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FOREST PRODUCTS LABORATORY

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WEIGHTS OF VARIOUS WOODS GROWN IN THE UNITED STATES

Calculated values of weights are necessarily approximate values owing to variations in moisture content, density, sapwood thickness, and the like that occur in different parts of the same timber. The calculated average weights obtained by the methods given here are not 100 percent accurate but are more accurate than the weight tables commonly given in grading rules as a basis for estimating timber transportation costs or other exacting transactions. The methods are also useful in roughly determining truck capacity needed to haul a given lot of timbers or the possibility of driving or towing logs.

There is enough difference between the weights of sawed and round timbers to require separate methods for estimating their average weights.

PART I. SAWED TIMBERS

Table 1 gives for various woods grown in the United States the average weights per cubic foot of sawed timbers at moisture content values of 8 and 15 percent, and the average weight of 1,000 board-feet when air-dry (15 percent moisture content). Factors for adjusting values for each 1 percent change in moisture content are given.

Table 1 is based on the weights and volumes of 2- by 2-inch, clear specimens from the top 4 feet of 16-foot butt logs of typical trees.

In any lot of lumber of a given species in the air-dry condition at 15 percent moisture content, the weight per cubic foot will rarely vary more than 10 percent from the figure given in table 1. The greatest changes in weight are those that occur in the early stages of drying of green wood. Changes in the moisture content of air-dry wood are attended by only

relatively small changes in weight per cubic foot, owing to the counter effect of change in volume as a result of accompanying shrinkage and swelling.

The values given in table 1 for weight per 1,000 board-feet at 15 percent moisture content were determined by multiplying the values per cubic foot at 15 percent by 83.3. The weights per 1,000 feet given in column 5 apply to theoretical board-foot measure (1,000 linear feet actually 1 inch thick and 12 inches wide, or equivalent) and not to a 1,000 board-feet lumber scale. Rough lumber is sometimes oversized and dressed lumber usually undersized with respect to nominal sizes. The values given in column 5 of table 1 will generally, therefore, need to be adjusted for actual shipments of lumber. The adjustment for 1- by 8-inch boards dressed to 25/32 inch in thickness and 7-1/2 inches in width is as follows:

$$\frac{25/32 \times 7\text{-}1/2}{1 \times 8} = 0.7324.$$

The value given in column 5 of table 1 (actual board-feet 15 percent moisture content) multiplied by this adjustment factor, gives the weight of the dressed lumber. The adjustment for rough oversized lumber is made in similar fashion, that is, actual size divided by nominal size. In like manner constants for any dressed size may be worked out and the weight per 1,000 board-feet computed.

Column (6) is an example of the weight per 1,000 board-feet of 1- by 8-inch boards dressed to 25/32 inch in thickness and 7-1/2 inches in width for various species. It has been computed by multiplying the values in column 5 by the foregoing constant 0.7324.

PART II. ROUND TIMBERS

The weight per unit volume of green round timbers, such as logs, pulpwood, posts, poles, and piling, may be estimated by means of tables 2, 3, and 4. Table 2 gives the average specific gravity and moisture content of sapwood and heartwood of various species in the green condition. Table 3 gives the percentage of sapwood in round timbers for various thicknesses, and diameters. Table 4 gives the weight per cubic foot of green wood at various specific gravities and moisture content values.

All three tables are necessary for estimating the weight per cubic foot of round timbers because in round timbers the proportions of sapwood and heartwood in the total volume often differ widely. Furthermore, the sapwood generally contains more water than the heartwood and both the sapwood and heartwood contain more moisture in the butt logs than in the top logs.

The following example illustrates how to determine the approximate weight per cubic foot of green round timber using tables 2, 3, and 4:

Example:

Given a species, say, black tupelo. The average specific gravity for the species is found from table 2 to be 0.46. The moisture content of the sapwood can be determined by actual measurement or estimated from table 2 as 115 percent. The moisture content of the heartwood can be determined by actual measurement or estimated from table 2 as 87 percent.

Next measure the average diameter of the timber and average width of sapwood. If the average diameter is, say, 10 inches and average sapwood thickness is 1-3/4 inches, then from table 3 the percentage of the volume of the round timber occupied by the sapwood is found to be 58 percent. The percentage of the volume occupied by the heartwood will therefore be, 100 percent minus 58 percent, or 42 percent.

Turning to table 4, and looking under a specific gravity of 0.46 for a sapwood moisture content of 115 percent, the weight per cubic foot is found to be 61.7 pounds per cubic foot. Under the same specific gravity value and a moisture content of 87 percent the weight of the heartwood is estimated to be half way between that given for moisture content values of 86 percent and 88 percent, or 53.7 pounds per cubic foot. (Moisture content values in the left column may be applied to either sapwood or heartwood.)

To find the weight in pounds per cubic foot of the round timber it is necessary to multiply the weight of sapwood by the percentage of sapwood divided by 100. Similarly for heartwood. Their sum gives the weight of the round timber in pounds per cubic foot.

Thus: $61.7 \times 58/100 = 35.8$ pounds

$53.7 \times 42/100 = 22.6$ pounds

Total weight of round timber per cubic foot = 35.8 + 22.6 = 58.4 pounds.

Table 1.--Weights of sawed wood of various trees grown in the United States, under different conditions of moisture, and accompanying adjusting factors

Species	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 15 percent	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 8 percent	Factor[1] for adjusting values for each 1 percent change in moisture content	Weight per 1,000 board-feet air-dry (15 percent moisture content): Actual board-feet	Weight per 1,000 board-feet air-dry (15 percent moisture content): Dressed (1 by 8 dressed to 25/32 by 7-1/2)
HARDWOODS					
Alder, red	28.8	28.0	0.112	2,400	1,760
Apple	48.5	47.6	.133	4,040	2,960
Ash					
Black	35.3	34.3	.142	2,940	2,150
Blue	40.7	39.2	.208	3,390	2,480
Green	40.7	39.4	.179	3,390	2,480
White	42.7	41.5	.175	3,560	2,610
Aspen					
Bigtooth	27.3	26.6	.104	2,270	1,660
Quaking	27.0	26.1	.129	2,250	1,650
Basswood,					
American	26.0	25.5	.075	2,170	1,590
Beech,					
American	44.3	43.2	.162	3,690	2,700
Birch					
Alaska paper	38.8	38.0	.117	3,230	2,370
Paper	38.9	38.2	.095	3,240	2,370
Sweet	47.2	46.0	.175	3,930	2,880
Yellow	43.4	42.4	.142	3,620	2,650
Buckeye,					
yellow	25.5	24.8	.104	2,120	1,550
Butternut	27.4	26.4	.145	2,280	1,670
California-laurel	39.5	38.2	.183	3,290	2,410
Cherry, black	36.1	34.8	.183	3,010	2,200
Chestnut,					
American	30.5	29.5	.145	2,540	1,860
Chinkapin,					
golden	32.3	31.3	.145	2,690	1,970
Cottonwood					
Black	24.5	23.8	.104	2,040	1,490
Eastern	28.9	28.0	.125	2,410	1,770
Cucumbertree	34.3	33.3	.142	2,860	2,090
Dogwood					
Flowering	51.5	50.7	.120	4,290	3,140
Pacific	45.9	44.9	.142	3,820	2,800
Elm					
American	36.3	35.5	.117	3,020	2,210
Cedar	45.9	44.6	.187	3,820	2,800
Rock	44.2	42.7	.208	3,680	2,700
Slippery	37.8	36.7	.154	3,150	2,310
Hackberry	37.4	36.2	.175	3,120	2,290
Hickory					
Mockernut	51.4	50.4	.145	4,280	3,130
Pecan	46.5	45.0	.212	3,870	2,830
Pignut	53.4	52.6	.120	4,450	3,260
Shagbark	51.2	50.3	.129	4,270	3,130
Shellbark	49.0	47.8	.170	4,080	2,990
Water	44.6	42.3	.329	3,720	2,720
Holly,					
American	39.8	38.9	.133	3,320	2,430
Honeylocust	45.3	43.6	.250	3,770	2,760
Hophornbeam,					
eastern	50.0	48.8	.167	4,170	3,050
Locust, black	49.0	46.7	.324	4,080	2,990
Madrone,					
Pacific	45.6	44.6	.150	3,800	2,780
Magnolia,					
southern	35.5	34.4	0.162	2,960	2,170
Mangrove	70.0	68.3	.241	5,830	4,270
Maple					
Bigleaf	34.2	33.2	.145	2,850	2,090
Black	40.9	39.8	.150	3,410	2,500
Red	37.0	35.6	.195	3,080	2,260
Silver	33.9	32.8	.154	2,820	2,070
Sugar	44.5	43.4	.154	3,710	2,720
Mountain-laurel	48.8	47.7	.158	4,070	2,980
Oak					
Red					
Black	44.0	43.0	.150	3,670	2,690
Cherry-bark	47.2	45.8	.200	3,930	2,880
Laurel	45.5	44.7	.108	3,790	2,780
Northern red	43.8	42.5	.187	3,650	2,670
Southern red	41.1	40.1	.142	3,420	2,500
Water	44.6	43.8	.120	3,720	2,720
Willow	44.6	43.8	.112	3,720	2,720
White					
Bur	45.0	3.5	.208	3,750	2,750
Post	47.9	47.1	.120	3,990	2,920
Swamp chestnut	48.5	47.9	.087	4,040	2,960
White	46.8	45.6	.167	3,900	2,860
Osage-orange	57.3	54.9	.337	4,770	3,490
Palmetto,					
cabbage	29.6	29.0	.087	2,470	1,810
Persimmon,					
common	50.8	9.7	.158	4,230	3,100
Poplar,					
balsam	23.2	22.5	.100	1,930	1,410
Sugarberry	36.5	35.3	.167	3,040	2,230
Sweetgum	36.4	35.5	.133	3,030	2,220
Sycamore,					
American	35.7	34.7	.137	2,970	2,180
Tupelo					
Black	36.4	35.5	.129	3,030	2,220
Water	35.1	34.0	.162	2,920	2,140
Walnut, black	38.6	37.0	.233	3,220	2,360
Willow, black	27.6	26.9	.104	2,300	1,680
Yellow-poplar	30.3	29.2	.150	2,520	1,850
SOFTWOODS					
Baldcypress	32.6	31.4	.167	2,720	1,990
Cedar					
Alaska-	31.6	30.4	.170	2,630	1,930
Atlantic					
white-	[illegible]	23.0	[illegible]	1,980	1,450
Eastern					
redcedar	33.5	32.2	.187	2,790	2,040
Incense-	25.5	24.2	.183	2,120	1,550
Northern					
white-	21.8	20.8	.145	1,820	1,330
Port-Orford-	30.1	28.9	.175	2,510	1,840
Western					
redcedar	23.4	22.4	.137	1,950	1,430
Douglas-fir					
Coast type	34.3	33.1	0.170	2,860	2,090
Intermediate type	31.8	30.8	.137	2,650	1,940
Rocky Mountain type	30.5	29.2	.179	2,540	1,860
Fir					
Alpine	22.5	21.3	.167	1,870	1,370
Balsam	26.9	26.4	.071	2,240	1,640
California red	28.3	27.2	.158	2,360	1,730
Grand	28.3	27.3	.145	2,360	1,730
Noble	27.1	26.2	.129	2,260	1,660
Pacific silver	28.1	27.3	.117	2,340	1,710
White	26.7	25.8	.129	2,220	1,630
Hemlock					
Eastern	29.0	28.0	.150	2,420	1,770
Western	29.6	28.7	.129	2,470	1,810
Juniper,					
alligator	36.7	35.4	.179	3,060	2,240
Larch,					
western	39.4	38.2	.170	3,280	2,400
Pine					
Eastern					
white	25.4	24.2	.167	2,120	1,550
Jack	30.3	29.2	.158	2,520	1,850
Lodgepole	29.2	28.2	.142	2,430	1,780
Pitch	34.9	33.8	.150	2,910	2,130
Ponderosa	28.6	27.5	.162	2,380	1,740
Red	31.4	30.4	.142	2,620	1,920
Southern yellow					
Loblolly	36.3	35.2	.154	3,020	2,210
Longleaf	41.6	40.3	.179	3,470	2,540
Shortleaf	35.7	34.6	.154	2,970	2,180
Slash	43.9	42.6	.179	3,660	2,680
Sugar	26.0	24.9	.162	2,170	1,590
Western white	28.0	27.1	.129	2,330	1,710
Redwood (old-growth)	28.6	27.4	.175	2,380	1,740
Spruce					
Black	28.8	27.8	.142	2,400	1,760
Engelmann	24.1	23.2	.129	2,010	1,470
Red	28.4	27.2	.175	2,370	1,740
Sitka	28.1	27.1	.145	2,340	1,710
White	29.4	28.7	.104	2,450	1,790
Tamarack	37.6	36.3	.187	3,130	2,290
Yew, Pacific	45.7	44.0	.250	3,810	2,790

[1] To adjust value to any desired moisture content, add factor to value to be adjusted for each 1 percent increase in moisture content; subtract factor from value to be adjusted for each 1 percent decrease in moisture content. These factors take shrinkage well with moisture changes into consideration.

Table 2.--Average moisture content and specific gravity of green wood

Species	Moisture content[1]			Average specific gravity[2]
	Heartwood	Sapwood	Mixed heartwood and sapwood	
	Percent	Percent	Percent	
SOFTWOODS				
Baldcypress	121	171		0.42
Cedar				
Alaska-	32	166		.42
Atlantic white-			35	.31
Eastern redcedar	33			.44
Incense-	40	215		.35
Northern white-			55	.29
Port-Orford-	50	98		.40
Western redcedar	58	249		.31
Douglas-fir				
Coast type	37	115		.45
Intermediate type	34	154		.41
Rocky Mountain type	30	112		.40
Fir				
Alpine			47	.31
Balsam			117	.34
California red			108	.37
Grand	91	136		.37
Noble	34	115		.35
Pacific silver	55	164		.35
White	98	160		.35
Hemlock				
Eastern	97	119		.38
Western	85	170		.38
Larch, western	54	119		.51
Pine				
Eastern white			68	.34
Lodgepole	41	120		.38
Ponderosa	40	148		.38
Red	32	134		.41
Southern yellow				
Loblolly	33	110		.47
Longleaf	31	106		.54
Shortleaf	32	122		.46
Sugar	98	219		.35
Western white	62	148		.36
Redwood (old-growth)	86	210		.38
Spruce				
Eastern	34	128		
Engelmann	51	173		.32
Sitka	41	142		.37
Tamarack	49			.49
HARDWOODS				
Alder, red		97		.37
Apple	81	74		.61
Ash				
Black	95			.45
Green		58		.53
White	46	44		.55
Aspen	95	113		
Basswood, American	81	133		0.32
Beech, American	55	72		.56
Birch				
Paper	89	72		.48
Sweet	75	70		.60
Yellow	74	72		.55
Buckeye, yellow			141	.33
Butternut			104	.36
California-laurel			65	.51
Cherry, black	58			.47
Chestnut, American	120			.40
Chinkapin, golden			134	.42
Cottonwood, black	162	146		.32
Dogwood, flowering			62	.64
Elm				
American	95	92		.46
Cedar	66	61		.59
Rock	44	57		.57
Hackberry	61	65		.49
Hickory				
Bitternut	80	54		.60
Mockernut	70	52		.64
Pignut	71	49		.66
Red	69	52		
Sand	68	50		
Water	97	62		.61
Holly, American			82	.50
Hophornbeam, eastern			52	.63
Locust, black			40	.66
Madrone, Pacific			81	.58
Magnolia	80	104		
Maple				
Silver (soft)	58	97		.44
Sugar (hard)	65	72		.56
Oak				
California black	76	75		.51
Live			50	.81
Northern red	80	69		.56
Southern red	83	75		.52
Tan			89	
Water	81	81		.56
White	64	78		.60
Willow	82	74		.56
Osage-orange			31	.76
Persimmon, common			58	.64
Sweetgum	79	137		.46
Sycamore, American	114	130		.46
Tupelo				
Black	87	115		.46
Swamp	101	108		
Water	150	116		.46
Walnut, black	90	73		.51
Willow, black			139	.34
Yellow-poplar	83	106		.40

[1] Based on weight when oven-dry.

[2] Based on weight when oven-dry and volume when green.

Table 3.--Sapwood, in percent of volume, of round timbers

Sapwood thickness	Average diameter of timber in inches											
	4	5	6	7	8	9	10	11	12	13	14	15	16
Inches													
1/4	23	19	16	14	12	11	10	9	8	8	7	7	6
1/2	44	36	31	27	23	21	19	17	16	15	14	13	12
3/4	61	51	44	38	34	31	28	25	23	22	20	19	18
1	75	64	56	49	44	40	36	33	31	28	27	25	23
1-1/4	86	75	66	59	53	48	44	40	37	35	33	31	29
1-1/2	94	84	75	67	61	56	51	47	44	41	38	36	34
1-3/4	98	91	83	75	68	63	58	54	50	47	44	41	39
2	100	96	89	82	75	69	64	60	56	52	49	46	44
2-1/4	...	99	94	87	81	75	70	65	61	57	54	51	48
2-1/2	...	100	97	92	86	80	75	70	66	62	59	56	53
2-3/4	...	...	99	95	90	85	80	75	71	67	63	60	57
3	...	...	100	98	94	89	84	79	75	71	67	64	61
3-1/4	...	...	...	99	96	92	88	83	79	75	71	68	65
3-1/2	...	...	...	100	98	95	91	87	83	79	75	72	68
3-3/4	...	...	...	...	100	97	94	90	86	82	78	75	72
4	...	...	...	...	100	99	96	93	89	85	82	78	75
4-1/4	...	...	...	...	...	100	98	95	91	88	85	81	78
4-1/2	...	...	...	...	...	100	99	97	94	91	87	84	81
4-3/4	...	...	...	...	...	...	100	98	96	93	90	87	83
5	...	...	...	...	...	...	100	99	97	95	92	89	86

Table 4.--Weight in pounds per cubic foot of green wood at various specif

Moisture content	Specific gravity, based on oven-dry weight and green volume																			
	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70
Percent																					
30	24.3	26.0	27.6	29.2	30.8	32.4	34.1	35.7	37.3	38.9	40.6	42.2	43.8	45.4	47.0	48.7	50.3	51.9	53.5	55.2	56.8
32	24.7	26.4	28.0	29.7	31.3	32.9	34.6	36.2	37.9	39.5	41.2	42.8	44.5	46.1	47.8	49.4	51.1	52.7	54.4	56.0	57.7
34	25.1	26.8	28.4	30.1	31.8	33.4	35.1	36.8	38.5	40.1	41.8	43.5	45.2	46.8	48.5	50.2	51.8	53.5	55.2	56.9	58.5
36	25.5	27.2	28.9	30.6	32.2	33.9	35.6	37.3	39.0	40.7	42.4	44.1	45.8	47.5	49.2	50.9	52.6	54.3	56.0	57.7	59.4
38	25.8	27.6	29.3	31.0	32.7	34.4	36.2	37.9	39.6	41.3	43.1	44.8	46.5	48.2	49.9	51.7	53.4	55.1	56.8	58.6	60.3
40	26.2	28.0	29.7	31.4	33.2	34.9	36.7	38.4	40.2	41.9	43.7	45.4	47.2	48.9	50.7	52.4	54.2	55.9	57.7	59.4	61.2
42	26.6	28.4	30.1	31.9	33.7	35.4	37.2	39.0	40.8	42.5	44.3	46.1	47.8	49.6	51.4	53.2	54.9	56.7	58.5	60.3	62.0
44	27.0	28.8	30.6	32.3	34.1	35.9	37.7	39.5	41.3	43.1	44.9	46.7	48.5	50.3	52.1	53.9	55.7	57.5	59.3	61.1	62.9
46	27.3	29.2	31.0	32.8	34.6	36.4	38.3	40.1	41.9	43.7	45.6	47.4	49.2	51.0	52.8	54.7	56.5	58.3	60.1	62.0	63.8
48	27.7	29.6	31.4	33.2	35.1	36.9	38.8	40.6	42.5	44.3	46.2	48.0	49.9	51.7	53.6	55.4	57.3	59.1	61.0	62.8	64.6
50	28.1	30.0	31.8	33.7	35.6	37.4	39.3	41.2	43.1	44.9	46.8	48.7	50.5	52.4	54.3	56.2	58.0	59.9	61.8	63.6	65.5
52	28.5	30.4	32.2	34.1	36.0	37.9	39.8	41.7	43.6	45.5	47.4	49.3	51.2	53.1	55.0	56.9	58.8	60.7	62.6	64.5	66.4
54	28.8	30.8	32.7	34.6	36.5	38.4	40.4	42.3	44.2	46.1	48.0	50.0	51.9	53.8	55.7	57.7	59.6	61.5	63.4	65.3	67.3
56	29.2	31.2	33.1	35.0	37.0	38.9	40.9	42.8	44.8	46.7	48.7	50.6	52.6	54.5	56.5	58.4	60.4	62.3	64.2	66.2	68.1
58	29.6	31.5	33.5	35.5	37.5	39.4	41.4	43.4	45.4	47.3	49.3	51.3	53.2	55.2	57.2	59.2	61.1	63.1	65.1	67.0	69.0
60	30.0	31.9	33.9	35.9	37.9	39.9	41.9	43.9	45.9	47.9	49.9	51.9	53.9	55.9	57.9	59.9	61.9	63.9	65.9	67.9	69.9
62	30.3	32.3	34.4	36.4	38.4	40.4	42.5	44.5	46.5	48.5	50.5	52.6	54.6	56.6	58.6	60.7	62.7	64.7	66.7	68.7	70.8
64	30.7	32.7	34.8	36.8	38.9	40.9	43.0	45.0	47.1	49.1	51.2	53.2	55.3	57.3	59.4	61.4	63.4	65.5	67.5	69.6	71.6
66	31.1	33.1	35.2	37.3	39.4	41.4	43.5	45.6	47.6	49.7	51.8	53.9	55.9	58.0	60.1	62.2	64.2	66.3	68.4	70.4	72.5
68	31.4	33.5	35.6	37.7	39.8	41.9	44.0	46.1	48.2	50.3	52.4	54.5	56.6	58.7	60.8	62.9	65.0	67.1	69.2	71.3	73.4
70	31.8	33.9	36.1	38.2	40.3	42.4	44.6	46.7	48.8	50.9	53.0	55.2	57.3	59.4	61.5	63.6	65.8	67.9	70.0	72.1	74.3
72	32.2	34.3	36.5	38.6	40.8	42.9	45.1	47.2	49.4	51.5	53.7	55.8	58.0	60.1	62.3	64.4	66.5	68.7	70.8	73.0	75.1
74	32.6	34.7	36.9	39.1	41.3	43.4	45.6	47.8	49.9	52.1	54.3	56.5	58.6	60.8	63.0	65.1	67.3	69.5	71.7	73.8	76.0
76	32.9	35.1	37.3	39.5	41.7	43.9	46.1	48.3	50.5	52.7	54.9	57.1	59.3	61.5	63.7	65.9	68.1	70.3	72.5	74.7	76.9
78	33.3	35.5	37.8	40.0	42.2	44.4	46.7	48.9	51.1	53.3	55.5	57.8	60.0	62.2	64.4	66.6	68.9	71.1	73.3	75.5	77.8
80	33.7	35.9	38.2	40.4	42.7	44.9	47.2	49.4	51.7	53.9	56.2	58.4	60.7	62.9	65.1	67.4	69.6	71.9	74.1	76.4	78.6
82	34.1	36.3	38.6	40.9	43.2	45.4	47.7	50.0	52.2	54.5	56.8	59.1	61.3	63.6	65.9	68.1	70.4	72.7	75.0	77.2	79.5
84	34.4	36.7	39.0	41.3	43.6	45.9	48.2	50.5	52.8	55.1	57.4	59.7	62.0	64.3	66.6	68.9	71.2	73.5	75.8	78.1	80.4
86	34.8	37.1	39.5	41.8	44.1	46.4	48.7	51.1	53.4	55.7	58.0	60.4	62.7	65.0	67.3	69.6	72.0	74.3	76.6	78.9	81.2
88	35.2	37.5	39.9	42.2	44.6	46.9	49.3	51.6	54.0	56.3	58.7	61.0	63.3	65.7	68.0	70.4	72.7	75.1	77.4	79.8	82.1
90	35.6	37.9	40.3	42.7	45.1	47.4	49.8	52.2	54.5	56.9	59.3	61.7	64.0	66.4	68.8	71.1	73.5	75.9	78.2	80.6	83.0
92	35.9	38.3	40.7	43.1	45.5	47.9	50.3	52.7	55.1	57.5	59.9	62.3	64.7	67.1	69.5	71.9	74.3	76.7	79.1	81.5	83.9
94	36.3	38.7	41.2	43.6	46.0	48.4	50.8	53.3	55.7	58.1	60.5	62.9	65.4	67.8	70.2	72.6	75.1	77.5	79.9	82.3	84.7
96	36.7	39.1	41.6	44.0	46.5	48.9	51.4	53.8	56.3	58.7	61.2	63.6	66.0	68.5	70.9	73.4	75.8	78.3	80.7	83.2	85.6
98	37.1	39.5	42.0	44.5	46.9	49.4	51.9	54.4	56.8	59.3	61.8	64.2	66.7	69.2	71.7	74.1	76.6	79.1	81.5	84.0	86.5
100	37.4	39.9	42.4	44.9	47.4	49.9	52.4	54.9	57.4	59.9	62.4	64.9	67.4	69.9	72.4	74.9	77.4	79.9	82.4	84.9	87.4
105	38.4	40.9	43.5	46.1	48.6	51.2	53.7	56.3	58.8	61.4	64.0	66.5	69.1	71.6	74.2	76.8	79.3	81.9	84.4	87.0	89.5
110	39.3	41.9	44.6	47.2	49.8	52.4	55.0	57.7	60.3	62.9	65.5	68.1	70.8	73.4	76.0	78.6	81.2	83.9	86.5	89.1	91.7
115	40.2	42.9	45.6	48.3	51.0	53.7	56.3	59.0	61.7	64.4	67.1	69.8	72.4	75.1	77.8	80.5	83.2	85.9	88.5	91.2	93.9
120	41.2	43.9	46.7	49.4	52.2	54.9	57.7	60.4	63.1	65.9	68.6	71.4	74.1	76.9	79.6	82.4	85.1	87.9	90.6	93.4	96.1
125	42.1	44.9	47.7	50.5	53.4	56.2	59.0	61.8	64.6	67.4	70.2	73.0	75.8	78.6	81.4	84.2	87.0	89.9	92.7	95.5	98.3
130	43.1	45.9	48.8	51.7	54.5	57.4	60.3	63.1	66.0	68.9	71.8	74.6	77.5	80.4	83.2	86.1	89.0	91.9	94.7	97.6	100.5
135	44.0	46.9	49.9	52.8	55.7	58.7	61.6	64.5	67.5	70.4	73.3	76.3	79.2	82.1	85.1	88.0	90.9	93.8	96.8	99.7	102.6
140	44.9	47.9	50.9	53.9	56.9	59.9	62.9	65.9	68.9	71.9	74.9	77.9	80.9	83.9	86.9	89.9	92.9	95.8	98.8	101.8	104.8
145	45.9	48.9	52.0	55.0	58.1	61.2	64.2	67.3	70.3	73.4	76.4	79.5	82.6	85.6	88.7	91.7	94.8	97.8	100.9	104.0	107.0
150	46.8	49.9	53.0	56.2	59.3	62.4	65.5	68.6	71.8	74.9	78.0	81.1	84.2	87.4	90.5	93.6	96.7	99.8	103.0	106.1	109.2

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