TECHNICAL NOTE NUMBER F-21
FOREST PRODUCTS LABORATORY · U. S. FOREST SERVICE · MADISON, WISCONSIN

CALCULATING THE VOLUME OF PILES AND POLES

To determine the amount of preservative per cubic foot of wood absorbed by piles and poles during treatment, a reliable estimate of the volume of the pieces is necessary. The most practical way of finding the volume of such timbers is to measure the diameter at a number of points and calculate the volume from a formula or volume table.

The volume table which follows has been adopted by the American Wood-Preservers Association and is included in standard 14b of that Association. It is absolutely correct only for poles of uniform taper, but errors from sources, such as irregular shape and large checks may be diminished if circumference measurements are taken at short intervals and the volume of each short section is computed separately. In using the table, an attempt should be made to secure the average diameter of ends which are not true circles.

The values in this table were calculated by the cone-frustum formula,

$$V = 0.2618\ L\ \frac{(D^2 + d^2 + dD)}{144}$$

Where V is the volume in cubic feet, L the length in feet, D the top diameter in inches, and d the butt diameter in inches.

Two other formulas are offered below, either of which will give results sufficiently accurate for ordinary purposes.

One is the prismoidal formula,

$$V = \frac{L}{6}(A_1 + 4A_3 + A_2)$$

in which V is the volume, L the length, and A_1, A_2, and A_3 the two end areas and the middle area, respectively. This formula is correct for poles of regular shape or for those either larger or smaller in the middle than at either end.

The second is the mean-end-area formula,

$$V = L\,\frac{(A_1 + A_2)}{2}$$

in which V is the volume, L the length, and A_1 and A_2 the two end areas. In this formula the pole is assumed to be a frustum of a paraboloid, but having a basal area equal to the average of the areas of its two ends. Volumes may be more rapidly calculated by this formula, but values are somewhat large for poles other than those which are larger in the middle than at either end.

TABLE FOR CALCULATING CUBICAL CONTENTS OF POLES AND PILING.

Find the average diameter at each end of the pile to the nearest half inch. Multiply the number in the table corresponding to these two diameters by the length of the pole or pile in feet. The result is in cubic feet.

DIAMETER OF LARGE END—INCHES	Diameter of Small End—Inches																					
	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15
4	.087																						
4½	.099	.110																					
5	.111	.123	.136																				
5½	.124	.137	.150	.165																			
6	.138	.151	.165	.180	.196																		
6½	.153	.167	.181	.197	.213	.230																	
7	.169	.185	.198	.214	.231	.249	.267																
7½	.186	.200	.216	.232	.250	.268	.287	.307															
8	.204	.219	.235	.251	.269	.288	.307	.328	.349														
8½	.222	.238	.254	.271	.290	.309	.329	.350	.371	.394													
9	.242	.258	.275	.292	.311	.330	.351	.372	.395	.418	.442												
9½	.262	.279	.298	.314	.333	.353	.374	.396	.419	.442	.467	.492											
10	.284	.300	.318	.337	.356	.377	.398	.420	.444	.468	.493	.519	.545										
10½	.306	.323	.341	.360	.380	.401	.423	.446	.470	.494	.520	.545	.573	.601									
11	.329	.347	.365	.385	.405	.427	.449	.472	.496	.521	.547	.574	.602	.630	.660								
11½	.353	.371	.390	.410	.431	.453	.476	.500	.524	.550	.576	.603	.631	.660	.690	.721							
12	.378	.397	.416	.437	.458	.480	.504	.528	.553	.579	.605	.633	.662	.691	.722	.753	.785						
12½	.404	.423	.443	.464	.486	.509	.532	.559	.582	.609	.636	.664	.693	.723	.754	.786	.819	.852					
13	.431	.450	.471	.492	.515	.538	.562	.587	.613	.640	.667	.696	.725	.756	.787	.819	.853	.887	.922				
13½	.459	.479	.500	.521	.544	.568	.592	.618	.644	.671	.700	.729	.759	.790	.821	.854	.888	.922	.958	.994			
14	.487	.508	.529	.551	.575	.599	.624	.650	.676	.704	.733	.762	.793	.824	.856	.890	.924	.959	.994	1.031	1.069		
14½	.517	.538	.560	.582	.606	.630	.656	.682	.710	.738	.767	.797	.828	.860	.892	.926	.960	.995	1.032	1.069	1.108	1.147	
15	.547	.569	.591	.614	.638	.663	.689	.716	.744	.772	.802	.832	.864	.896	.929	.963	.998	1.034	1.071	1.109	1.147	1.187	1.227
15½	.579	.600	.623	.647	.671	.697	.723	.750	.779	.808	.838	.869	.900	.933	.967	1.001	1.037	1.073	1.110	1.149	1.188	1.228	1.269
16	.611	.633	.656	.680	.705	.731	.758	.786	.815	.844	.875	.906	.938	.971	1.005	1.040	1.076	1.113	1.151	1.189	1.229	1.269	1.311
16½	.644	.667	.690	.715	.740	.767	.794	.822	.851	.881	.912	.944	.977	1.010	1.045	1.080	1.117	1.154	1.192	1.231	1.271	1.312	1.354
17	.678	.701	.725	.750	.776	.803	.831	.860	.889	.920	.951	.983	1.016	1.050	1.085	1.121	1.158	1.196	1.234	1.274	1.314	1.356	1.398
17½	.713	.737	.761	.787	.813	.840	.869	.898	.928	.959	.991	1.023	1.057	1.091	1.127	1.163	1.200	1.239	1.278	1.318	1.359	1.400	1.443
18	.749	.773	.798	.824	.851	.879	.907	.937	.967	.999	1.031	1.064	1.098	1.133	1.169	1.206	1.244	1.282	1.322	1.362	1.404	1.446	1.489
18½	.786	.810	.836	.862	.890	.918	.947	.977	1.008	1.039	1.072	1.106	1.140	1.176	1.212	1.249	1.288	1.327	1.367	1.408	1.449	1.492	1.536
19	.824	.849	.875	.901	.929	.958	.987	1.018	1.049	1.081	1.114	1.149	1.184	1.210	1.256	1.294	1.333	1.372	1.413	1.454	1.496	1.539	1.584
19½	.862	.888	.914	.941	.969	.999	1.029	1.059	1.091	1.124	1.158	1.192	1.228	1.264	1.301	1.339	1.379	1.419	1.459	1.501	1.544	1.588	1.632
20	.902	.928	.955	.982	1.011	1.040	1.071	1.102	1.134	1.168	1.202	1.237	1.273	1.309	1.347	1.386	1.425	1.466	1.507	1.549	1.593	1.637	1.682
20½	.942	.969	.996	1.024	1.053	1.083	1.114	1.146	1.179	1.212	1.247	1.282	1.319	1.356	1.394	1.433	1.473	1.514	1.556	1.599	1.642	1.687	1.732
21	.984	1.010	1.038	1.067	1.096	1.127	1.158	1.190	1.224	1.258	1.293	1.329	1.365	1.403	1.442	1.481	1.522	1.563	1.605	1.649	1.693	1.738	1.784
21½	1.026	1.053	1.081	1.110	1.140	1.171	1.203	1.236	1.269	1.304	1.339	1.376	1.413	1.451	1.490	1.530	1.571	1.613	1.656	1.699	1.744	1.789	1.836
22	1.069	1.097	1.125	1.155	1.185	1.217	1.249	1.282	1.316	1.351	1.387	1.424	1.462	1.500	1.540	1.580	1.622	1.664	1.707	1.751	1.796	1.842	1.889
22½	1.113	1.141	1.170	1.200	1.231	1.263	1.296	1.329	1.364	1.399	1.436	1.473	1.511	1.550	1.590	1.631	1.673	1.716	1.759	1.804	1.849	1.896	1.943
23	1.158	1.187	1.216	1.247	1.278	1.310	1.344	1.378	1.413	1.449	1.485	1.523	1.562	1.601	1.642	1.683	1.725	1.769	1.813	1.858	1.903	1.950	1.998
23½	1.204	1.233	1.263	1.294	1.326	1.359	1.392	1.427	1.462	1.499	1.536	1.574	1.613	1.653	1.694	1.736	1.779	1.822	1.867	1.912	1.958	2.006	2.054
24	1.251	1.280	1.311	1.342	1.374	1.408	1.442	1.477	1.513	1.549	1.587	1.626	1.665	1.706	1.747	1.789	1.833	1.877	1.922	1.968	2.014	2.062	2.111
24½	1.299	1.329	1.359	1.391	1.424	1.458	1.492	1.528	1.564	1.601	1.639	1.679	1.719	1.759	1.801	1.844	1.888	1.932	1.978	2.024	2.071	2.119	2.168
25	1.347	1.378	1.409	1.441	1.474	1.509	1.544	1.579	1.616	1.654	1.693	1.732	1.773	1.814	1.856	1.899	1.943	1.988	2.034	2.081	2.129	2.178	2.227

Formula $\frac{D^2+d^2+Dd}{141} \times 0.2618 = (D^2+d^2+Dd) \times 0.001818$