DRY-KILN TEMPERATURE SCHEDULES FOR AIRCRAFT LUMBER

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DRY-KILN TEMPERATURE SCHEDULES FOR AIRCRAFT LUMBER[1]

The objective in the kiln drying of aircraft lumber is to produce material of maximum strength. It has been demonstrated that, unless temperatures are kept within proper limits, the strength of wood may be seriously reduced. Freedom from checking, honeycombing, and other drying defects, moreover, has been shown to be no guarantee of the suitability of wood for use in airplane construction.

Drying Schedules

A drying schedule usually specifies both the temperatures and relative humidities that are to be used at various stages of the drying process. The temperatures and relative humidities are based on the current moisture content of the stock. The Forest Products Laboratory prefers to make changes in temperatures and relative humidities at specific moisture content values, and uses this type of drying schedule almost exclusively. When, however, green lumber of a given species and thickness has been dried in a specific kiln often enough to establish the relationship between moisture content and the length of time the lumber has been in the kiln, a time-temperature schedule can be adopted.

The temperatures and relative humidities given in a drying schedule are assumed to be those which exist in the hottest and driest zone of the kiln, hence knowledge of the distribution of temperature and humidity within the kiln is presupposed. Successful drying cannot be accomplished if the kiln is incapable of maintaining the conditions specified by the drying schedule. The temperatures along the length of the kiln on the side at which air enters should be as nearly uniform as possible, and the variation should at no time during the drying process exceed 10° F.

Kiln Samples

The successful use of a drying schedule based upon current moisture content requires a system by which the moisture content of the lumber in the various zones of the charge can be determined with both ease and certainty. The best system so far developed involves the use of kiln samples. These are relatively short pieces of the wettest, thickest, and slowest-drying stock in the kiln charge. All samples are coated at both ends with a moisture-resistant material before being dried. After their initial moisture content values have been determined, the samples are distributed in kiln trucks located in those

[1] This mimeograph is one of a series of progress reports issued by the Forest Products Laboratory to aid the Nation's defense effort. It constitutes a revision of Forest Products Laboratory Mimeo. No. 1360, "Aircraft Kiln Schedules," October, 1941.

parts of the kiln where drying occurs most rapidly and most slowly, and allowed to dry with the rest of the kiln charge. Periodically, these samples are weighed and returned to their respective locations in the kiln. The current moisture content of each sample is calculated and this moisture content is assumed to be at least as high as that of any board in that part of the kiln in which the sample is placed.

Kiln Temperatures

The temperatures permitted by tables 1 and 2 are based on thousands of strength tests on material kiln dried in many experimental runs. Careful adherence to these temperature schedules, together with proper regulation of the relative humidity, may be expected to produce lumber that is fully equal in strength properties and all other respects to the most carefully air-dried stock. Since relative humidities in themselves do not affect the strength of aircraft wood as long as they are high enough to prevent checking and honeycombing, the relative humidity schedule is left to the discretion of the kiln operator, whose judgment will be influenced by a desire to dry the stock as rapidly as possible without kiln degrade. The specified temperatures are maximum values, and are to be changed from time to time in accordance with the wetter half of the samples in the hottest location in the kiln.

Table 1.--Temperature schedule.

Species	Schedule numbers according to thickness				
	Up to and including				Greater than 3 inches
	1 inch	1-1/2 inches	2 inches	3 inches	
Softwoods:					
Baldcypress	4	4	5	6	7
Douglas-fir	3	4	5	6	7
Fir, noble	2	3	4	6	7
red	3	4	5	6	7
Hemlock, western	4	5	6	6	7
Pine, northern white	4	5	6	7	8
ponderosa	4	5	6	6	7
red	2	3	4	6	7
sugar	3	4	5	6	7
western white	4	5	6	7	8
Spruce, red	2	3	4	5	6
Sitka	2	3	4	5	6
white	2	3	4	5	6
White-cedar, Port Orford	2	3	4	5	6
Hardwoods:					
Ash, commercial white	5	5			
Birch, yellow	5	5			
Cherry, black	5	5			
Khaya ("African mahogany")	5	5			
Mahogany, West Indies	5	5			
Maple, silver	3	3			
sugar	3	3			
Oak, commercial red	8	8			
commercial white	8	8			
Sweetgum	6	6			
Yellowpoplar	3	4	5	6	7
Walnut, black	4	4			

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Table 2.--Drying temperatures.

Moisture content	Schedule number							
	1	2	3	4	5	6	7	8
Percent	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
45 or more	140	135	130	125	120	115	110	105
[1]40	145	140	135	130	125	120	115	110
30	150	145	140	135	130	125	120	115
25	155	150	145	140	135	130	125	120
20	160	155	150	145	140	135	130	125
15	165	160	155	150	145	140	135	130
10 to final	170	165	160	155	150	145	140	135

[1]When the initial moisture content of the stock exceeds 40 percent, the initial temperature should be maintained until the moisture content reaches 40 percent, at which stage of the drying the temperature may be increased 5° F.

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