286737 1.524764 532.113403 0.000000 541.924866 1172.055176

[[30]]

[1] 5488.140625 3554.989990 654.120300 131.958389 24.280420 3341.603760 614.856934 61.509121 11.317942 19.918663 3.665045 1279.030273 0.000000 1302.613892 2817.245361

[[31]]

[1] 0

[[32]]

[1] 0

[[33]]

[1] 0

**To get the default NSVB equation**

> regn = 9

> forst = "03"

> dist = "01"

> spcd = 316

> voleq = " "

> errflg = 0

> .Fortran("getnvbeq\_r",as.integer(regn),as.character(forst),as.character(dist),as.integer(spcd),as.character(voleq),as.integer(errflg))

[[1]]

[1] 9

[[2]]

[1] "03"

[[3]]

[1] "01"

[[4]]

[1] 316

[[5]]

[1] "NVB0210316"

[[6]]

[1] 0

# 8. Citations by Volume Model.

| **Model\_Name** | **Citation** |
| --- | --- |
| Behres Hyperbola | USFS-R6 Sale Preparation and Valuation Section of Diameter and Volume Procedures - R6 Timber Cruise System. 1978. |
| Bruce Profile Model | Bruce, D., 1984. Volume estimators for Sitka spruce and western hemlock in coastal Alaska. In Inventorying forest and other vegetation of the high latitude and high altitude regions. SAF pub 84-11. Bethesada, MD. pp. 96-102. |
| Byrne Equation | Johsn C. Byrne 1993. Incorporating Additional Tree and Environmental Variables in Lodgepole Pine Stem Profile Model. Western Journal of Applied Forestry Vol. 8 |
| Chojnacky Equation | David Chojnacky 1985. Pinyon-Juniper Volume Equations for the Central Rocky Mountain States. Intermountain Research Station Research Paper INT-339. |
| Clark Profile Model | Clark, Alexander, Ray A. Souter, and Bryce E. Schlaegel. 1991. Stem Profile Equations for Southern Tree Species. Southeastern Forest Experiment Station Research Paper SE-282 |
| Curtis Profile Model | Curtis, Robert O, David Bruce, and Caryanne VanCoevering. 1968. Volume and Taper Tables for Red Alder. Pacifc Northwest Forest and Range Exp. Sta. Research Paper PNW-56. |
| Czaplewski Profile Model | Czaplewski, Raymond L., Amy S. Brown, and Raymond C. Walker. 1989. Profile Models for Estimating Log End Diameters in the Rocky Mountain Region. Rocky Mtn. Forest and Range Experiment Station Research Paper RM-284 |
| Czaplewski Profile Model 3pt | Unpublished. Based on work presented in Czaplewski & McClure. 1988. Conditioning a segmented stem profile model for two diameter measurements. Forest Science, Vol 34 |
| Demars Profile Model | Demars, Donald. Relative Diameter and Relative Basal Area as Dependent Variables in Tree Profile Equations. Manuscript in Preparation. |
| Direct Volume Equation | (unknown source) |
| Direct Volume Equations - Bdft | Ted Lasher (unknown source) |
| Eager Mill Study Equation | Unpublished. Timber Cruising Handbook, Region 3 Suppliment. |
| Edminster Equation | Edminster, Carleton B., James R. Getter, and Donna R. Story. 1977. Past Diameters and Gross Volumes of Plains Cottonwood in Eastern Colorado. Rocky Mtn. Forest and Range Experiment Station Research Note RM - 351 |
| Edminster Equation 1 | Carleton B. Edminster et al 1980. Research Paper RM-218 |
| Edminster Equation 2 | Edminster, Carleton B., H. Todd Mowrer, and Thomas E. Hinds. 1982. Volume Tables and Point-Sampling Factors for Aspen in Colorado. Rocky Mtn Forest and Range Experiment Station Research Paper RM-232 |
| Flewelling Profile Model | Unpublished. Based on work presented by Flewelling and Raynes. 1993. Variable-shape stem-profile predictions for western hemlock. Canadian Journal of Forest Research Vol 23. Part I and Part II. |
| Flewelling Profile Model 3pt | Unpublished. Based on work presented by Flewelling and Raynes. 1993. Variable-shape stem-profile predictions for western hemlock. Canadian Journal of Forest Research Vol 23. Part I and Part II. |
| Gevorkiantz Equation | Gevorkiantz, S.R. and L. P. Olsen. 1955. Composite Voume Tables for Timber and Their Application in the Lake States. USDA Forest Service Technical Bulletin No. 1104 |
| Hann and Bare Equation | Hann, David W. and B. Bruce Bare 1978. Comprehensive Tree Volume Equations for Major Species of New Mexico and Arizona. Intermountain Forest and Range Experiment Station Research Paper INT-209. |
| Kemp Equation | Kemp, P.D. 1958. Unpublished report on file at USDA, Forest Service, Rocky Mountain Research Station, Interior West Resource Inventory, Monitoring, and Evaluation Program, Ogden, UT. |
| Larson Volume Equation | Larson, Frederic R. and Kenneth C Winterberger. 1988. Tables and Equations for Estimating Volumes of trees in the Susitna River Basin, Alaska. Pacific Northwest Research Station Research Note PNW-478. |
| Malone DVE | Malone, T., Liang, J., and Packee, E. C. 2013. Total and Merchantable Volume of White spruce in Alaska. West. J. Appl. For. 28(2):71-77 |
| Myers Equation 1 | Clifford A. Myers 1964. Volume tables and point sampling factors for ponderosa pine in the Black Hills. Research Paper RM - 8 |
| Myers Equation 2 | Clifford A. Myers 1969. Board-foot volumes to a 6-inch top for lodgepole pines in Colorado and Wyoming. Research Note RM - 157 |
| Myers Equation 3 | Clifford A. Myers 1972. Volume, taper, and related tables for southwestern ponderosa pine. Research Paper RM - 2 |
| Myers Equation 4 | Clifford A Myers & Carleton B Ediminster 1972. Volume tables and point-sampling factors for Engelmann spruce in Colorado and Wyoming. Research Paper RM-95 |
| Pillsbury and Kirkley Equation | Norman H Pillsbury and Michael L Kirkley 1984 Equations for Total, Wood, and saw-Log Volume for Thirteen California Hardwoods. Pacific Northwest Forest and Range Experiment Station Research Note PNW-414. |
| PNW tariff Equation | Karen Waddell 2012. FIA Volume Equation Documentation. |
| Rustagi Profile Model | Rustagi, K.R. and Loveless, R.S.,Jr., 1991. Compatible variable-form volume and stem-profile equations for Douglas-fir. Can. J. For. Res. 21:143-151. |
| Sharpnack Profile Model | Sharpnack, David A. 1966. Predicting Volumes in Four Hawaii Hardwoods. Southwest Forest and Range Research Station Research Note SW-121. |
| Wensel and Olsen Profile Model | Wensel, L. C. and C. M. Olson. 1993. Tree Taper Models for Major Commercial California Conifers. Research Note No. 33. Northern Calif. Forest Yield Cooperative. Dept. of Forstry and Mgmt., Univ. of Calif., Berkeley. 28 pp. |
| Haack & Gregory Volume Equation | Haack, Paul M. 1963. Volume tables for trees of interior Alaska. Res. Note NOR-5. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 11 p.  Gregory, Robert A. and Paul M. Haack. 1964. Equations and tables for estimating cubic-foot volume of interior Alaska tree species. Res. Note NOR-6. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 21 p. |
| Brackett Volume Equation | Brackett, Michael. 1973. Notes on tariff tree volume computation. Resource Management Report No. 24. Olympia, WA: State of Washington Department of Natural Resources. 26 p. |
| Westfall NSVB Equation | Westfall etal 2023. A national-scale tree volume, biomass, and carbon modeling system for the United States. USDA Forest Service GTR- |

# APPENDIXES

## Region and Forest Numbers.

**NORTHERN REGION**

| **Region 1 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Beaverhead-Deerlodge | 2 | MT |
| Bitterroot | 3 | MT |
| Idaho Panhandle | 4 | ID |
| Clearwater | 5 | ID |
| Custer | 8 | MT |
| Flathead | 10 | MT |
| Gallatin | 11 | MT |
| Helena | 12 | MT |
| Kootenai | 14 | MT |
| Lewis & Clark | 15 | MT |
| Lolo | 16 | MT |
| Nezperce | 17 | ID |

**ROCKY MOUNTAIN REGION**

| **Region 2 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Bighorn | 2 | WY |
| Black Hills | 3 | SD |
| GMUG | 4 | CO |
| Medicine Bow-Routt | 6 | WY |
| Nebraska | 7 | CO |
| San Jaun-Rio Grande | 9 | CO |
| Arapaho-Roosevelt | 10 | CO |
| Pike-San Isabel | 12 | CO |
| Shoshone | 14 | WY |
| White River | 15 | CO |

**SOUTWESTERN REGION**

| **Region 3 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Apache-Sitgreaves | 1 | AZ |
| Carson | 2 | NM |
| Cibola | 3 | NM |
| Coconino | 4 | AZ |
| Coronado | 5 | AZ |
| Gila | 6 | NM |
| Kaibab | 7 | AZ |
| Lincoln | 8 | NM |
| Prescott | 9 | AZ |
| Santa Fe | 10 | NM |
| Tonto | 12 | AZ |

**INTERMOUNTAIN REGION**

| **Region 4 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Ashley | 1 | UT |
| Boise | 2 | ID |
| Bridger-Teton | 3 | WY |
| Caribou | 5 | ID |
| Dixie | 7 | UT |
| Fishlake | 8 | UT |
| Humboldt | 9 | NV |
| Manti-LaSal | 10 | UT |
| Payette | 12 | ID |
| Challis | 13 | ID |
| Salmon | 13 | ID |
| Sawtooth | 14 | ID |
| Targhee | 15 | ID |
| Toiyabe | 17 | NV |
| Uinta | 18 | UT |
| Wasatch-Cache | 19 | UT |

**PACIFIC SOUTHWEST REGION**

| **Region 5 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Angeles | 1 | CA |
| Cleveland | 2 | CA |
| Eldorado | 3 | CA |
| Inyo | 4 | CA |
| Klamath | 5 | CA |
| Lassen | 6 | CA |
| Los Padres | 7 | CA |
| Mendocino | 8 | CA |
| Modoc | 9 | CA |
| Plumas | 11 | CA |
| San Bernardino | 12 | CA |
| Sequoia | 13 | CA |
| Shasta-Trinity | 14 | CA |
| Sierra | 15 | CA |
| Six Rivers | 10 | CA |
| Stanislaus | 16 | CA |
| Tahoe | 17 | CA |

**PACIFIC NORTHWEST**

| **Region 6 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Deschutes | 1 | OR |
| Fremont | 2 | OR |
| Gifford Pinchot | 3 | WA |
| Malheur | 4 | OR |
| Mt. Baker-Snoqualmie | 5 | WA |
| Mt. Hood | 6 | OR |
| Ochoco | 7 | OR |
| Okanogan | 8 | WA |
| Olympic | 9 | WA |
| Rogue River | 10 | OR |
| Siskiyou | 11 | OR |
| Siuslaw | 12 | OR |
| Umatilla | 14 | OR |
| Umpqua | 15 | OR |
| Wallowa-Whitman | 16 | OR |
| Wenatchee | 17 | WA |
| Willamette | 18 | OR |
| Winema | 20 | OR |
| Colville | 21 | WA |

**SOUTHERN REGION**

| **Region 8 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| National Forests Alabama | 1 | AL |
| Daniel Boone | 2 | KY |
| Chattahoochee-Oconee | 3 | GA |
| Cherokee | 4 | TN |
| National Forests Florida | 5 | FL |
| Kisatchie | 6 | LA |
| National Forests Mississippi | 7 | MS |
| George Washington-Jefferson | 8 | VA |
| Ouachita | 9 | AR |
| Ozark-St. Francis | 10 | AR |
| National Forests N.Carolina | 11 | NC |
| Francis Marion-Sumter | 12 | SC |
| National Forests Texas | 13 | TX |
| Caribbean | 16 | PR |

**EASTERN REGION**

| **Region 9 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Chequamegon | 2 | WI |
| Chippewa | 3 | MN |
| Huron-Manistee | 4 | MI |
| Mark Twain | 5 | MO |
| Nicolet | 6 | WI |
| Ottawa | 7 | MI |
| Shawnee | 8 | IL |
| Superior | 9 | MN |
| Hiawatha | 10 | MI |
| Wayne-Hoosier | 11 |  |
| Hoosier | 12 | IN |
| Wayne | 14 | OH |
| Allegheny | 19 | PA |
| Green Mountain | 20 | VT |
| Monongahela | 21 | WV |
| White Mountain | 22 | NH |

**ALASKA REGION**

| **Region 10 Forest Name** | **Forest Number** | **State** |
| --- | --- | --- |
| Chugach | 4 | AK |
| Tongass | 5 | AK |

## R9 Clark and Gevorkiantz (DVE) Equations

|  |  |  |  |
| --- | --- | --- | --- |
| **Clark Equations** | **Gevorkiantz (DVE) Equations** | | |
| **Boardfoot** | | **Cubic** |
| 900CLKE012  900CLKE068  900CLKE090  900CLKE094  900CLKE095  900CLKE100  900CLKE105  900CLKE110  900CLKE125  900CLKE129  900CLKE241  900CLKE261  900CLKE299  900CLKE310  900CLKE316  900CLKE317  900CLKE318  900CLKE370  900CLKE371  900CLKE375  900CLKE400  900CLKE407  900CLKE531  900CLKE540  900CLKE541  900CLKE543  900CLKE621  900CLKE740  900CLKE741  900CLKE742  900CLKE743  900CLKE746  900CLKE752  900CLKE760  900CLKE762  900CLKE800  900CLKE802  900CLKE806  900CLKE809  900CLKE823  900CLKE833  900CLKE837  900CLKE950  900CLKE951  900CLKE970  900CLKE972  900CLKE998 | 901DVEE094  901DVEE105  901DVEE125  901DVEE129  901DVEE241  901DVEE261  901DVEE318  901DVEE375  901DVEE531  901DVEE541  901DVEE951  901DVEE970  901DVEE999  902DVEE400  902DVEE602  902DVEE621  902DVEE694  902DVEE731  902DVEE742  902DVEE824  902DVEE830  902DVEE832  902DVEE068  902DVEE110  902DVEE125  902DVEE129  902DVEE241  902DVEE842  902DVEE806  902DVEE833  902DVEE835  902DVEE837  902DVEE999  903DVEE129  903DVEE261  903DVEE531  903DVEE541  903DVEE543  903DVEE621  903DVEE951  903DVEE806  903DVEE813  903DVEE823  903DVEE824  903DVEE830  903DVEE833  903DVEE835  903DVEE837  903DVEE999 | 904DVEE012  904DVEE261  904DVEE094  904DVEE097  904DVEE125  904DVEE129  904DVEE316  904DVEE746  904DVEE762  904DVEE833  904DVEE951  904DVEE970  904DVEE375  904DVEE541  904DVEE376  904DVEE371  904DVEE999  905DVEE316  905DVEE371  905DVEE802  905DVEE951  905DVEE318  905DVEE373  905DVEE531  905DVEE541  905DVEE621  905DVEE651  905DVEE261  905DVEE833  905DVEE999  906DVEE097  906DVEE129  906DVEE999 | 911DVEE999  912DVEE071  912DVEE094  912DVEE095  912DVEE097  912DVEE105  912DVEE110  912DVEE125  912DVEE129  912DVEE241  912DVEE316  912DVEE318  912DVEE371  912DVEE375  912DVEE400  912DVEE404  912DVEE460  912DVEE531  912DVEE543  912DVEE601  912DVEE602  912DVEE621  912DVEE651  912DVEE694  912DVEE731  912DVEE742  912DVEE746  912DVEE762  912DVEE802  912DVEE806  912DVEE813  912DVEE823  912DVEE824  912DVEE830  912DVEE833  912DVEE835  912DVEE837  912DVEE920  912DVEE951  912DVEE970  912DVEE999  921DVEE999 |

## Fleweling Profile Model Equations

|  |  |  |
| --- | --- | --- |
| **2 points equations** | **3 points equations** | **Used by region** |
| I00FW2W012  I00FW2W017  I00FW2W019  I00FW2W073  I00FW2W093  I00FW2W108  I00FW2W119  I00FW2W122  I00FW2W202  I00FW2W242  I00FW2W263  I00FW2W264 | I00FW3W012  I00FW3W017  I00FW3W019  I00FW3W073  I00FW3W093  I00FW3W108  I00FW3W119  I00FW3W122  I00FW3W202  I00FW3W242  I00FW3W263  I00FW3W264 | 01, 06 |
| I11FW2W017  I11FW2W019  I11FW2W093  I11FW2W122  I11FW2W202  I11FW2W263  I11FW2W264  I12FW2W017  I12FW2W019  I12FW2W093  I12FW2W122  I12FW2W202  I12FW2W263  I12FW2W264  I13FW2W017  I13FW2W019  I13FW2W093  I13FW2W122  I13FW2W202  I13FW2W263  I13FW2W264 | I11FW3W017  I11FW3W019  I11FW3W093  I11FW3W122  I11FW3W202  I11FW3W263  I11FW3W264  I12FW3W017  I12FW3W019  I12FW3W093  I12FW3W122  I12FW3W202  I12FW3W263  I12FW3W264  I13FW3W017  I13FW3W019  I13FW3W093  I13FW3W122  I13FW3W202  I13FW3W263  I13FW3W264 | 06 |
| I14FW2W017  I14FW2W019  I14FW2W093  I14FW2W122  I14FW2W202  I14FW2W263  I14FW2W264 | I14FW3W017  I14FW3W019  I14FW3W093  I14FW3W122  I14FW3W202  I14FW3W263  I14FW3W264 | 01 |
| I15FW2W017  I15FW2W019  I15FW2W093  I15FW2W122  I15FW2W202  I15FW2W263  I15FW2W264 | I15FW3W017  I15FW3W019  I15FW3W093  I15FW3W122  I15FW3W202  I15FW3W263  I15FW3W264 | 04 |
| I21FW2W017  I21FW2W019  I21FW2W093  I21FW2W122  I21FW2W202  I21FW2W263  I21FW2W264  I22FW2W017  I22FW2W019  I22FW2W093  I22FW2W122  I22FW2W202  I22FW2W263  I22FW2W264  I23FW2W017  I23FW2W019  I23FW2W093  I23FW2W122  I23FW2W202  I23FW2W263  I23FW2W264 | I21FW3W017  I21FW3W019  I21FW3W093  I21FW3W122  I21FW3W202  I21FW3W263  I21FW3W264  I22FW3W017  I22FW3W019  I22FW3W093  I22FW3W122  I22FW3W202  I22FW3W263  I22FW3W264  I23FW3W017  I23FW3W019  I23FW3W093  I23FW3W122  I23FW3W202  I23FW3W263  I23FW3W264 | Canada Model |
| F00FW2W202  F00FW2W242  F00FW2W263  F01FW2W202  F01FW2W242  F01FW2W263  F02FW2W202  F02FW2W242  F02FW2W263  F03FW2W202  F03FW2W242  F03FW2W263  F04FW2W202  F04FW2W242  F04FW2W263  F05FW2W202  F05FW2W242  F05FW2W263  F06FW2W202  F06FW2W242  F06FW2W263  F07FW2W202  F07FW2W242  F07FW2W263  F08FW2W202  F08FW2W242  F08FW2W263 | F00FW3W202  F00FW3W242  F00FW3W263  F01FW3W202  F01FW3W242  F01FW3W263  F02FW3W202  F02FW3W242  F02FW3W263  F03FW3W202  F03FW3W242  F03FW3W263  F04FW3W202  F04FW3W242  F04FW3W263  F05FW3W202  F05FW3W242  F05FW3W263  F06FW3W202  F06FW3W242  F06FW3W263  F07FW3W202  F07FW3W242  F07FW3W263  F08FW3W202  F08FW3W242  F08FW3W263 | 06, 07 |
| 200FW2W015  200FW2W108  200FW2W122  200FW2W202  200FW2W746  203FW2W122 | 200FW3W015  200FW3W108  200FW3W122  200FW3W202  200FW3W746  203FW3W122 | 02 |
| 300FW2W122 | 300FW3W122 | 03 |
| 407FW2W122  407FW2W093 | 407FW3W122  407FW3W093 | 04 |
| A00F32W042  A00F32W098  A00F32W242  A00F32W260  A00F32W263  A00F32W264  A00FW2W042  A00FW2W098  A00FW2W242  A00FW2W260  A00FW2W263  A00FW2W264  A02F32W098  A02F32W260  A02F32W263  A02F32W264  A02FW2W098  A02FW2W260  A02FW2W263  A02FW2W264 | A00F33W042  A00F33W098  A00F33W242  A00F33W260  A00F33W263  A00F33W264  A00FW3W042  A00FW3W098  A00FW3W242  A00FW3W260  A00FW3W263  A00FW3W264  A02F33W098  A02F33W260  A02F33W263  A02F33W264  A02FW3W098  A02FW3W260  A02FW3W263  A02FW3W264 | 10 |

## Species Codes

| **Species Codes for Volume Equation Numbers** | | | |
| --- | --- | --- | --- |
| **Softwood Species** | | **Hardwood Species** | |
| **Species Code** | **Species Name** | **Species Code** | **Species Name** |
| 012 | Balsam fir | 300 | Acacia |
| 014 | Bristlecone fir | 301 | Koa |
| 015 | White fir | 310 | Maple |
| 017 | Grand fir | 312 | Bigleaf maple |
| 018 | Corkbark fir | 313 | Boxelder |
| 019 | Subalpine fir | 314 | Black maple |
| 020 | California red fir | 316 | Red maple |
| 021 | Shasta red fir | 317 | Silver maple |
| 022 | Noble fir | 318 | Sugar maple |
| 041 | Port Orford cedar | 321 | Rocky Mountain maple |
| 042 | Alaska yellow cedar | 322 | Bigtooth maple |
| 050 | Cypress | 330 | California buckeye |
| 051 | Arizona cypress | 350 | Alder |
| 059 | Redberry juniper | 351 | Red alder |
| 060 | Juniper | 352 | White alder |
| 062 | California juniper | 361 | Pacific madrone |
| 063 | Alligator juniper | 370 | Birch |
| 064 | Western juniper | 371 | Yellow birch |
| 065 | Utah juniper | 373 | River birch |
| 066 | Rocky Mountain juniper | 374 | Water birch |
| 068 | Eastern redcedar | 375 | Paper birch |
| 069 | Oneseed juniper | 376 | Western paper birch |
| 070 | Larch | 378 | Northwestern paper |
| 071 | Tamarack | 400 | Hickory |
| 072 | Subalpine larch | 404 | Pecan |
| 073 | Western larch | 431 | Golden chinkapin |
| 081 | Incense cedar | 460 | Hackberry |
| 090 | Spruce | 475 | Curlleaf mountain mahogany |
| 092 | Brewer's spruce | 476 | True mountain mahogany |
| 093 | Engelmann's spruce | 477 | Hairy mountain mahogany |
| 094 | White spruce | 478 | Birchleaf mountain mahogany |
| 095 | Black Spruce | 492 | Pacific dogwood |
| 096 | Blue spruce | 500 | Hawthorn |
| 097 | Red spruce | 510 | Eucalyptus |
| 098 | Sitka spruce | 521 | Common persimmon |
| 100 | Pine | 531 | American beech |
| 101 | Whitebark pine | 540 | Ash |
| 102 | Bristlecone pine | 541 | White ash |
| 103 | Knobcone pine | 542 | Oregon ash |
| 104 | Foxtail pine | 543 | Black ash |
| 105 | Jack pine | 544 | Green Ash |
| 106 | Pinyon Pine | 545 | Pumpkin ash |
| 107 | Sand pine | 546 | Blue ash |
| 108 | Lodgepole pine | 550 | Honeylocust |
| 109 | Coulter's pine | 580 | Silverbell |
| 110 | Shortleaf pine | 594 | ? |
| 111 | Slash pine | 600 | California walnut |
| 112 | Apache pine | 601 | Butternut |
| 113 | Limber pine | 602 | Black walnut |
| 114 | Southwestern white pine | 611 | Sweetgum |
| 115 | Spruce pine | 621 | Yellow popular |
| 116 | Jeffrey pine | 631 | Tanoak |
| 117 | Sugar pine | 650 | Magnolia |
| 118 | Chihuahuan pine | 651 | Cucumbertree |
| 119 | Western white pine | 652 | Southern magnolia |
| 120 | Bishop pine | 653 | Sweetbay |
| 121 | Longleaf pine | 660 | Apple |
| 122 | Ponderosa pine | 671 | Ohia |
| 123 | Table mountain pine | 691 | Water tupelo |
| 124 | Monterey pine | 693 | Black tupelo |
| 125 | Red pine | 694 | Swamp tupelo |
| 126 | Pitch pine | 711 | Sourwood |
| 127 | California foothill pine | 730 | California sycamore |
| 128 | Pond pine | 731 | American sycamore |
| 129 | Eastern white pine | 740 | Cottonwood |
| 131 | Loblolly pine | 741 | Balsam poplar |
| 132 | Virginia pine | 742 | Eastern cottonwood |
| 133 | Singleleaf pinyon | 743 | Bigtooth Aspen |
| 134 | Border pinyon | 745 | Plains cottonwood |
| 135 | Arizona pine | 746 | Quaking aspen |
| 197 | Spruce | 747 | Black cottonwood |
| 201 | Bigcone Douglas fir | 748 | Fremont's cottonwood |
| 202 | Douglas fir | 749 | Narrowleaf cottonwood |
| 211 | Redwood | 755 | Syrian mesquite |
| 212 | Giant sequoia | 756 | Honey mesquite |
| 221 | Baldcypress | 757 | Velvet mesquite |
| 222 | Pondcypress | 758 | Screwbean mesquite |
| 231 | Pacific yew | 760 | Sweet cherry |
| 240 | Cedar | 762 | Black cherry |
| 242 | Western redcedar | 764 | Bitter cherry |
| 251 | California nutmeg | 800 | Oak |
| 260 | Hemlock | 801 | California live oak |
| 261 | Eastern hemlock | 802 | White oak |
| 263 | Western hemlock | 803 | Gray oak |
| 264 | Mountain hemlock | 804 | Swamp white oak |
| 268 | Eastern red cedar | 805 | Canyon live oak |
| 299 | Other Softwoods | 806 | Scarlet oak |
|  |  | 807 | Blue oak |
|  |  | 810 | Emory's oak |
|  |  | 811 | Engelmann's oak |
|  |  | 812 | Southern red oak |
|  |  | 813 | Cherrybark oak |
|  |  | 814 | Gambel's oak |
|  |  | 815 | Oregon white oak |
|  |  | 817 | Shingle oak |
|  |  | 818 | California black oak |
|  |  | 820 | Lauel oak |
|  |  | 821 | California white oak |
|  |  | 822 | Overcup oak |
|  |  | 823 | Bur oak |
|  |  | 824 | Blackjack oak |
|  |  | 825 | Swamp chestnut oak |
|  |  | 826 | Chinkapin oak |
|  |  | 827 | Water oak |
|  |  | 828 | Nuttall oak |
|  |  | 829 | Mexican blue oak |
|  |  | 830 | Pin oak |
|  |  | 831 | Willow oak |
|  |  | 832 | Chestnut oak |
|  |  | 833 | Northern red oak |
|  |  | 834 | Shumard oak |
|  |  | 835 | Post oak |
|  |  | 837 | Black oak |
|  |  | 839 | Interior live oak |
|  |  | 843 | Silverleaf oak |
|  |  | 901 | Black locust |
|  |  | 902 | New Mexico locust |
|  |  | 920 | Willow |
|  |  | 930 | Sassafras |
|  |  | 950 | Basswood |
|  |  | 951 | American basswood |
|  |  | 970 | Elm |
|  |  | 981 | California laurel |
|  |  | 990 | Desert ironwood |
|  |  | 998 | Other Hardwoods |
|  |  | 999 | Unknown |

## List of NSVB Equations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **List of NSVB Equations** | | | | | |
| **SPCD** | **DIVISION** | **NSVBEQ** | **SPCD** | **DIVISION** | **NSVBEQ** |
| 10 | M240 | NVBM240010 | 311 |  | NVB0000311 |
| 10 |  | NVB0000010 | 312 | M240 | NVBM240312 |
| 11 | 240 | NVB0240011 | 312 |  | NVB0000312 |
| 11 | M210 | NVBM210011 | 313 |  | NVB0000313 |
| 11 | M240 | NVBM240011 | 315 |  | NVB0000315 |
| 11 |  | NVB0000011 | 316 | 210 | NVB0210316 |
| 12 | 130 | NVB0130012 | 316 | 220 | NVB0220316 |
| 12 | 210 | NVB0210012 | 316 | 230 | NVB0230316 |
| 12 | 220 | NVB0220012 | 316 | M220 | NVBM220316 |
| 12 | M210 | NVBM210012 | 316 |  | NVB0000316 |
| 12 |  | NVB0000012 | 317 |  | NVB0000317 |
| 15 | M260 | NVBM260015 | 318 | 210 | NVB0210318 |
| 15 | M310 | NVBM310015 | 318 | 220 | NVB0220318 |
| 15 | M330 | NVBM330015 | 318 | M210 | NVBM210318 |
| 15 |  | NVB0000015 | 318 | M220 | NVBM220318 |
| 16 |  | NVB0000016 | 318 |  | NVB0000318 |
| 17 |  | NVB0000017 | 330 | M220 | NVBM220330 |
| 18 |  | NVB0000018 | 330 |  | NVB0000330 |
| 19 | M130 | NVBM130019 | 351 | M240 | NVBM240351 |
| 19 | M210 | NVBM210019 | 351 |  | NVB0000351 |
| 19 | M240 | NVBM240019 | 370 | 230 | NVB0230370 |
| 19 | M330 | NVBM330019 | 370 | M220 | NVBM220370 |
| 19 |  | NVB0000019 | 370 |  | NVB0000370 |
| 20 | M260 | NVBM260020 | 371 | 130 | NVB0130371 |
| 20 |  | NVB0000020 | 371 | 210 | NVB0210371 |
| 42 | M240 | NVBM240042 | 371 | 220 | NVB0220371 |
| 42 |  | NVB0000042 | 371 | M210 | NVBM210371 |
| 43 | 230 | NVB0230043 | 371 |  | NVB0000371 |
| 43 |  | NVB0000043 | 372 |  | NVB0000372 |
| 68 | 220 | NVB0220068 | 373 |  | NVB0000373 |
| 68 | 230 | NVB0230068 | 374 |  | NVB0000374 |
| 68 | 250 | NVB0250068 | 375 | 130 | NVB0130375 |
| 68 |  | NVB0000068 | 375 | 210 | NVB0210375 |
| 71 | 130 | NVB0130071 | 375 | 220 | NVB0220375 |
| 71 | 210 | NVB0210071 | 375 | M130 | NVBM130375 |
| 71 | M130 | NVBM130071 | 375 | M210 | NVBM210375 |
| 71 | M210 | NVBM210071 | 375 | M330 | NVBM330375 |
| 71 | M330 | NVBM330071 | 375 |  | NVB0000375 |
| 71 |  | NVB0000071 | 391 |  | NVB0000391 |
| 73 |  | NVB0000073 | 400 | 220 | NVB0220400 |
| 81 | M260 | NVBM260081 | 400 | 230 | NVB0230400 |
| 81 |  | NVB0000081 | 400 | M220 | NVBM220400 |
| 90 | 130 | NVB0130090 | 400 | M230 | NVBM230400 |
| 90 | M130 | NVBM130090 | 400 |  | NVB0000400 |
| 90 | M210 | NVBM210090 | 402 |  | NVB0000402 |
| 90 | M330 | NVBM330090 | 403 | 220 | NVB0220403 |
| 90 |  | NVB0000090 | 403 |  | NVB0000403 |
| 91 | 210 | NVB0210091 | 404 | 230 | NVB0230404 |
| 91 |  | NVB0000091 | 404 |  | NVB0000404 |
| 93 | M130 | NVBM130093 | 405 |  | NVB0000405 |
| 93 | M210 | NVBM210093 | 407 |  | NVB0000407 |
| 93 | M240 | NVBM240093 | 409 |  | NVB0000409 |
| 93 | M330 | NVBM330093 | 421 | 220 | NVB0220421 |
| 93 | M340 | NVBM340093 | 421 |  | NVB0000421 |
| 93 |  | NVB0000093 | 460 | 230 | NVB0230460 |
| 94 | 130 | NVB0130094 | 460 |  | NVB0000460 |
| 94 | 210 | NVB0210094 | 461 | 230 | NVB0230461 |
| 94 | 220 | NVB0220094 | 461 |  | NVB0000461 |
| 94 | M130 | NVBM130094 | 462 |  | NVB0000462 |
| 94 |  | NVB0000094 | 471 |  | NVB0000471 |
| 95 | 130 | NVB0130095 | 491 | 230 | NVB0230491 |
| 95 | 210 | NVB0210095 | 491 |  | NVB0000491 |
| 95 | M130 | NVBM130095 | 521 | 230 | NVB0230521 |
| 95 |  | NVB0000095 | 521 |  | NVB0000521 |
| 96 |  | NVB0000096 | 531 | 210 | NVB0210531 |
| 97 | 130 | NVB0130097 | 531 | 220 | NVB0220531 |
| 97 | 210 | NVB0210097 | 531 | 230 | NVB0230531 |
| 97 | M210 | NVBM210097 | 531 | M210 | NVBM210531 |
| 97 |  | NVB0000097 | 531 | M220 | NVBM220531 |
| 98 | M240 | NVBM240098 | 531 |  | NVB0000531 |
| 98 |  | NVB0000098 | 540 | 230 | NVB0230540 |
| 100 | 130 | NVB0130100 | 540 | M220 | NVBM220540 |
| 100 | M210 | NVBM210100 | 540 |  | NVB0000540 |
| 100 |  | NVB0000100 | 541 | 210 | NVB0210541 |
| 101 |  | NVB0000101 | 541 | 220 | NVB0220541 |
| 105 | 130 | NVB0130105 | 541 | M210 | NVBM210541 |
| 105 | 210 | NVB0210105 | 541 | M220 | NVBM220541 |
| 105 | 220 | NVB0220105 | 541 |  | NVB0000541 |
| 105 |  | NVB0000105 | 543 | 210 | NVB0210543 |
| 107 | 230 | NVB0230107 | 543 |  | NVB0000543 |
| 107 |  | NVB0000107 | 544 | 230 | NVB0230544 |
| 108 | 130 | NVB0130108 | 544 |  | NVB0000544 |
| 108 | 330 | NVB0330108 | 552 |  | NVB0000552 |
| 108 | M130 | NVBM130108 | 555 | 230 | NVB0230555 |
| 108 | M210 | NVBM210108 | 555 |  | NVB0000555 |
| 108 | M240 | NVBM240108 | 591 | 230 | NVB0230591 |
| 108 | M330 | NVBM330108 | 591 |  | NVB0000591 |
| 108 |  | NVB0000108 | 601 |  | NVB0000601 |
| 110 | 220 | NVB0220110 | 602 | M220 | NVBM220602 |
| 110 | 230 | NVB0230110 | 602 |  | NVB0000602 |
| 110 | 250 | NVB0250110 | 611 | 230 | NVB0230611 |
| 110 | M220 | NVBM220110 | 611 |  | NVB0000611 |
| 110 | M230 | NVBM230110 | 621 | 220 | NVB0220621 |
| 110 |  | NVB0000110 | 621 | 230 | NVB0230621 |
| 111 | 230 | NVB0230111 | 621 | M220 | NVBM220621 |
| 111 |  | NVB0000111 | 621 |  | NVB0000621 |
| 111 | 230 | NVB0230111P | 651 |  | NVB0000651 |
| 111 |  | NVB0000111P | 652 |  | NVB0000652 |
| 113 |  | NVB0000113 | 653 | 230 | NVB0230653 |
| 115 | 230 | NVB0230115 | 653 |  | NVB0000653 |
| 115 |  | NVB0000115 | 680 |  | NVB0000680 |
| 116 |  | NVB0000116 | 691 | 230 | NVB0230691 |
| 117 | M260 | NVBM260117 | 691 |  | NVB0000691 |
| 117 |  | NVB0000117 | 693 | 220 | NVB0220693 |
| 119 | M240 | NVBM240119 | 693 | 230 | NVB0230693 |
| 119 | M330 | NVBM330119 | 693 | M220 | NVBM220693 |
| 119 |  | NVB0000119 | 693 |  | NVB0000693 |
| 121 | 230 | NVB0230121 | 694 | 230 | NVB0230694 |
| 121 |  | NVB0000121 | 694 |  | NVB0000694 |
| 122 | 310 | NVB0310122 | 701 |  | NVB0000701 |
| 122 | 330 | NVB0330122 | 711 |  | NVB0000711 |
| 122 | M210 | NVBM210122 | 731 | 230 | NVB0230731 |
| 122 | M240 | NVBM240122 | 731 |  | NVB0000731 |
| 122 | M260 | NVBM260122 | 740 | 130 | NVB0130740 |
| 122 | M310 | NVBM310122 | 740 | 230 | NVB0230740 |
| 122 | M330 | NVBM330122 | 740 | M330 | NVBM330740 |
| 122 | M340 | NVBM340122 | 740 |  | NVB0000740 |
| 122 |  | NVB0000122 | 741 | 130 | NVB0130741 |
| 123 | M220 | NVBM220123 | 741 | 210 | NVB0210741 |
| 123 |  | NVB0000123 | 741 |  | NVB0000741 |
| 125 | 130 | NVB0130125 | 742 | 250 | NVB0250742 |
| 125 | 210 | NVB0210125 | 742 |  | NVB0000742 |
| 125 | 220 | NVB0220125 | 743 | 130 | NVB0130743 |
| 125 |  | NVB0000125 | 743 | 210 | NVB0210743 |
| 126 | M220 | NVBM220126 | 743 | 220 | NVB0220743 |
| 126 |  | NVB0000126 | 743 |  | NVB0000743 |
| 128 | 230 | NVB0230128 | 746 | 130 | NVB0130746 |
| 128 |  | NVB0000128 | 746 | 210 | NVB0210746 |
| 129 | 130 | NVB0130129 | 746 | 220 | NVB0220746 |
| 129 | 210 | NVB0210129 | 746 | M130 | NVBM130746 |
| 129 | 220 | NVB0220129 | 746 | M210 | NVBM210746 |
| 129 | 230 | NVB0230129 | 746 | M240 | NVBM240746 |
| 129 | M210 | NVBM210129 | 746 | M330 | NVBM330746 |
| 129 | M220 | NVBM220129 | 746 |  | NVB0000746 |
| 129 |  | NVB0000129 | 747 | 130 | NVB0130747 |
| 130 |  | NVB0000130 | 747 | M130 | NVBM130747 |
| 131 | 220 | NVB0220131 | 747 | M210 | NVBM210747 |
| 131 | 230 | NVB0230131 | 747 | M330 | NVBM330747 |
| 131 | M230 | NVBM230131 | 747 |  | NVB0000747 |
| 131 |  | NVB0000131 | 762 | 210 | NVB0210762 |
| 131 | 230 | NVB0230131P | 762 | 230 | NVB0230762 |
| 131 |  | NVB0000131P | 762 | M220 | NVBM220762 |
| 132 | 220 | NVB0220132 | 762 |  | NVB0000762 |
| 132 | 230 | NVB0230132 | 800 | 230 | NVB0230800 |
| 132 | M220 | NVBM220132 | 800 |  | NVB0000800 |
| 132 |  | NVB0000132 | 802 | 210 | NVB0210802 |
| 202 | 130 | NVB0130202 | 802 | 220 | NVB0220802 |
| 202 | 240 | NVB0240202 | 802 | 230 | NVB0230802 |
| 202 | 260 | NVB0260202 | 802 | 250 | NVB0250802 |
| 202 | 340 | NVB0340202 | 802 | M220 | NVBM220802 |
| 202 | M210 | NVBM210202 | 802 | M230 | NVBM230802 |
| 202 | M240 | NVBM240202 | 802 |  | NVB0000802 |
| 202 | M260 | NVBM260202 | 804 |  | NVB0000804 |
| 202 | M310 | NVBM310202 | 806 | 220 | NVB0220806 |
| 202 | M330 | NVBM330202 | 806 | 230 | NVB0230806 |
| 202 |  | NVB0000202 | 806 | M220 | NVBM220806 |
| 211 | 260 | NVB0260211 | 806 |  | NVB0000806 |
| 211 |  | NVB0000211 | 809 | 220 | NVB0220809 |
| 221 | 230 | NVB0230221 | 809 |  | NVB0000809 |
| 221 |  | NVB0000221 | 812 | 230 | NVB0230812 |
| 222 | 230 | NVB0230222 | 812 |  | NVB0000812 |
| 222 |  | NVB0000222 | 813 | 230 | NVB0230813 |
| 241 | 210 | NVB0210241 | 813 |  | NVB0000813 |
| 241 |  | NVB0000241 | 817 |  | NVB0000817 |
| 242 | 240 | NVB0240242 | 820 | 230 | NVB0230820 |
| 242 | 340 | NVB0340242 | 820 |  | NVB0000820 |
| 242 | M210 | NVBM210242 | 822 | 230 | NVB0230822 |
| 242 | M240 | NVBM240242 | 822 |  | NVB0000822 |
| 242 | M330 | NVBM330242 | 823 |  | NVB0000823 |
| 242 |  | NVB0000242 | 825 | 230 | NVB0230825 |
| 260 | M210 | NVBM210260 | 825 |  | NVB0000825 |
| 260 | M240 | NVBM240260 | 826 |  | NVB0000826 |
| 260 | M330 | NVBM330260 | 827 | 230 | NVB0230827 |
| 260 |  | NVB0000260 | 827 |  | NVB0000827 |
| 261 | 210 | NVB0210261 | 828 | 230 | NVB0230828 |
| 261 | M220 | NVBM220261 | 828 |  | NVB0000828 |
| 261 |  | NVB0000261 | 830 |  | NVB0000830 |
| 263 | 240 | NVB0240263 | 831 | 230 | NVB0230831 |
| 263 | 340 | NVB0340263 | 831 |  | NVB0000831 |
| 263 | M210 | NVBM210263 | 832 | 220 | NVB0220832 |
| 263 | M240 | NVBM240263 | 832 | 230 | NVB0230832 |
| 263 | M330 | NVBM330263 | 832 | M220 | NVBM220832 |
| 263 |  | NVB0000263 | 832 |  | NVB0000832 |
| 264 | M240 | NVBM240264 | 833 | 210 | NVB0210833 |
| 264 |  | NVB0000264 | 833 | 220 | NVB0220833 |
| 1 |  | NVB0000001 | 833 | 230 | NVB0230833 |
| 2 |  | NVB0000002 | 833 | M220 | NVBM220833 |
| 3 |  | NVB0000003 | 833 |  | NVB0000833 |
| 4 |  | NVB0000004 | 834 |  | NVB0000834 |
| 5 |  | NVB0000005 | 835 | 220 | NVB0220835 |
| 6 |  | NVB0000006 | 835 | 230 | NVB0230835 |
| 7 |  | NVB0000007 | 835 |  | NVB0000835 |
| 8 |  | NVB0000008 | 837 | 210 | NVB0210837 |
| 9 |  | NVB0000009 | 837 | 220 | NVB0220837 |
|  |  |  | 837 | 230 | NVB0230837 |
|  |  |  | 837 | 250 | NVB0250837 |
|  |  |  | 837 | M210 | NVBM210837 |
|  |  |  | 837 | M220 | NVBM220837 |
|  |  |  | 837 |  | NVB0000837 |
|  |  |  | 838 | 230 | NVB0230838 |
|  |  |  | 838 |  | NVB0000838 |
|  |  |  | 901 | M220 | NVBM220901 |
|  |  |  | 901 |  | NVB0000901 |
|  |  |  | 920 |  | NVB0000920 |
|  |  |  | 922 |  | NVB0000922 |
|  |  |  | 931 |  | NVB0000931 |
|  |  |  | 950 | 210 | NVB0210950 |
|  |  |  | 950 | M220 | NVBM220950 |
|  |  |  | 950 |  | NVB0000950 |
|  |  |  | 951 | 210 | NVB0210951 |
|  |  |  | 951 | 220 | NVB0220951 |
|  |  |  | 951 |  | NVB0000951 |
|  |  |  | 970 | 230 | NVB0230970 |
|  |  |  | 970 |  | NVB0000970 |
|  |  |  | 971 |  | NVB0000971 |
|  |  |  | 972 | 210 | NVB0210972 |
|  |  |  | 972 |  | NVB0000972 |
|  |  |  | 975 |  | NVB0000975 |
|  |  |  | 999 | 230 | NVB0230999 |
|  |  |  | 999 | M220 | NVBM220999 |
|  |  |  | 999 |  | NVB0000999 |

Note: The character “P” in the equation NVB0230111P, NVB0000111P, NVB0230131P and NVB0000131P means for plantation

1. Only one required for any one tree. The use of either TOTHT or HT1PRD is dependent upon the volume equation number and/or Regional requirements. [↑](#footnote-ref-1)
2. Only one required (UPSD1 or AVGZ1) if using a Flewelling 3-point model. [↑](#footnote-ref-2)