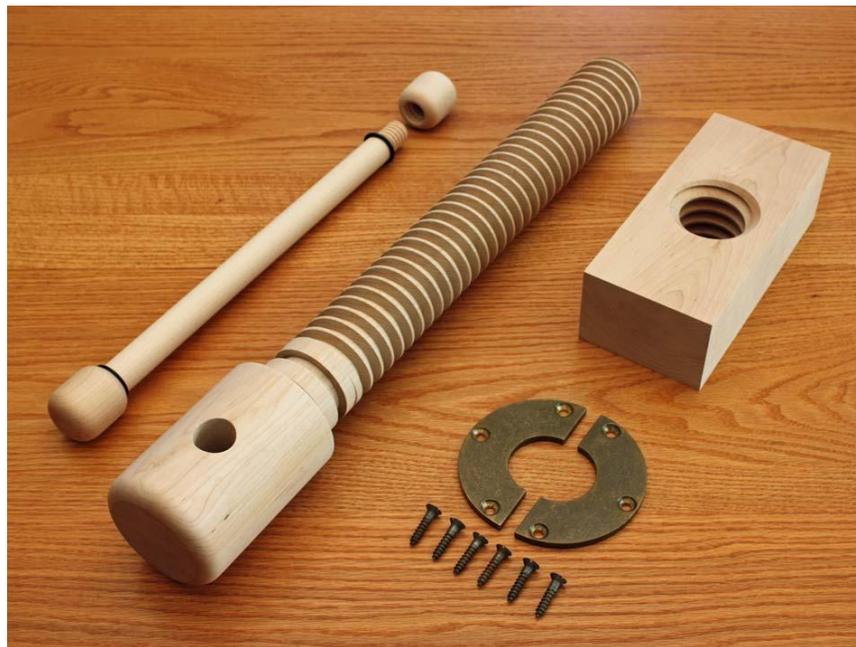




### **Lake Erie Toolworks Whitepaper:**

This document explains in detail the reasons behind the design decisions of our vises and components. You have a lot of choices when it comes to woodworking bench vises. There are metal vises and other wooden vises available and many different styles. This document is intended to shed some light on wooden vise screws as well as make our case for why we feel that we make the best workbench vises .



### **Why a wooden vise?**

- Rapid movement

There are several reasons why a wooden vise makes the best woodworking bench vise. First of all is the rapid movement of the vise. Our vises move exactly 1" for every two turns of the handle. Most steel vises with some exceptions take 4 to 6 turns to move 1", so you will be turning the handle two to three times as much for the same vise travel. This really adds up when clamping different length boards on your benchtop with your tail vise or moving from thin boards to assembled components such as drawers when clamping them in your face vise.

- Feel

Wooden visescrews have a wonderful feel and feedback when used that has to be experienced. They move smoothly for rapid movements and lock up quickly when tightened.

- No grease or oil needed

Steel screws need to be regularly oiled or greased for long term reliability. This can be transferred to your workpiece and can cause problems with finishing. Wooden screws typically use wax as a lubricant.

- Visually appealing

Our wooden visescrews are built to the highest standards and are sure to inspire you to do your best woodworking in the same way that a finely made plane, saw or chisel will.

### **Vise Screw Size – Diameter**

- Why 2-1/2"?
  - It has significantly more thread surface area than a smaller diameter screw, say 2". This larger diameter spreads the clamping load out across a larger area, decreasing the stress on the screw threads and limiting any wear.
  - 2-1/2" is a common size found on many antique workbenches.
- Why not a bigger diameter?
  - The larger the size of a piece of wood, the greater its total dimensional change due to seasonal changes in humidity. This requires adding even more clearance to the fit between the vise screw and the nut, therefore causing a sloppy fit. If the necessary clearance for functioning properly in a variety of climates is not added, then the vise can bind up in humid conditions. Neither situation is good, a sloppy fit or a binding vise so we have determined that 2-1/2" diameter is the optimal size for a functional workbench vise screw. It seems the old-timers knew what they were doing, which is usually the case in traditional tool building. We can and do make a bigger vise for custom orders when requested, but our main focus is to build a vise with the best combination of strength and seasonal stability and we feel that 2-1/2" diameter fits this perfectly.

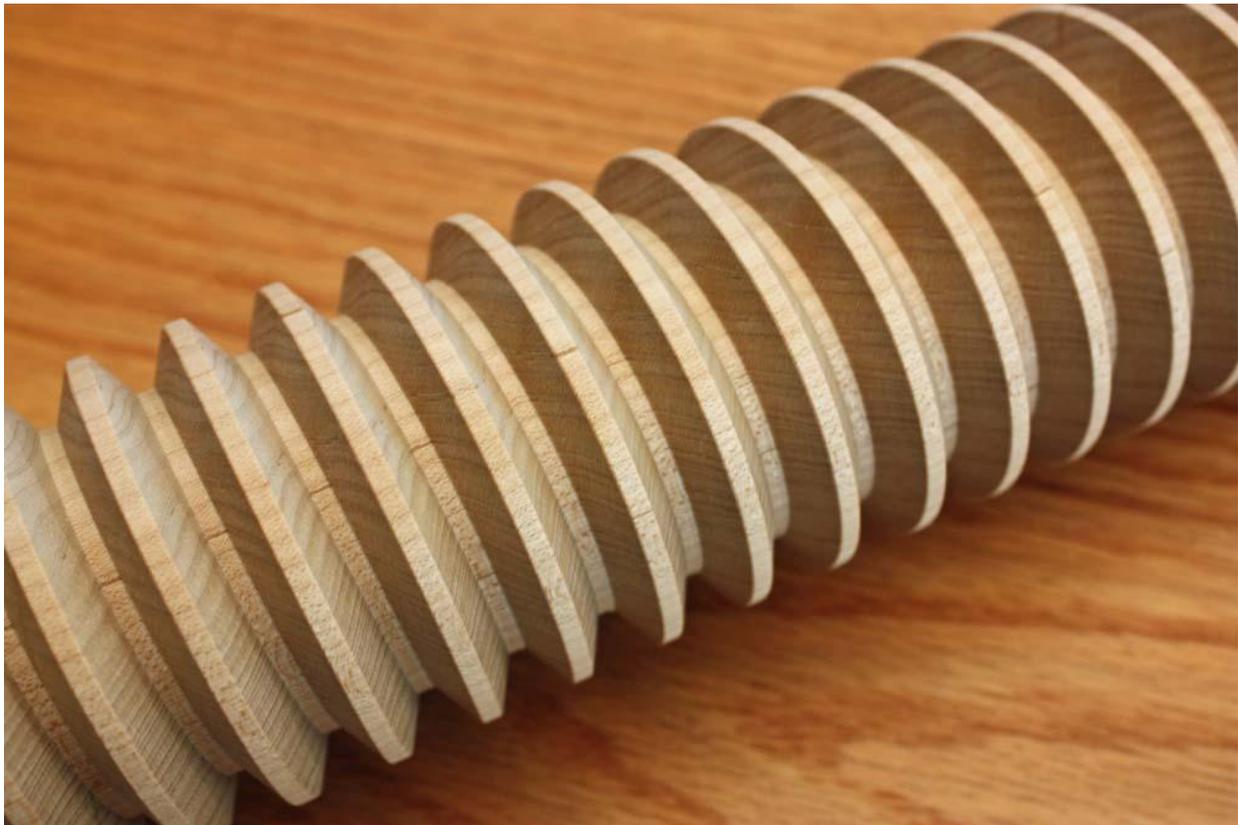
### **Quality Control**

- Screw/ Nut fit and moisture content
  - A Delmhorst J-2000 moisture meter is used to keep track of wood moisture content and several thermometers and hygrometers (relative humidity sensors) are used to keep track of our shop's current conditions. A spreadsheet program is used to determine the optimal fit between the vise and the nut based on the woods moisture content and

Hard Maple's wood movement properties, which is adjustable down to .001" of diameter. Based on the relative humidity of the shop and the moisture readings taken from the wood, an optimal clearance value for the vises is determined and then built into each batch. Our goal is to give you the tightest fitting vise/ nut interface that won't bind, even if you move. We offer a one year warranty that will get you through one full cycle of seasonal changes. If anything happens you just let us know and we will work with you to make it right. If something is our fault we will cover all shipping costs to and from you. We want you to be happy and comfortable with your purchase and we can offer this exceptional warranty because we are confident in our vises.

- Wood quality
  - We work with our supplier to get the best quality of wood for our vises. Wood defects such as knots or cracks are graded out at the supplier and then graded out during the visescrew production process if they should turn up as wood is cut away. We won't send you a vise that we wouldn't be happy receiving.

**Production Process:**



(Close-up of vise threads)

- Visescrew building:

- Threading:

We use a custom designed and built machine for cutting the critical dimensions of the vise screws and for threading them with a powered cutter. We experimented with a manual threading method but we weren't happy with the results and I wasn't willing to send them out to customers. The cutters dulled fast and if there was any grain variation in the wood, which there always is, it would tear out. Essentially you are trying to lever out a giant wood chip and the surface of the threads pretty much always gets torn, to a small degree or a larger one. This can be alleviated somewhat by soaking the wood in oil but it doesn't solve the problem completely. With a powered cutter, we are taking about a .002-.003" chip load during the finish pass, that is, each flute of the cutter is cutting only .002" off of the surface of the thread, not enough to lever up a big chip and pull out chunks of wood along with it. We use multiple threading passes; two roughing passes to clear out most of the waste and then we switch to two lighter finish passes. This is time consuming but it ensures an exceptionally smooth and accurate threadform with no tearing in the surface.

- Sanding:

All of our vise screw hubs are sanded to 220 grit and the top crests of the threads are sanded and eased to increase their durability. The thread faces are not sanded because they don't need it due to the care taken during the threading process and sanding would deform the thread shape.



(Close-up of nut threads)

- Nut building
  - We use another custom designed and built machine to cut the internal thread for the vise nuts. The same problems with a manual threading tool occur in a manual tapping tool. When an internal thread is manually tapped into the face of a wooden block, half of the time the cutter is cutting against the grain, similar to faceplate/bowl turning on a lathe. With a manual tapping tool, you are trying to lever out a large chip and you are also working against the grain half of the time. This leads to deeply torn grain and a much weaker nut, not to mention that it provides a much smaller total surface area for the visescrew to work against, due to the chipped out surface. This would lead to increased stress on the surface of the vise threads and a higher probability of chipped threads. We use a powered cutter in our machine that follows the proper helix pattern of the thread and leaves an exceptionally smooth and accurate surface. With a powered cutter, the same advantages of powered cutter vise screw threading are realized. A small chipload is used and this results in minimal tearout in the angles of rotation where the cutter is working against the grain. This ensures the best possible interface between the vise screw and the nut and results in long term reliability.



(Wooden nut)

- Nut dimensions
  - We make our nuts 4" wide by 2-3/4" thick by 9" long. This is longer than is necessary for most cases but it's better to leave more wood than to make the nut too small. We also feel that the 4" width is important to ensure maximum strength in the nut. Basically the nuts are made larger than necessary to ensure maximum strength and reliability while giving the owner the ability to trim it down to fit their own needs.
- Material (Hard Maple)
  - Shear Strength:

There are several reasons why Hard Maple is the best wood out there for wooden visescrew building. One reason is its shear strength. It has among the highest tested amount of shear strength for domestic woods, that is it's resistance to coming apart along the length of the grain when it is loaded in shear. When a vise is tightened against a work piece, the threads of the vise push on the threads of the nut. The threads of the visescrew are held on to the root diameter, or "dowel" of the screw beneath by the long-grain surface at the base of the triangular thread. The clamping load is parallel to the axis of the visescrew and these surfaces at the base of the threads are loaded in shear when the vise is tightened. This is the reason that shear strength is such an important factor in the choice of material to use for a wooden visescrew; it has the largest impact on whether a wooden vise's threads will withstand the clamping force. R. Bruce Hoadley's book Understanding Wood goes into detail with pictures on the different strengths and properties of wood. I highly recommend this book to anyone who works with wood.
  - Grain:

The fine pores of Hard Maple also make it ideal for vises. The threads of a vise are not very big and if an open pored wood such as oak or ash is used, there are big gaps relative to the size of the thread that cause stress concentration points especially at the base or root of the thread. This can lead to chipping. Also, the finer pores of maple lead to a larger total surface area of the thread compared to an open grain wood. This will wear better over time.
  - Density:

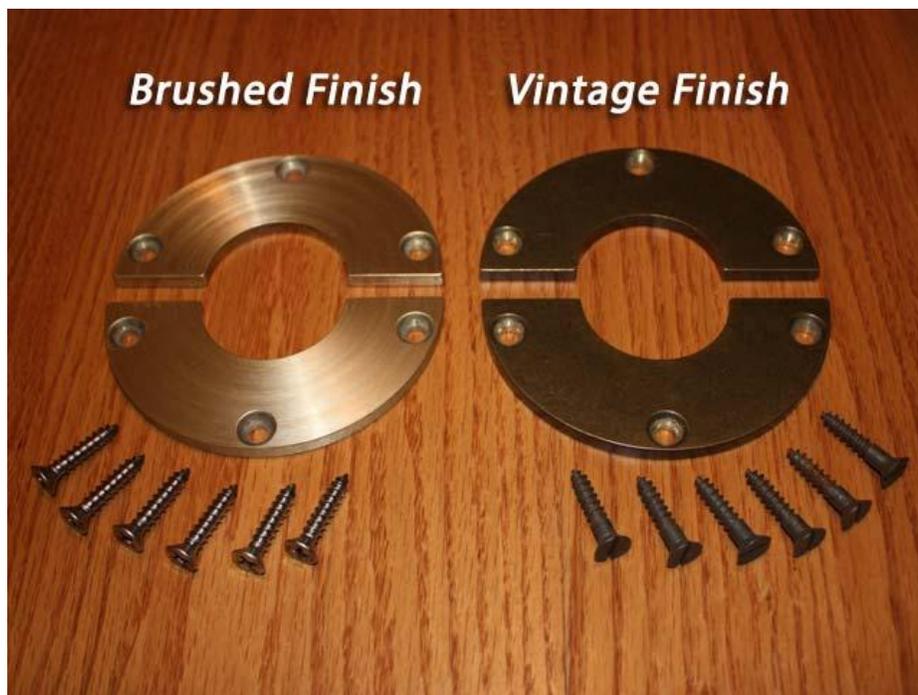
Hard Maple is rather dense and hard and when coupled with its high shear strength and fine pore structure, it makes for the best type of wood for a strong, long lasting vise.



(Threaded endcap handles)

**Handles:**

- The ends of our handles are threaded and the endcaps are tapped. Most vise handles have either press fit and/or glued endcaps or use metal screws to attach the endcaps. Press fit handles can come off and if they are glued on then they need to be sawn off to remove them, therefore ruining the handle. All you have to do with our handles is twist off an endcap and then hand tighten it back on. Some antique benches feature wooden threaded handles and we felt that it would be a historically accurate and very functional addition to our vises. The endcaps are turned and sanded and the rubber o-rings prevent your hand from being pinched between a vise and a falling handle endcap.



(Brass garter set, brushed and vintage finishes)

### **Garters:**

- Brass was chosen for our external garters because it is more than strong enough to withstand the clamping and spreading forces that it is subjected to, it won't rust like steel or iron, it machines well and looks good. The garters are made in house from barstock so that we can control the quality. Also, antique bench vises often have a metal external garter. We think that the brass garters are a functional and visually appealing solution to keeping the vise jaw attached to the visescrew.
- Internal garters are useful when the vise jaw needs to move independent of the screw or at an angle to the screws axis. This is most common in twin-screw vises and allows tapered or irregular work to be clamped in the vise. The internal garters are removed allowing the visescrews to be operated independently and the visejaw to be angled.

### **Made in the USA:**

- Our vises are made in the USA with Hard Maple grown domestically as well as Canada. The lumber is custom sawn and dried by wood suppliers who specialize in large diameter wood stock. All of our hardware and metal stock is also sourced from domestic and Canadian suppliers (Lee Valley).

We hope that you have found this information regarding vise screws and our product details to be helpful as you make your decision on which type of vises to use for your workbench, as well as where you purchase them from.

We feature a risk free 30 day return policy as well as a full one year warranty to get you through all 4 seasonal changes wherever you live to ensure that you are happy with your vise.

Our products are designed, engineered and built to last and with that in mind, you will surely receive the best quality and value in a workbench vise from Lake Erie Toolworks along with the outstanding service and support that goes with it.

Best regards,

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