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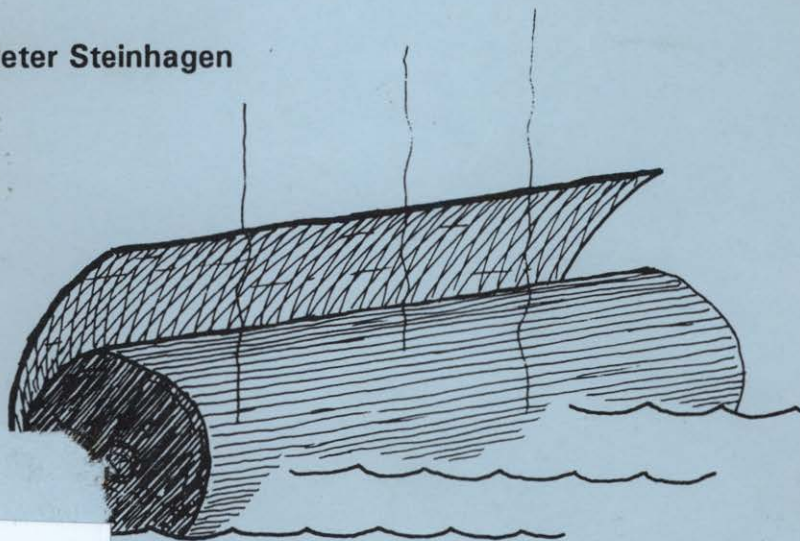
Technical Report 23

University of Idaho
College of Forestry, Wildlife and Range Sciences

Veneer Block Conditioning Manual

For Veneer and Plywood Production Personnel

By
H. Peter Steinhagen



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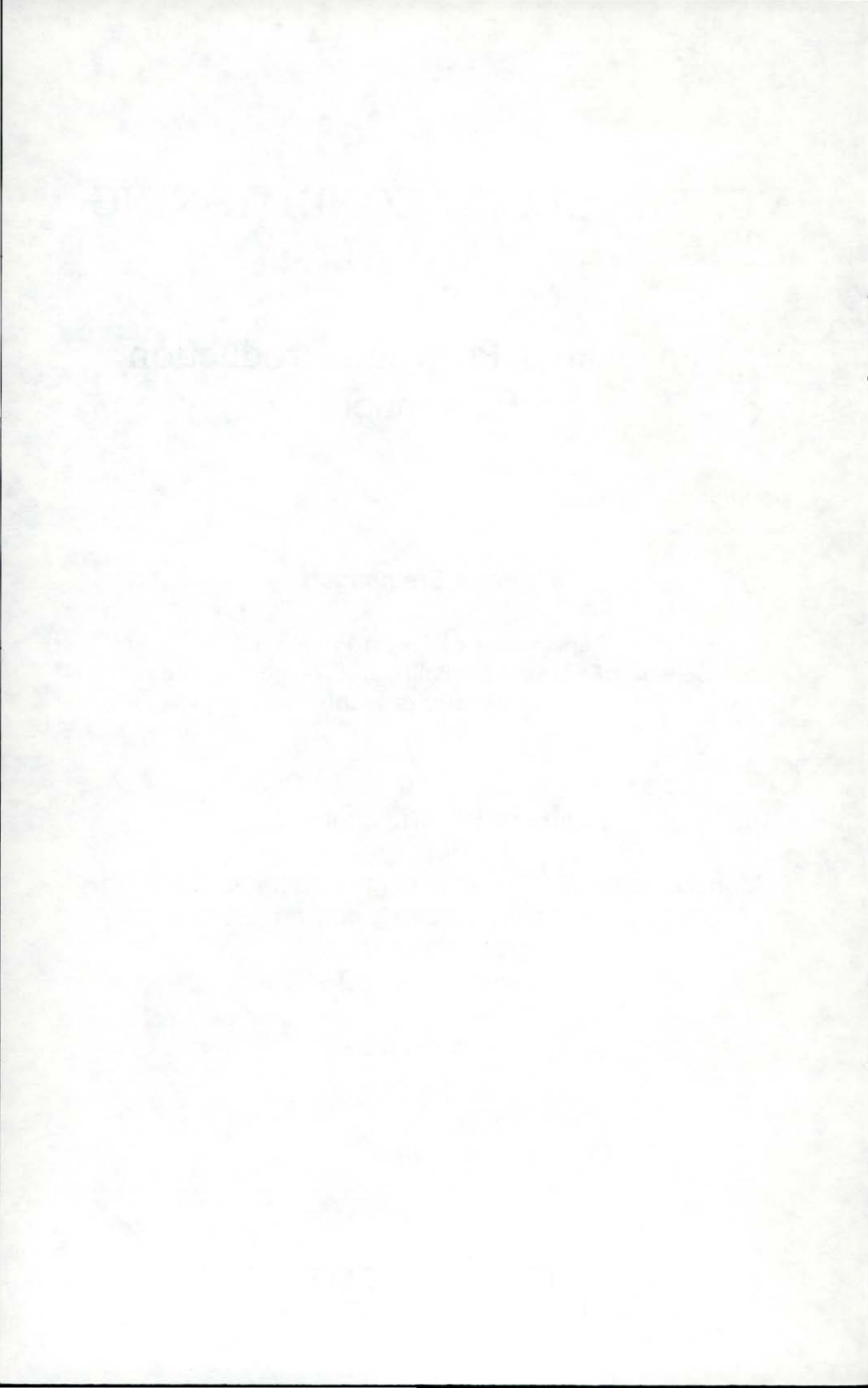
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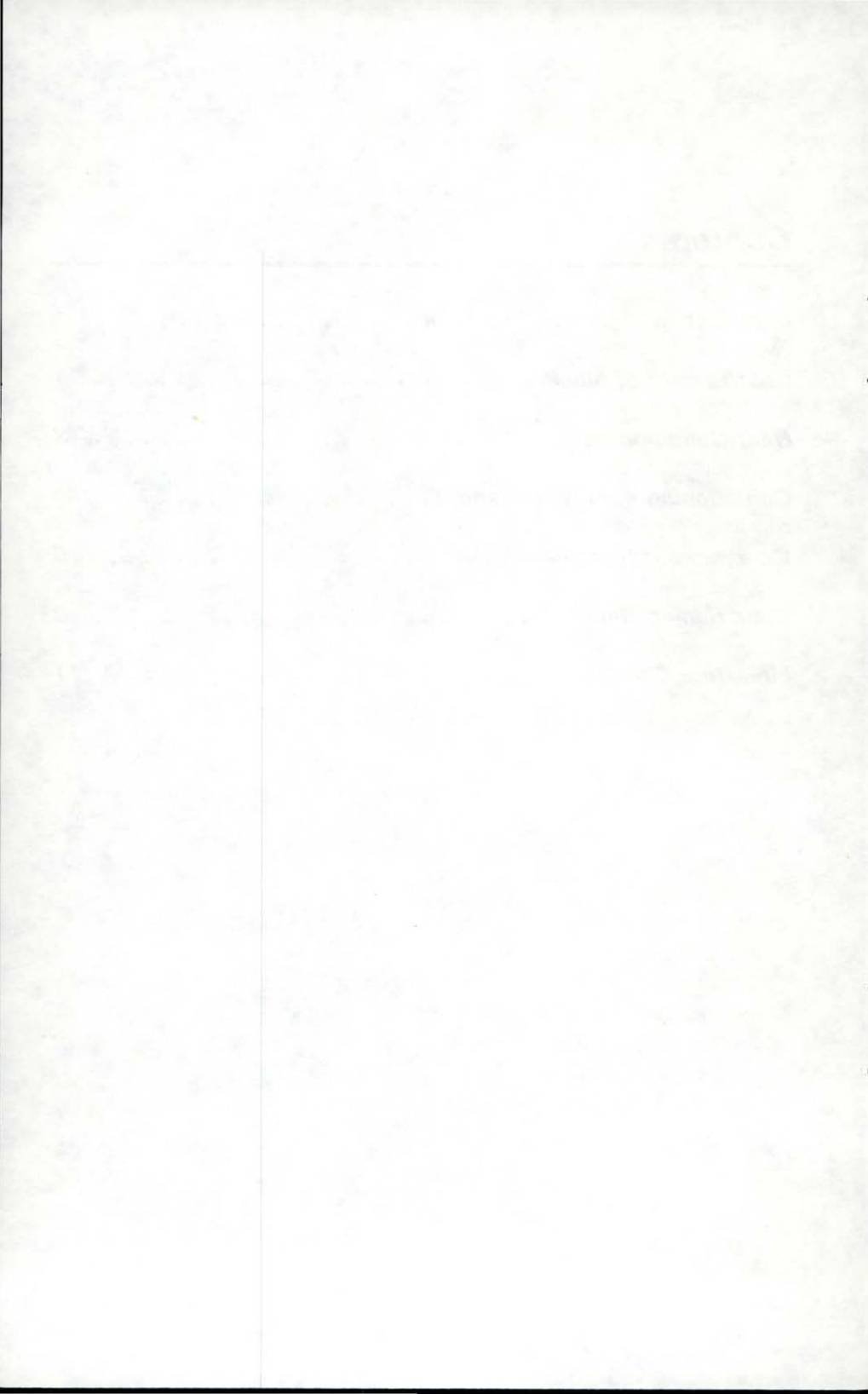
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Introduction

Veneer blocks are heat-conditioned in water or steam in an effort to plasticize ("soften") the wood. When a sufficiently heated block is cut into veneer, the veneer will bend over the lathe's knife without splitting. This leads to improved volume recovery as the greatest conditioning benefit. Since conditioning adds to the production costs, a site-specific economic analysis will be necessary to determine profit margins.

This manual is based on selected literature sources. It briefly addresses the cost/benefit of block conditioning, heat-conditioning systems, energy demand, target temperatures, and conditioning times.

Cost/benefit of block conditioning

Advantages and disadvantages of block conditioning (Resch 1988) are given in Table 1. Based on mill studies and industrial observations, conditioning reportedly increased the volume recovery by 3 to 25 percent. Payback of increased production costs, on the other hand, may often occur at a less-than-10-percent additional volume recovery, assuming fixed capital investment (Resch 1988, Steinhagen et al. 1989). If boiler capacity must be added, payback and return on investment should be carefully calculated. A rigorous cost/benefit analysis of block conditioning has not been published.

Penalties of insufficient block conditioning have been studied in two mills (Steinhagen et al. 1989, Sim et al. 1989). Underheating the blocks by a given amount of time appeared more costly than overheating them. Maximum economic benefit coincided closely with maximum veneer recovery (Fig. 1, where "a" denotes differences between adjacent data points as statistically significant at the 0.05 level, using Scheffé's method).

Table 1. Advantages and disadvantages of block conditioning (Resch 1988).

Advantages	Reasons
Increased volume of recovered veneer	There is less splitting and breakage in handling
Increased quality of recovered veneer from high-quality and frozen blocks	There is decreased splitting, reduced degrade from surface roughness
Reduced knife wear	Knots are softened
Reduced glue spread	Peel is smoother
Tighter veneer with finer checks and reduced nosebar pressure, especially for thickness above 1/8 inch	Wood is more plastic and less resistant to fine checking, thus reducing deep splits
Greater tensile strength of veneer perpendicular to the grain	Veneer is tighter and fine, checks are shallower
Reduced power required for peeling	Softened wood offers less resistance to peeling
increased production	Faster peeling of softer wood
Reduced drying time with in-line dryers	Some heat is stored in wood, and steamed wood is more permeable
Decreased spinouts	Thoroughly softened wood requires a lower turning force
Disadvantages	Reasons
Increased spinouts	Main block remains cold despite heat-softened ends
Fuzzy veneer surface	Blocks are overheated
End-checking of blocks and veneer	Blocks are heated in dry steam

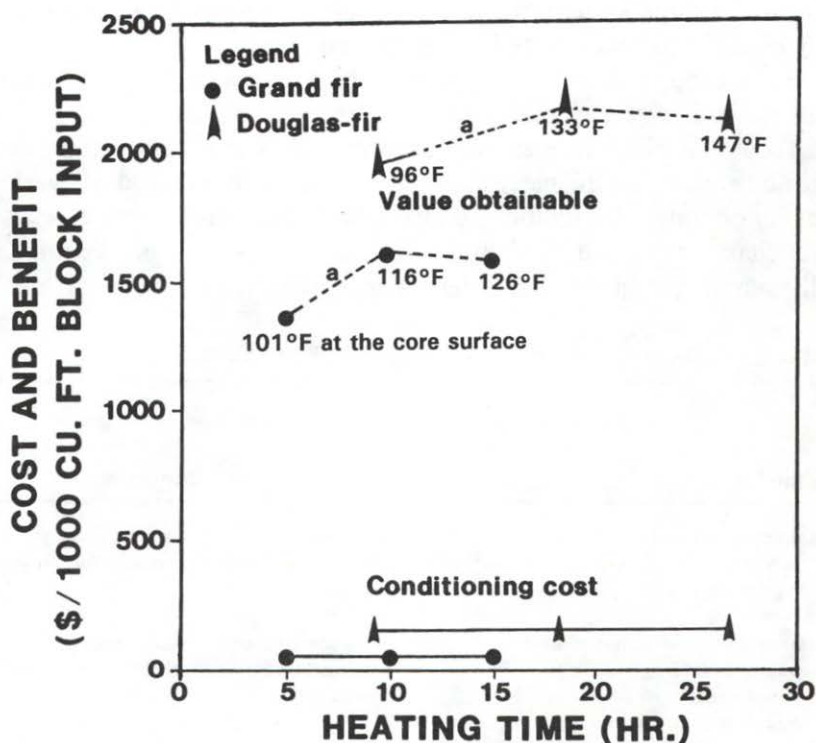


Figure 1. Cost and benefit of block conditioning as a function of heating time (Steinhagen et al. 1989).

Heat-Conditioning systems

Blocks are usually heat-conditioned via (a) steaming in drive-in chambers which is a batch process, or (b) hot-water spraying (deluging) in drive-in chambers, also a batch process, or (c) feeding through hot water vats which is a continuous process (Resch 1988). An overview is given in Table 2.

Steam chambers (a) are relatively inexpensive to build and maintain. But the condensate from steaming is "dirty" and must be handled in accordance with governmental guidelines on effluent discharge. Also, the steam must be saturated for conditioning, or blocks will dry and

flowing out

check.

In the deluge system (b), the water can be reused in a closed loop. Blocks may not heat evenly by this method.

Feed-through in hot water (c) will heat submerged blocks evenly. This method is very capital-intensive initially.

To help achieve temperature uniformity between blocks, the blocks must be sorted into diameter classes and classes conditioned for various lengths of time. In addition, doors rather than curtains must be used with chambers (a and b) to avoid heat leakage. Also, blocks must be fully submerged in water and the water agitated (c).

Table 2. Methods for block conditioning (Resch 1988).

Method	Process	
	Batch	Continuous
Steam sprayed under low pressure high pressure	Aboveground chambers (drive-in vaults)	Aboveground chamber (conveyors)
Spray or deluge with hot water: below 200°F super heated mixed with steam	Aboveground or belowground chambers	Aboveground chamber (conveyors)
Immersion in water heated by: steam coils live steam external heat exchanger	Submerged, covered soaking vat	Feed-through soaking vats, above or below ground

Conditioning energy demand

Examples of net energy required to heat green wood (Steinhagen 1977) are given in Table 3. The table values, reflecting unit energy demand in terms of BTU/CU.FT.x°F, vary strongly with moisture content: wood low in moisture content (Douglas-fir heartwood, etc.) demands relatively little unit energy, and wood high in moisture content (red oak, aspen, etc.) demands much unit energy. Thawing also has an important effect on unit energy demand.

Unit energy demand values must be multiplied by the total volume input and the total temperature increase over the heating range to estimate the total net energy demand.

The gross energy demand is the sum of the net energy demand and energy losses to the surroundings. Losses occur by warming up the construction, and by leakage, and reach a peak during winter. Losses may account for 95 percent, and leakage alone for 60 percent, of actual gross energy consumption (Kuhlmann 1962). This should offer substantial opportunities for improvement.

Table 3. Net energy required to heat green wood (Steinhagen 1977).

	Initially nonfrozen (BTU/CU.FT.x°F)	Initially frozen (BTU/CU.FT.x°F)
Douglas-fir (heartwood)	25	30
Red oak	50	60
Aspen	50	60

Conditioning temperatures

Softwood block temperatures suggested for rotary peeling (Resch 1988) are often between 120° and 140°F or above, measured at the core limit (Table 4). Using the upper-range table values appears economically beneficial (Resch 1988, Sim et al. 1989).

Hardwood block temperatures suggested for peeling (Fleischer 1959) are strongly correlated with the wood's specific gravity. For example, light wood species (basswood, aspen, etc.) peel well at 70°F, but dense wood species (oak, hickory, etc.) may require 200°F, measured at the core limit (Fig. 2).

Temperatures recommended for slicing are often 10 to 20°F higher than for peeling (Lutz 1972).

Table 4. Conditioning temperatures suggested for softwood peeler blocks (Resch 1988).

Species	Temp.(°F)	Species	Temp.(°F)
Western		Western	
Alaska yellow cedar	120-140	Digger pine	140-180
Incense cedar	70-120	Lodgepole pine	140-180
Port Orford cedar	120-160	Ponderosa pine	140-180
Western redcedar	140-160	Sugar pine	120-140
		Western white pine	120-140
Douglas-fir	60-140	Redwood	160-180
Balsam fir	70-130	Engelmann spruce	120-140
California red fir	70-150	Sitka spruce	120-140
Grand fir	70-150		
Noble fir	70-150	Pacific yew	180-200
Shasta red fir	70-150		
White fir	70-150	Southern	
Western hemlock	120-160	Loblolly pine	120-160
Western juniper	140-160	Longleaf pine	120-160
		Pond pine	120-160
Western larch	140-150	Shortleaf pine	120-160
		Slash pine	120-160
		Spruce pine	120-140

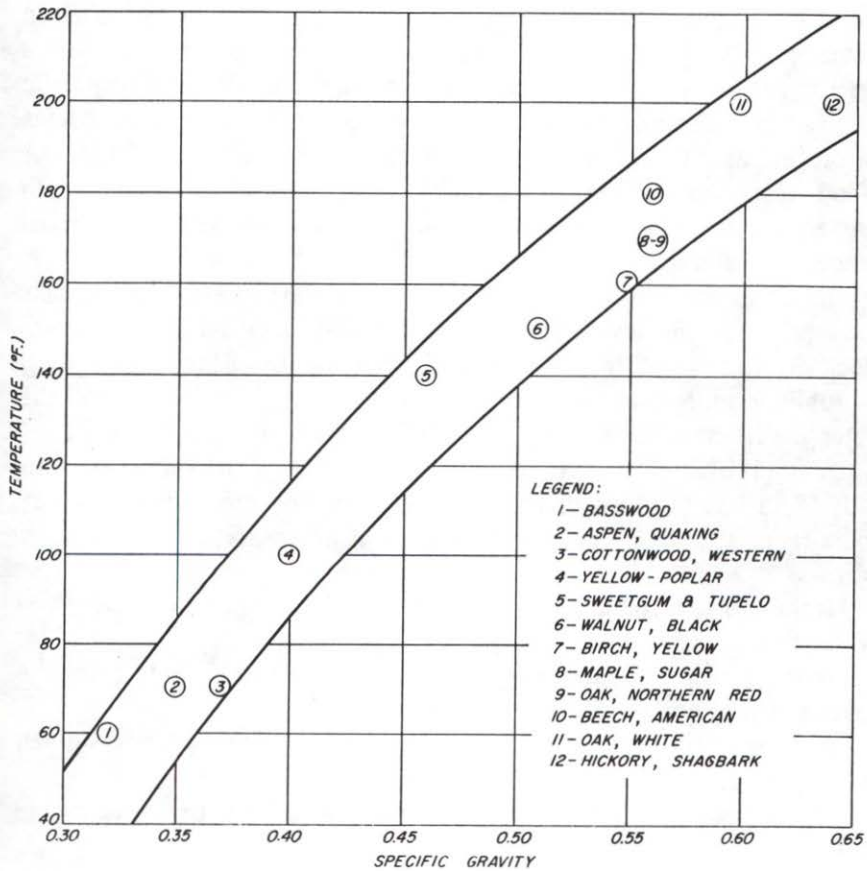


Figure 2. Conditioning temperatures suggested for hardwood peeler blocks (Fleischer 1959).

Conditioning times

Conditioning periods necessary to meet target temperatures (Steinhagen 1989) are shown in Figures 3 and 4, respectively, for nonfrozen and frozen peeler blocks 8 feet long and up to 25 inches in diameter. The graphs apply to a target core diameter of 5 inches, a specific gravity of 0.5, and a moisture content of 100 percent. (Specific gravity and moisture content are used here as a key to the wood species effect, and data for many wood species may be looked up in the USDA Wood Handbook 1987). Also, the steam or agitated water bath temperature must be known or estimated, as well as the block's initial temperature and its target temperature.

As an example of how to use the heating time graphs, let us make assumptions as follows: the block under consideration is nonfrozen; block diameter = 18 inches; the initial temperature of the block (T_{initial}) = 70°F; the target temperature of the block (T_{final}) = 140°F; and the water bath temperature (T_{bath}) = 180°F. Then, $(T_{\text{bath}} - T_{\text{final}})/(T_{\text{bath}} - T_{\text{initial}}) = (180^\circ\text{F} - 140^\circ\text{F})/(180^\circ\text{F} - 70^\circ\text{F}) = 0.36$. This value, together with 18 inches of block diameter, gives a heating time estimate of 25 hours (Fig. 3, dashed line). Adjustments, if necessary, can be made as follows:

If the target core diameter = 4 inches, add 1 hour to the hours given by the figure.

If the target core diameter = 6 inches, subtract 1 hour from the hours given by the figure.

If the specific gravity = 0.3, subtract 5 percent from the hours given by the figure.

If the specific gravity = 0.7, add 5 percent to the hours given by the figure.

If the moisture content = 50 percent, subtract 10 percent from the hours given by the figure.

If the moisture content = 150 percent, add 10 percent to the hours given by the figure.

If the water bath is not agitated, add 10 percent to the hours given by the figure.

If the wood species contains much ray volume (oak, hickory, etc.), subtract 10 percent from the hours given by the figure.

The user may perform linear interpolations between these values to find the proper adjustment to the hours given by the figure.

The significance of block diameter on heating time should be noted. For example, if block A has twice the diameter of block B, block A will require about five times as much heating time as block B, given equal core diameters. Therefore, small-diameter and large-diameter blocks should not be conditioned together and for the same number of hours.

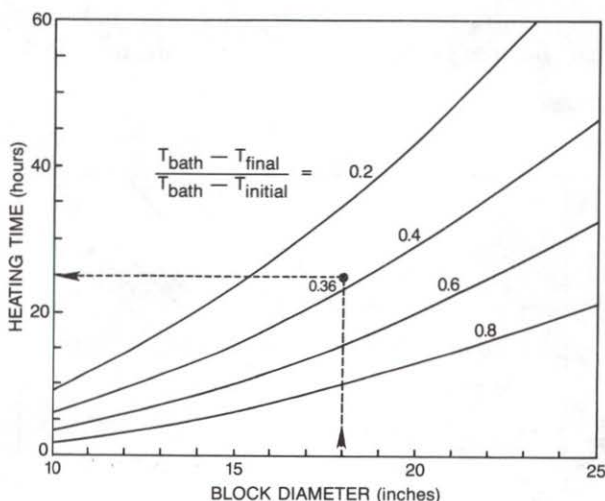


Figure 3. Conditioning time to reach target temperature in a nonfrozen block, given a specific gravity of 0.5, a moisture content of 100 percent, and a target core diameter of 5 inches. The dashed line and data point refer to the example given in the text (Steinhagen 1989).

Let us now reconsider the previous example but assume that the block is frozen. Then, $T_{\text{bath}} - T_{\text{final}} = 180^{\circ}\text{F} - 140^{\circ}\text{F} = 40^{\circ}\text{F}$. This value, together with the assumed 18 inches of block diameter, gives a heating time estimate of 42 hours (Fig. 4, dashed line). For frozen wood, it is not important to know the initial temperature precisely, as long as it is safely below 32°F .

Adjustments, if necessary, can be made as stated for nonfrozen blocks, with the following exceptions:

If the moisture content = 50 percent, subtract 20 percent from the hours given by the figure.

If the moisture content = 150 percent, add 20 percent to the hours given by the figure.

The effect of block diameter on heating time is the same as mentioned for nonfrozen wood.

Heated blocks cool rapidly during transfer from the conditioning facility to the lathe, particularly in winter. It is advisable to install, for process control, an infrared temperature sensor at the lathe so that veneer temperature can be monitored continuously while the block is peeled (Resch 1988).

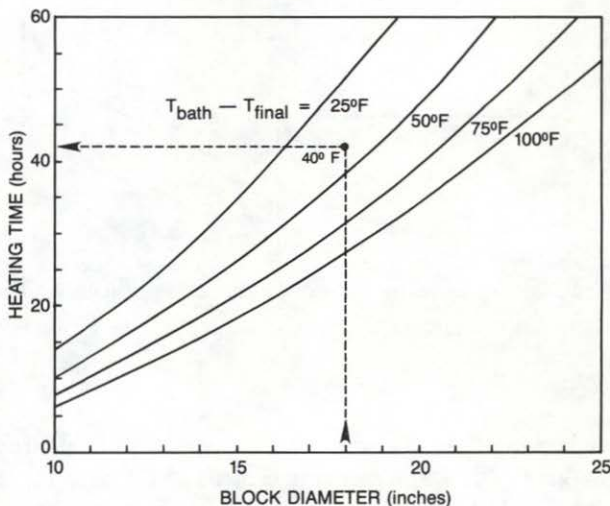
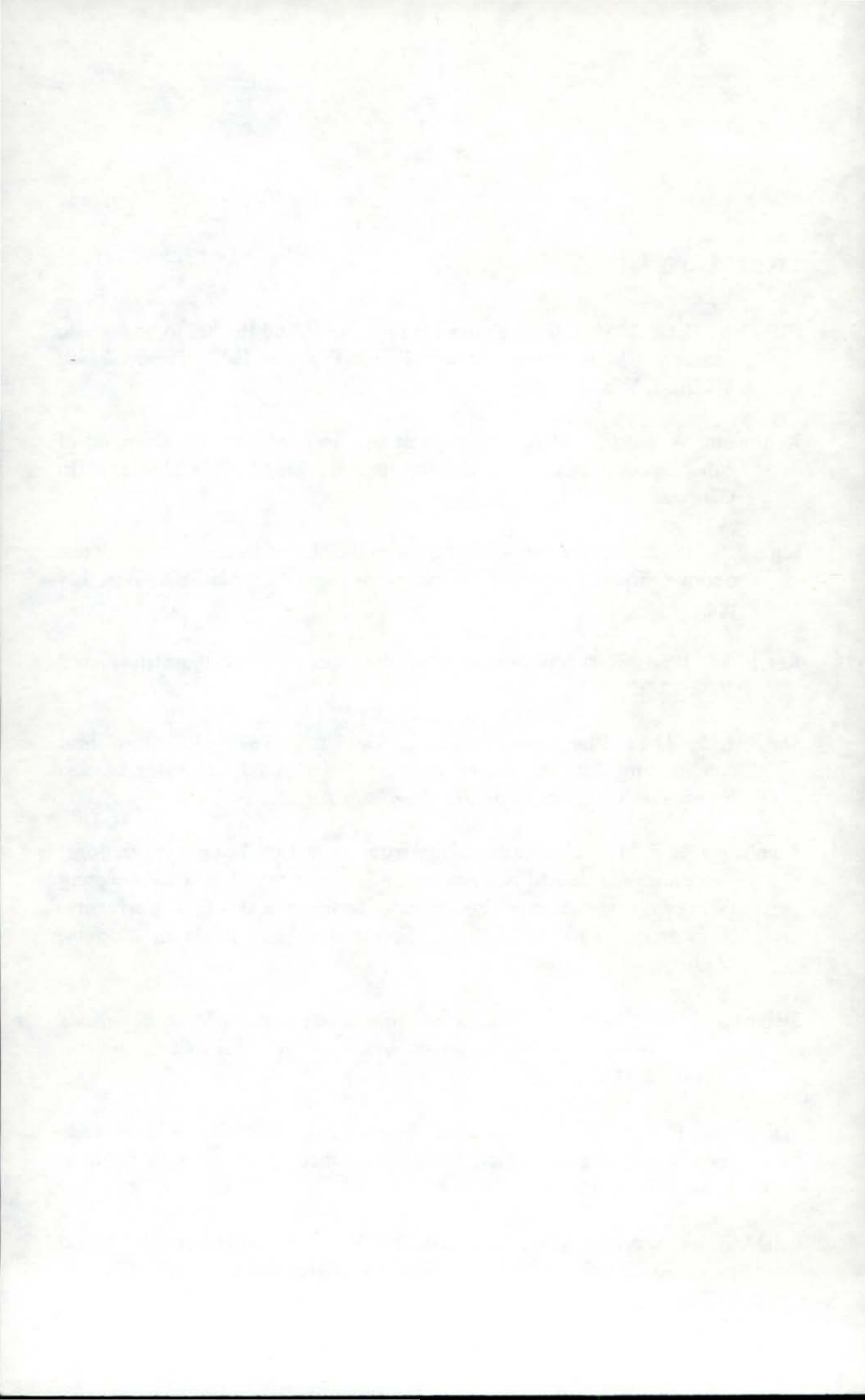


Figure 4. Conditioning time to reach target temperature in a frozen block, given a specific gravity of 0.5, a moisture content of 100 percent, and a target core diameter of 5 inches. The dashed line and data point refer to the example given in the text (Steinhagen 1989).

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