

# TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE

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## PROCEDURE FOR OBTAINING PERCENT NORMAL BASAL AREA

AND

## NORMAL YIELD TABLES

The most common expression of site quality is site index. Site index is the average height attained by dominant and codominant trees at key ages such as 50 or 100 years. Site index does not accurately reflect the volume of wood fiber produced.

A Normal Yield Table translates site index and stand age to volume of wood fiber per unit area i.e., cubic feet of wood per acre. Normal Yield Tables assume that forest growth will follow a predictable pattern and form a "normal stand". A "normal stand" is one in which all the growing space is effectively occupied, but ample room is available for the development of crop trees.

Normal Yield Tables rely on only two variables, site index and stand age. For the sake of simplicity an equally important variable, stocking rate, is assigned a value that reflects the growth pattern of a "normal stand".

Stocking rate is commonly expressed as "basal area". Basal area relates trees per acre and the diameter of the trees. Basal area =  $.005454 \times \text{trees per acre} \times (\text{average diameter breast height})^2$  squared.

With increased levels of human activity "normal stands" are rarely given an opportunity to form. Tree planting, brush control, thinning, and livestock grazing all influence the number of trees per acre. Soil type can also effect the density of a stand i.e., warm or cold soils in dry areas often support fewer trees per acre than assumed by Normal Yield Tables.

When providing landowners with potential yields use the following procedure to adjust the volumes found in Normal Yield Tables.

## ADJUSTING NORMAL YIELDS

When a unit fails to support a fully stocked stand an adjustment can be made by comparing the "normal basal area" with the basal area actually measured. On the unit in question determine the mean basal area, mean site index, and mean stand age. Calculate "percent normal basal area" by dividing the measured basal area by the "normal basal area" for same age and site index and multiply by 100. Normal basal area can be obtained from volume table publications. (See attached reference list for commonly used volume table publications.) Multiply the normal yield by the percent normal basal area to obtain the adjusted yield.

Ex: Mean Site Index: 120  
 Mean Stand Age: 50 years  
 Measured Basal Area: 160 square feet  
 Normal Basal Area from table at site index 120 and age 50: 241 square feet  
 Therefore:  $160/241 = .66 \times 100 = 66$  Percent Normal Basal Area  
 Normal Yield (from table): 6790 cuft/ac  
 Adjusted Yield:  $.66 \times 6790 = 4481$  cuft/ac

Yield can also be expressed as average annual growth or Mean Annual Increment (MAI) by dividing yield by the mean stand age.

Ex:  $(4481 \text{ cuft/ac}) / 50 \text{ years} = 90 \text{ cuft/ac/year}$ .

## Examples of Volume Tables and Basal Area Tables for Ponderosa Pine

### PONDEROSA PINE

*Cubic-foot volume per acre,<sup>1</sup> including stump and tip but not bark, of trees 6.8 inches and more in diameter*

*From Table 10, U.S.D.A. Tech. Bul. 630*

Age (years)	Volume per acre, by site index—													
	40	50	60	70	80	90	100	110	120	130	140	150	160	
20					20	140	350	830	1,300	1,840	2,520	3,150	3,970	
30			50	210	420	1,060	1,770	2,630	3,420	4,320	5,150	6,050	7,040	
40		80	310	720	1,290	2,280	3,260	4,290	5,260	6,380	7,370	8,320	9,610	
50	60	280	820	1,480	2,240	3,300	4,540	5,710	6,790	8,050	9,240	10,420	11,830	
60	160	640	1,450	2,220	3,100	4,340	5,560	6,820	8,000	9,420	10,860	12,260	13,760	
70	360	1,130	2,080	2,920	3,820	5,000	6,350	7,710	9,040	10,600	12,260	13,860	15,450	
80	690	1,640	2,650	3,530	4,440	5,720	7,020	8,460	9,940	11,640	13,460	15,150	16,950	
90	1,090	2,100	3,150	4,050	4,970	6,250	7,600	9,090	10,700	12,550	14,550	16,250	18,250	
100	1,480	2,500	3,570	4,480	5,410	6,700	8,090	9,620	11,350	13,350	15,450	17,200	19,360	

### PONDEROSA PINE

*Basal area per acre<sup>1</sup> of trees 6.8 inches and more in diameter*

*From Table 8, U.S.D.A. Tech. Bul. 630*

Age (years)	Basal area per acre, by site index—													
	40	50	60	70	80	90	100	110	120	130	140	150	160	
20					2	9	20	36	59	82	100	119	138	
30			3	15	32	58	94	124	148	172	192	210	227	
40		6	20	51	88	126	161	188	212	235	252	268	282	
50	3	22	52	96	134	165	195	219	241	260	277	292	306	
60	8	42	81	125	157	185	210	231	252	268	285	301	315	
70	16	69	106	144	172	195	217	237	255	271	286	302	317	
80	30	93	128	157	181	202	222	240	256	272	287	302	318	
90	58	109	140	167	187	207	224	242	257	272	287	303	318	
100	80	121	149	173	192	210	226	242	257	272	288	303	318	

## REFERENCES

Following is a list of references commonly used to obtain volumes of commercial forest trees in Oregon (see Forestry Tech Note #2). Some Normal Basal Area Tables can also be found in the SCS Forestry Handbook. The appropriate page and/or table numbers are given below.

SITE INDEX CURVE #	NAT'L PLANT SYMBOL	FORESTRY HANDBOOK PAGE #	REFERENCE
035	ABGR	--	Cochran, P.H. 1979. <u>Gross Yield for Even-aged Stands of Douglas-fir and White of Grand Fir East of the Cascades in Oregon and Washington.</u> Table 4. USFS Res. Paper PNW-263.
050	ABMA	W-541 W-542	Schumacher, F.X. 1928. <u>Normal Yield Tables for Red Fir.</u> Table 1. Calif. Ag. Exp. Sta. Bull. No. 456.
100	ALRU2	W-814 W-815	Worthington, M.P. 1960. <u>Normal Yield Tables for Red Alder.</u> Table 9 & 10. USFS Res. Paper 36.
265	LAOC	--	Schmidt, W.C. 1976. <u>Ecology and Silviculture of Western Larch Forests.</u> Table 29. USFS Tech. Bull. 1520.
520	PICO	--	Dahms, W.G. 1964. <u>Gross and Net Yield Tables for Lodgepole Pine.</u> Table 3. USFS PNW Res. Paper 8.
570	PIMO3	W-411	Haig, I.T. 1932. <u>Second Growth Yield Stand and Volume Tables for Western White Pine Type.</u> Table 5. USFS Tech. Bull. No. 323.
600	PIPO	W-308 W-312 W-317	Meyer, W.H. 1961. <u>Yield of Even-aged Stands of Ponderosa Pine.</u> Tables 4,8,13. USFS Tech Bull. No. 630.

SITE INDEX CURVE #	NAT'L PLANT SYMBOL	FORESTRY HANDBOOK PAGE #	REFERENCE
490	PISI	--	Meyer, W.H. 1937. <u>Yield of Even-aged Stands of Sitka Spruce and Western Hemlock.</u> Table 2. USFS PNW Tech. Bull. 544.
733	POTR5	W-831 W-835	Baker, F.S. 1925. <u>Aspen in the Central Rocky Mountain Region.</u> USDA Dept. Bull. No. 1291.
765	PSMEG	--	Cochran, P.H. 1979. <u>Gross Yield for Even-aged Stands of Douglas-fir and White of Grand Fir East of the Cascades in Oregon and Washington.</u> Table 3. USFS Res. Paper PNW-263.
790	PSME	W-206	McArdle, R.E. 1961. <u>The Yield of Douglas-fir in the Pacific Northwest.</u> Table 1. USFS PNW Tech. Bull. No. 201.
795	PSME	--	Chambers, C.J. 1972. <u>Empirical Yield Tables for the Douglas-fir Zone.</u> Table 1. Washington DNR Report No. 20R.
930	SESE	W-702	Lindquist, J.L. 1963. <u>Empirical Yield Tables for Young Growth Redwood.</u> Table 3. Calif. Ag. Exp. Sta. Bull. 796.
990	TSHE	W-624	Barnes, G.H. 1962. <u>Yield of Even-aged Stands of Western Hemlock.</u> Table 7. USFS Bull. No. 1273.