

SEASONING OF LUMBER FOR FURNITURE PRODUCTION

By Harold D. Hall, Dry Kiln Foreman,
Grays Harbor Chair & Manufacturing Co., Hoquiam, Wash.

One of the purposes of this joint meeting is to emphasize the importance of seasoned lumber to the specifier, distributor, and consumer. I don't believe there is any wood product that the consumer is more familiar with than furniture. In a product where pieces of wood are fitted and fastened together and then used daily in the home, the value of good seasoning is dramatically emphasized. Certainly it is one of the principle factors in determining the beauty and life of the product.

There are many aspects of drying furniture stock that differ quite a bit from the usual drying operation. Many of the drying qualities that most kiln operators are vitally concerned with are of minor importance to us and the reverse is also true. We're not in the least concerned as to whether a knot is loose or tight, but we are concerned very much with getting the spread between the wettest board and the driest board down to at least two or three per cent if possible.

Not only is the drying of furniture stock considerably different from most drying operations, but the company I work for is very unusual in the furniture industry. A brief description of our operation will make my remarks a little more understandable, and I think will explain some of the out-of-the-ordinary procedures we follow. Our products consist of chairs, tables, beds, chests, wardrobes, cabinets, etc. Some of our output is finished before shipping but the bulk of it is shipped unfinished, either completely knocked-down or partially-knocked down, to our assembly plants or to jobbers in all sections of the country.

We use such species of lumber as fir, spruce, hemlock, mahogany, alder, and pine. In most of these species the thicknesses are from 4/4" to 8/4". We receive a considerable amount of fir and hemlock already cut and ripped to the rough size of various parts of furniture, thus creating another group of segregations. Our company purchases a considerable amount of lumber that is already dried and cut to chair seat lengths. This would be fine except, in almost every instance, it must be dried to a lower moisture content, thus creating another group of segregations.

Such a large number of segregations creates problems from the yard to the shipping department. The capacity of the yard, kilns, and storage sheds of wood-working plants is determined by their volume of business. It follows that the more numerous the segregations the smaller must be the amount of each item. An adequate supply of each item for production in our sheds leaves very little room for any surplus, therefore a continuous flow of each item is necessary. It makes close coordination from the purchasing department not just desirable, but an absolute necessity because our management deems it inadvisable to ship three-legged chairs or tables, or chests without drawers, or wardrobes minus doors.

I would imagine that a majority of those present are kiln operators so I'll present my talk in the sequence to which most kiln operators give consideration to the material they will dry; first, the different-from-usual

aspects of our green storage, second, the actual drying, and third, dry storage and the importance of kiln drying in regards to machining, gluing, finishing and the ultimate use of furniture.

GREEN STORAGE

Our green storage does not differ greatly from that in any lumber yard except in the case of items trimmed and ripped to the rough size for which they will be used. In these items anything but the slightest defect will make it unfit for production. End checking is our biggest problem. In a thousand board feet of 1 3/4" x 1 3/4" x 17 1/2" leg stock there are over 5,500 ends just waiting to be checked. This problem becomes apparent when you stop to realize that a warm sun shining on these ends for as short a time as a half hour can check them so badly they will be unfit for production and it is possible for a warm wind to do the same thing in as little as two or three hours.

Labor costs run high in a set up such as ours. Most lumber yards have offset the rising cost of labor by the use of automatic equipment. We have such a large variety of sizes of material, and no large amount of any one size, that it does not lend itself favorably to the use of automatic devices. Just to give you a rough idea of our labor costs problem, between 30% and 40% of our raw material is in the shorts or trimmed and ripped to rough size group. The labor costs for handling these items is about two or three times greater than for handling long lumber.

DRY KILNS

We have two types of dry kilns; one two-track charge kiln and two progressive kilns, one of which is a three-track kiln and the other a two-track kiln. All of these kilns are 104 feet long with cross circulation.

There are probably several persons present who are not familiar with both of these types of kilns so a brief description would not be out of order. Very briefly; a charge kiln is one in which all the lumber in the kiln is subjected to the same drying conditions at all times. As the drying progresses the temperature and relative humidity is changed to aid the drying process, thereby completing the entire charge at the same time.

A progressive kiln is one in which a certain amount of lumber is taken from one end of the kiln at regular or irregular intervals and an equal amount is put into the kiln at the other end. The condition at the entering, or green end, is set to approximate the required condition necessary to start the drying process and the condition at the exit, or dry end, is set to approximate the condition required in the final drying period.

Charge kilns are far more common and more popular than progressive kiln and permit closer application of desired conditions. We have found that when the segregations are numerous and dry storage space is limited, the progressive kiln has distinct advantages.

I am not going to elaborate on our drying practices except to point out that we try to subject all of the material we dry to conditions that are generally recommended for that particular size, grade, and species of wood and to explain how we handle some of our hard-to-dry items. Our segregations are so numerous that to maintain ideal drying conditions for all of our stock is an impossibility. When we vary from the correct

condition we always take into consideration what the item will be used for. For instance; if the item happens to be long lumber, which will be trimmed and ripped to small details, we don't have to be careful to avoid a slight amount of surface or end checking and some cupping and bowing is acceptable as it will be of little consequence when the lumber is trimmed and ripped to small pieces.

All of our slow-drying items we put in the middle track of our three-track progressive kiln and advance them through the kiln at a much slower rate of speed than the two outside tracks. (See figure 1). While we have this slow-drying condition set up on the middle track we put in as many slow-drying items as time and storage space will allow.

In a progressive kiln the temperature is lowest and the relative humidity highest in the green end of the kiln and this condition gradually changes so that the highest temperature and the lowest humidity is at the exit end of the kiln. We take advantage of this progressive change in condition to dry our cut-to-length items that must not be end checked, such as our leg stock.

The amount of lumber we take from the kiln and put in at the other end each time we pull the kiln is a twenty-foot load, or it's equivalent, from each track. Our cut-to-rough-size items are in kiln loads six feet to eight feet long. We put a load of something that is not susceptible to kiln damage, such as one inch by two inch dowel stock, ahead of a couple of loads of leg stock. (See figure 1). The leg stock is exposed to a condition that is slightly milder or less severe than is the dowel stock, and, trivial as this difference is, as the loads progress through the kiln, it is enough to avoid considerable end checking. Often times, when we are unable to arrange the loads in a satisfactory manner, we adjust the temperatures to accommodate the hard-to-dry items. We avoid doing this if possible because it does slow up the drying throughout the entire kiln.

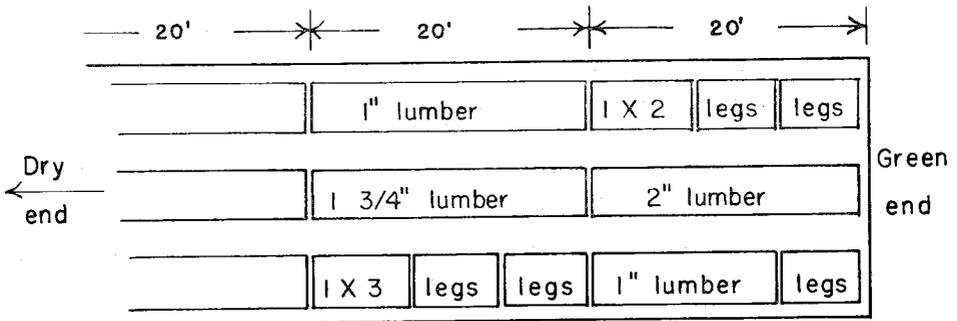


Figure 1

These examples are typical of the various methods used to group our numerous segregations to obtain the best possible equality in the least possible time. One of the biggest drawbacks to a setup such as ours is that we take considerably longer to dry some of our items than is necessary, which is due to the conditions being set for slower drying items or because of their position in the kiln.

One phase of drying for furniture production that is considerably different from most drying operations is the moisture content to which we dry the stock. The equilibrium moisture content of the air in homes and offices varies slightly in different sections of the country and also with the seasons, but in almost every instance, it will not go below six per cent or above eight per cent. In severe winter weather it will go as low as four per cent, sometimes, and, in some sections of the Gulf States it will go as high as ten percent, but for all practical purposes we aim at six per cent to eight per cent; meaning the driest board six per cent and the wettest board eight per cent.

Usually the term six per cent to eight per cent would mean an average of six per cent to an average of eight per cent which would mean there would be boards as dry as four per cent or five per cent and boards as wet as ten per cent or maybe even twelve per cent. Such an understanding of that term is not acceptable in the drying of lumber for furniture.

Kiln operators who dry lumber to moisture contents over ten per cent shake their heads when you mention drying to a moisture content under ten per cent. They know what it means in terms of shrinkage, warping, bowing, loose knots, etc. and these characteristics are of utmost importance to them. In furniture manufacture we are mainly concerned with stability, moisture gradient, checking, and stresses, and the danger of these characteristics does not increase with the lower moisture content. The lower moisture content even makes it easier for us because the difference in moisture content from shell to core and from wettest to driest board decreases rapidly as these low moisture contents are reached. The distribution of moisture content in the boards, and from board to board, is of utmost importance to us as my subsequent remarks will show.

MACHINING, GLUING, and STORAGE

The importance of avoiding the appearance of an occasional wet board in our drying can be best illustrated by describing the damage that one wet board can cause. For the illustration I will use a wet board 1 1/2" x 8" x 10' which will be used for chair seats. This board will be trimmed into 16" lengths and the cuttings with defects will go to the rip saw and thence to the planer, jointer, and glue press. The clear cuttings will go to the planer, jointer, and glue press. At each of these operations these pieces go through they become more and more mixed with the dry pieces from the load. There was enough lumber in this one board to make four chair seats but during the various operations it went through it became so thoroughly mixed with the dry pieces that it found its way into from 12 to 15 seats. I would guess that a dozen wet boards in a kiln load would find their way into over half the seats manufactured from the kiln load.

The presence of a wet piece of wood in the production line can show up in many different ways. It will not always machine smoothly, but will be rough or fuzzy; it will usually change its shape when machined or when exposed to room temperature after machining; room temperatures can also cause end checking and roughness to appear after the sanding operation.

In our plant most of the gluing is done on an electronic glue press, the principle of which is to pass electric impulses through the pieces to be glued, thereby setting the glue joints. If there is a wet piece mixed in, it will draw most of the juice causing the other joints not to set at all or at best to be weakened. If there is enough difference in moisture content the wet piece will even become charred or burnt in spots.

A board that has been dried to an excessively low moisture content will not cause as much damage as a wet board will, but it is far from desirable. It can show up in just as many parts of the furniture as a wet board. A board will pick up moisture much more rapidly in the ends than it will in the center of the piece and the resultant swelling in the ends can weaken or destroy glue joints. Moulding-type details can change shape and become distorted from picking up moisture which these too-dry pieces will do.

It is common practice for sticker machine operators to set up their machine so that the bottom head and one side head take just barely enough wood off so that the material will clean up and the top head and other side head take off whatever is necessary to make the detail. ((see figures 2-5) This is done to take care of uneven sized stock so that a maximum amount of the stock will clean up. I point this out to emphasize the importance of equal distribution of moisture in the shell and core and also the importance of having the stock as free from stresses as possible before machining.

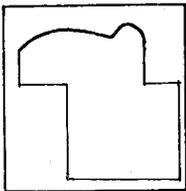


Figure 2

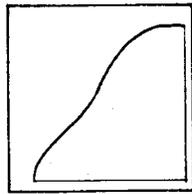


Figure 3

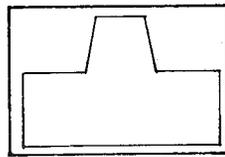


Figure 4

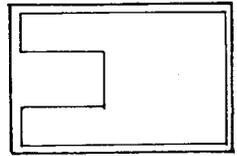


Figure 5

When there are stresses in the stock to be machined or an uneven distribution of moisture and the machine takes considerably more wood off on one or two sides than it does on the other sides of the stock, (see figures 2-5) if it is long moulding, it either comes from the machine in a crooked or bowed condition or these conditions develop when exposed to room temperature. The core in many instances becomes the shell. In most cases, if the conditions are not too far out of line, the loss is minor as the crooked pieces are cut to short lengths and the straight pieces to long cuttings. We have two or three details in which there are no short cuttings and a little incident that happened last year emphasizes the care that must be taken with stock run to these details.

The machine foreman ordered a kiln load of lumber to run to one of these details (see figure 2) and when they started to run it the results were very good so I forgot about it. About two or three weeks later I was called back to this department because they had started to run this detail again and the results were so bad that they had shut the machine

down after a small truck load. We found that on the previous run they had used only half of the kiln load and had shoved the remaining half into a closed but unheated storage shed. In that short time it had picked up enough moisture so that almost every piece came from the machine in a bowed condition.

Just to see what would happen we placed that load in a favorable spot in a heated storage shed and after about three weeks we gave them the load again to run to the same detail and the results were very satisfactory.

In many articles of furniture the glue joints are the key to the life of the furniture. Every glue joint consists of at least two pieces of wood joined by a bond of glue. While it is possible that inferior glue may be used, or improperly applied, or the pieces of wood could be machined incorrectly, for all practical purposes, we can discount the possibility that a glue joint will fail from these causes. The only other cause of failure of the glue joint can be from the change in shape or size of the wood. Wood can be machined to many different shapes to contribute to the strength of a glue joint but the basic principle remains the same and the fact still remains that the only cause of failure of the glue joint can be the change in shape or size of the wood after gluing.

When two pieces of wood are joined by a glue bond, each of the pieces of wood and the glue contribute to a strong joint. If the wood does not change in shape or size the glue joint will remain stronger than the wood itself. If either or both of the pieces of wood are allowed to lose or pick up moisture with a subsequent change in shape they become a weakening factor instead of a strengthening factor in the glue joint. The more they change from their shape and size at the time of gluing, the greater is the possibility that a strain or jolt will destroy the glue joint.

I shudder when I think of the costs that can result from improper drying. Often times defects will not show up until the stock is pretty far along the production line or maybe even into the assembly of the furniture. The waste often becomes many, many times the value of the defective piece. I tell the superintendent that these defective pieces and the stock they damage, along with the labor involved, aren't a total loss; they have to have fuel to keep the boilers going.

I have used extremes in many parts of my talk and have cited situations and procedures that we aren't confronted with very often. I have done this to better illustrate some of the inconsistencies of wood and how it can react to the detriment of our product. If I have created the impression that it takes a miracle man to dry furniture stock, I have misrepresented the facts. Except for a very few details, it is not at all difficult to dry the lumber well within the requirements of furniture production. Constant attention and testing are required and I think those are musts in all kiln operations.

It should be the constant consideration of all who are responsible in furniture production to put enough quality into their product, not just to get it past the shipping department, but to get it into the customer's home for a lifetime of service.