Chapter Four

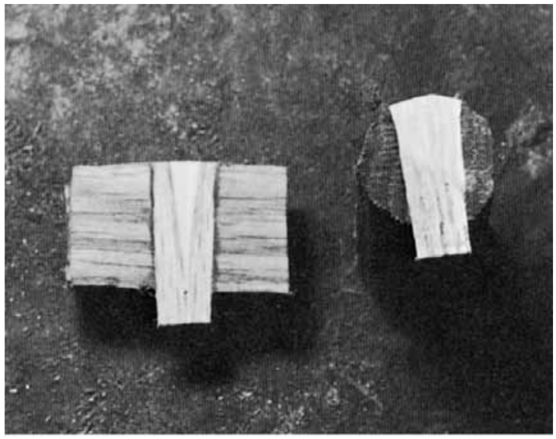
Windsor Chair Joints

Windsor chairs are held together by socket construction: cylindrical tenons fit into cylindrical holes or sockets. Chairmakers have long relied on socket joints because they can be made very quickly and easily. The holes can be made with a brace and bit or an electric drill. The bit makes a hole of exactly the same diameter each time it is used, and by scribing a line on the bit each socket can be made to the same depth. Tenons can be easily whittled or turned on a lathe.

The speed and ease with which socket joints – round hole, round tenon – can be made is a real advantage. However, socket joints have a dirty little secret. They are the second worst joint known to woodworking. The worst is gluing end grain to end grain. To understand why a socket joint is so impermanent, imagine opening a box of soda straws. You see a cluster of closely spaced openings but little surface. Under magnification, end grain is the same – closely spaced tubes. If you took two handfuls of soda straws and smeared glue on the ends, you would not have a lot of luck getting them to adhere permanently; most of the ends are tiny voids. It's the same problem you encounter when gluing end gain to end grain.

Now, consider a hole drilled into wood. Almost all of its inside surface is end grain, inhibiting a good glue bond. That's why socket joints fail. You know this from experience. What's the first question you're asked when friends and family learn you're trying your hand at chairmaking? "Can you glue my kitchen chairs?" Why this ubiquitous inquiry? Because chair factories glue their socket joints and it does not work over the long haul. Higher end factories try esoteric solutions such as compressing an oversized tenon before inserting it into the socket. Low end factories drive a screw into their joint. Neither work.

This is the lesson for us is. If we wish to take advantage of socket construction's speed and ease, we cannot rely on glue alone. For that reason, every joint in a handmade Windsor chair incorporates some mechanical feature that holds the joint together after the glue has failed. Below, you will learn these mechanical features and how they are accomplished. The ways Windsor chairmakers overcame socket construction's inherent weakness are truly remarkable. Like me, you will hold the old guys in high regard.



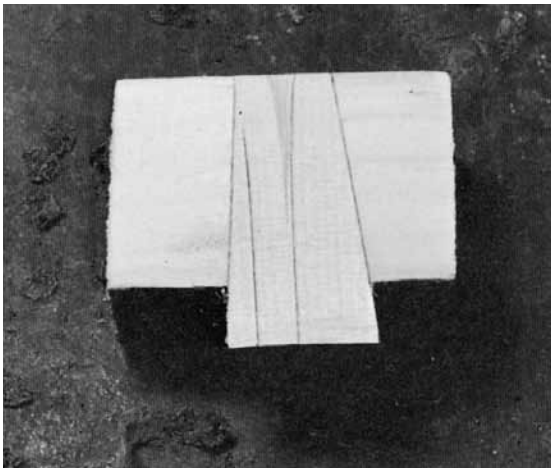
A simple through joint, like *those used in the backs of both the sack back and the continuous arm are flared at the top by the wedge.*

There are two types of socket joints, blind and through, and I use both in my chairs. The names of these joints are self-explanatory - the blind socket does not go all the way through the piece, the through socket does. In the sack back and continuous arm there are two types of blind socket joints and two types of through joints.

Through Socket Joints

Straight Wedged Joints The simplest of the through joints are used in the backs of the continuous arm and the sack back chairs where the short and long spindles are fixed to the bow and/or arm. The ends of the spindles are split with a chisel and a wedge is driven into the split. Glue is smeared on the inside of the hole and on the wedge. The glue on the wedge is important, as an unglued wedge will work its way back out of the split, and loose its effectiveness.

The purpose of the wedge is to flare the end of the spindle so the part cannot pull off the end



A LOCKING TAPER JOINT CUT *in half shows the tapered tenon and the tapered hole.*

after the glue in the joint fails. You can see this flaring in the adjacent picture. To show how the wedge works, two joints have been cut in half.

LOCKING TAPER JOINTS The joints used to secure the legs and stumps into the seats and the top of the stumps into the arm are truly clever. They are locking tapers. The tenon is a truncated cone and fits into a hole with the same degree of taper. If the degree of taper is within a certain range of angles the friction between the parts will lock them together.

This lock is powerful. I demonstrate this for students by clamping a piece of wood with a tapered hole in it to a corner of a workbench. I then tap a leg with a tapered tenon into the hole. Finally, I lift the corner of a 300 pound bench top by pulling upward on the leg.

This is the principle of the self-holding, or locking taper systems that machinists know by such names as Morse, Jacobs, and Brown and Sharps. You are likely to have encountered the locking taper in the drive center of a wood turning lathe. You know how effectively these parts are held in place if you have ever had to remove the center. This friction bond is so strong that to break it and loosen the center you must insert a drift pin into the rear of the spindle and give the pin a sharp rap.

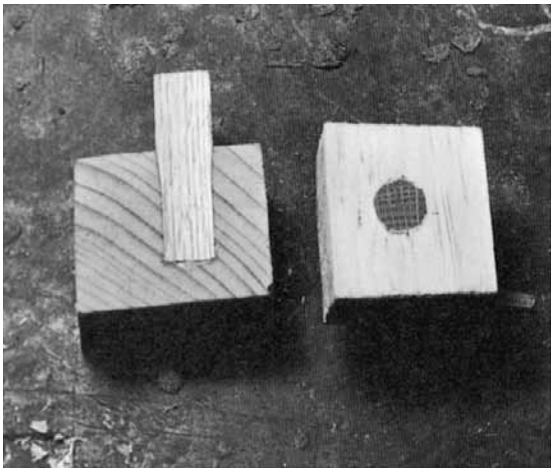
Although the tapered sockets and tenons that join the legs and the seat of a Windsor lock in the same way, nothing will spare them from inevitably loosening as the wood swells and shrinks with changes in humidity. However, each time someone sits in the chair the tenons are driven back into the tapered sockets and relocked. The beauty of this joint is that use, which wears out all other types of chairs, works to hold a Windsor together.

Tapered tenons and sockets are easy to make. The tenons are turned to shape in the lathe. The sockets are bored with a brace and spoon bit then tapered with a tool called a reamer. A reamer resembles a steel cone that has been sliced in half along its axis; the two exposed edges are sharpened by beveling them toward the inside of the cone. My reamer tapers a socket at about 7 degrees. (Wood has different properties than steel so the angle of the taper is not as critical as for tapers used by machinists.) I generally turn the tenons so that their taper is slightly shallower than those of the sockets. Wedging the tenon at assembly spreads the tenon and makes it conform to the socket. This allows a considerable margin of error when turning the tenons, so gauging the size and taper by eye is quite feasible. (I discuss making this joint in later chapters.)

Of course, you can use a straight, through socket joint to fix the legs to the seat. When doing this, I make a shoulder on a straight tenon, so that only the tenon can enter the socket. Undercutting the socket opening to house this shoulder will make a more presentable joint. At assembly, I wedge the tenon, just as for the tapered joint. The wedge prevents the tenon from retracting. Even when the joint eventually loosens the tenon is permanently trapped between the shoulder and the flared top created by the wedge. At worst a loose, wedged through tenon will rattle and twist in its socket. You can minimize the potential for twisting by using a wedge that is wider than the diameter of the tenon. The edges of the wedge will key into the soft pine of the seat and prevent the shaft from turning. I will explain this technique in greater detail later.

BLIND SOCKET JOINTS

A blind socket is simply a hole bored partway into, but not through the chair part. The tenon, which is turned or whittled to the diameter of the bit used to bore the socket, is glued into the socket. However,



THESE TWO SECTIONS OF DRIVE *fit tenons show how effectively they distort the holes in the pine seat to their individual shapes.*

glue cannot be the only thing that secures the joint, as when the glue bond fails, so does the joint.

DRIVE FIT TENONS This joint is used on the sack back and continuous arm to secure the short and long spindles to the seat. The principal is the same as square peg in round hole. The holding power is from a series of flat facets and sharp corners biting into the pine seat and distorting the hole to the shape of the tenon. I start by making the ends of my tenons ⅝" and drilling 9⁄16" holes in the seat. Then, with a gouge, as shown in a later chapter, I make pronounced facets. They create relief, while the corners remain ⅝" across. When I am ready, I swab the holes with glue and then drive the tenons into the seat with a hammer, like I was driving nails.

TENONS IN COMPRESSION The stretchers of many types of chairs are blind-socketed into the legs and here is where most of these chairs usually first come apart. Manufacturers have devised super glues, liquids that swell wood, and tenon compressors in an effort to find a way to overcome the tendency of wooden chairs to fail at the leg/stretcher joints. These joints have long baffled anyone who has tried to keep them from loosening. Eighteenth century Windsors tell a different story. The old chairmakers overcame this problem, and obviously knew something that is not general knowledge today. I wish I could show you the joint in a photograph, but you cannot see the technique. I have to describe it.

Like the old guys, I put these joints in compression by making each of the three stretchers a bit over long. In other words the stretchers push the legs apart. Factories use their stretchers to hold the legs together, so their joints are in tension. Because the glue will fail, these joints continually come apart. The compression technique works because the legs are anchored in the solid wood seat and because the locking tapered joints renew each time someone sits in the chair. Pretty neat, huh? I will explain how to do this as we get into assembling the undercarriage.

I know that the four joints described above work. Why? They were used in making 18th century chairs, and after more than 200 years most of these chairs are still as tight as the day they were made. We can say they have been tested in the ultimate laboratory – daily use.

There are numerous other clever joints used in Windsor chairmaking, such as the one used to secure a footrest to a youth chair, the applied arm to the Nantucket fan back. Since they are not part of either the sack back or continuous arm, they are not included here.