Today's Lathes

what's right & what's wrong

Oneway - Revolutionary steel bed design combined with VFD created a new standard for the 21st century

I admit it. When it comes to lathes, I'm a big complainer. I can't understand why designers don't see the mistakes that are obvious to me. By what right, you might ask, does this engineering school drop out (yours truly) judge the decisions of the professional engineers who designed these lathes?

Vicmarc - Large swing lathes are attractive to bowl turners, and these lathes are also offered in long bed versions

Well, for one thing, I have used hundreds of lathes, both wood and metal, in my life, and spent a great deal of time studying lathe design. Dropping out of engineering school worked out well for me, since the university did not have any machine tools, only microwave labs and nuclear reactors, and I immediately began my real engineering education by working in machine shops, millwork shops, repairing woodworking machinery and automobile engines.

Even earlier, I had plenty of exposure to woodworking machinery, since my father and his brothers ran an architectural millwork shop in Chicago, where they had over 50 pieces of industrial woodworking machinery.

What follows is a review of new lathes, and also a guide for the reader who is shopping for a lathe. I have tried to balance my complaints with constructive comments.

History of the Modern Wood Lathe

After 1900, mass production took over, and hand woodturning became obscure. None of the architectural woodwork shops where I was employed in the 60's (including my father's) had a wood lathe, and in this period most wood lathes were sold to schools for industrial arts classes.

Suddenly the woodturning renaissance of the 1970's brought about a new surge in demand for wood lathes, and the old four-speed 12˝ lathes which were standard for decades were inadequate for the artist woodturner, who over the next two decades became the driving force in lathe design. No longer concerned with porch posts or furniture parts, modern lathes are now designed for bowls, and thus have become taller (greater swing) and shorter (less length capacity).

Modern Improvements

In the nearly half century I have watched this evolution of lathe design, one thing stands out as the most significant improvement

– speed control through variable speed motors. In the old days we had four-speed lathes. But really they were two-speed lathes: the lowest speed for bowls, and the second speed for spindles. The other two speeds were too fast to be used for anything.

Then came mechanical variable speed – variable diameter pulleys. This was a great improvement because it was continuous, but almost without exception the lowest speed was not low enough. The great thing about modern variable speed motors (especially Variable Frequency Drive, or VFD) is that they can be adjusted almost to zero, and for heavy or out of balance workpieces, starting out at a very low speed is essential. Many modern lathes, especially smaller ones, have a range of speed that is too fast, and in general most lathes would benefit by having their speed range reduced in half.

Record - Lathe beds made from two steel rails are unsatisfactory

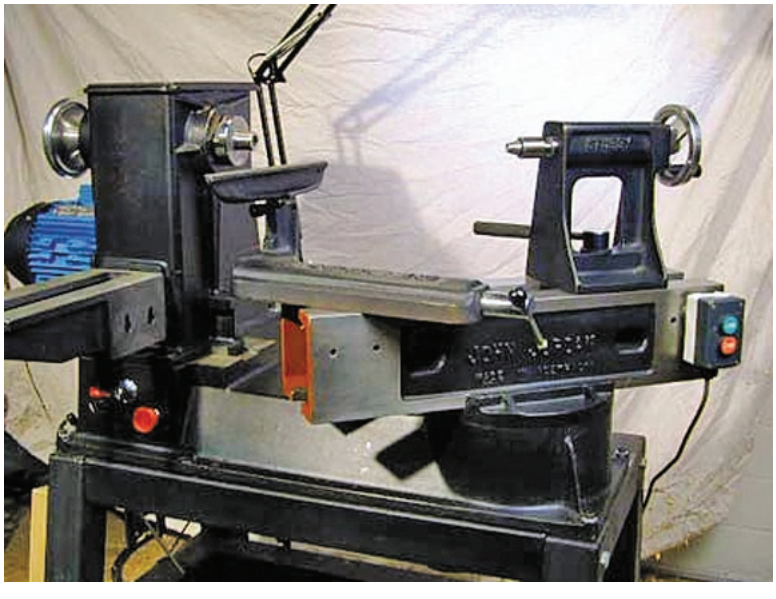
Lathe Beds

In the past 300 years, lathes gradually evolved from machines made almost entirely of wood, to ones made from iron and steel. The last component of the lathe, which underwent this conversion, was the bed. Influenced by advances in machine tools, cast iron lathe beds have been considered the gold standard of quality for well over a century.

I am a firm believer in the liberal use of cast iron for the bed or foundation of machines. Cast iron has excellent vibration dampening properties, and pattern designs are uncompromising, providing bosses, ribs and braces which are integral to the one-piece structure. Nearly all large lathes of the twentieth century are made from cast iron, but simultaneously many people have tried to make lathe beds out of steel, to dodge the need for casting and take advantage of cheap rolled steel. All of these attempts failed because they were based on the fundamentally flawed concept of the lathe bed as consisting of two parallel rails. These designs, whether the rails are I-beams, round or square bars, either solid or hollow, are doomed because the rails are not braced to each other (except at the ends) and thus provide no torsion control, and the beds simply do not have sufficient rigidity. Notable current examples of this folly are the lathes made by the otherwise prestigious English firms of Record and Sorby. The worst of all possible lathe beds are the monorail types once made by Sears (and are still copied in China), which resemble a drill press lying on its back.

The new millennium changed all that, when the Canadian firm Oneway invented the first successful steel lathe bed. They discarded the faulty concept of dual rails, and instead based their bed on a large hollow tube, onto which steel plates were attached and supported at intervals along the length. The hollow tube has tremendous torsional strength and rigidity. Combining these beds with modern variable frequency motor drive created a revolutionary wood lathe for the 21st century.

Another revolutionary breakthrough is the Stubby lathe which has a bed on a swivel. This allows the bed to rotate at any angle to the axis of the lathe providing better positioning of the tool rest and eliminating the problem of the bed obstructing the tool. This is a great example of "thinking outside the box"! The Stubby may represent the sprouting of a new branch in lathe evolution. As its name implies, this lathe is strictly for bowls or short spindles, but it deserves to be better known.



Stubby - Innovative design allows the bed to be rotated at any angle to the axis

Spindle Nose

The spindle nose is your interface with the machine. It's how you hold the work and access the power of the lathe. You MUST have basic accessories (chucks, drive centers, etc.) to fit the spindle nose, or your lathe is useless.

The features of the spindle nose are:

1. Taper. Most wood lathes use Morse Tapers, which have been standardized for 140 years. Other taper systems were invented later which were better, but like the QWERTY keyboard, the Morse system was too deeply entrenched to be replaced. Of the eight sizes in the series, wood lathes use #1, #2, and #3, with #2 (which is just under ¾″at the big end) by far the most common.

VB - In a class by itself

2. Spindle Thread. Almost without exception, wood lathes have threaded spindle noses. To remove a chuck or faceplate from the lathe, there must be a spindle lock built into the headstock. Some lathes have an indexing mechanism built into the headstock, which is expected to double as a spindle lock, but being too weak to serve this purpose, is inevitably broken.

Modern lathes can be reversed or may have electronic braking applied to them, and this reveals a flaw in the principle of the threaded spindle nose. Workpieces which unexpectedly unscrew from the lathe while in motion are at least disheartening, and probably dangerous. Designers of metal lathes realized this a half century ago and abandoned the threaded spindle for new types of mounts which are reversible. The only wood lathe to be so equipped is the VB lathe at $9,000.

Some misguided lathe designers have attempted to solve this problem by adding set screws to the hub of the faceplate or chuck. This scheme inevitably leads to damaged spindle threads when the set screws are insufficiently retracted. If you have one of these, remove the setscrews and throw them away.

Until wood lathes adopt one of the new types of spindle nose designs which are reversible (and I know this will be expensive), we have to attach our chucks carefully, and buy lathes that have robust spindle locks for easy removal.

More on Threads

In the 19th century, lathe designers purposely used odd threads on spindle noses to force customers to buy accessories from them. This thinking gradually lost hold as people began to realize the benefits of standardization and interchangeability. With so many after-market accessories now available, few consumers today would fail to recognize odd spindle design as a disadvantage.

At the risk of sounding like an old school American clinging hopelessly to the archaic inch system, I would argue that there are still too many spindle threads, and we didn't need the addition of the recently established 33 millimeter size, a German DIN standard.

While there are about a dozen threads that can be considered standard, and accommodated with accessories off the shelf, these five are the most common:

- ¾" - 16: for mini lathes (Carba-Tec) and older Sears with #1 MT.
- 1" - 8: the most common for small (and midi) lathes. This is the smallest thread, which will accommodate (barely) a #2 MT.
- 1¼" - 8: Used by Nova, Powermatic, Jet, and Vicmarc and becoming increasingly popular.
- 1½" - 8: Used by Conover and No. 1 Lathe, will accommodate #3 MT.
- 33 x 3.5 metric: Used by Oneway and Vicmarc.

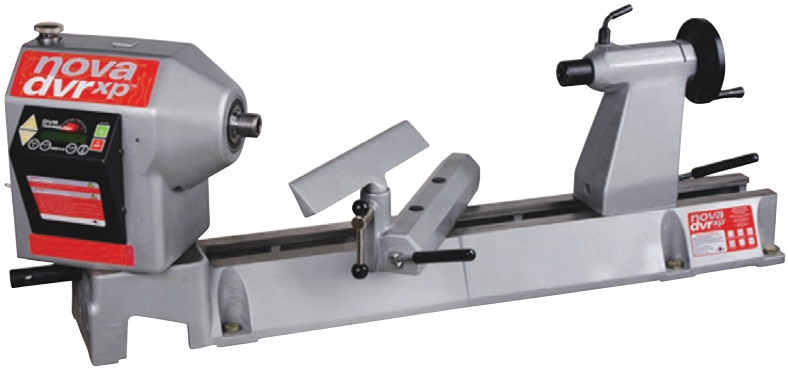
Siegel's Law

Siegel's law of lathe design is simply that the footprint of the headstock and the tailstock should be wider (axial measure) than the height of centers. This is an empirical law that dates back 200 years, and has been followed by knowledgeable lathe designers ever since. Unfortunately, as lathes have been stretched vertically to accommodate larger bowls, the width of the headstock and tailstock have not increased proportionally in most cases.

Tool Rests

The tool rest is the part of the machine closest to where the cutting takes place, and is often where vibrations develop. Not enough attention is paid to the tool rest by designers or consumers. Rigidity, positive locking, and smooth operation are essential, because adjustments are made constantly during operation.

Tool rest bases should be two to three inches



Nova - Reasonable price and good features, but the beds are light and the tailstocks have a very small footprint

below the center height (depending on the size of the lathe), and this allows the tee-rest to vary at least ½″ either above or below the center line. This amount of variation is not too much to ask, yet this simple design principle still evades the Taiwanese makers of mid/low priced ($650) lathes such as the ubiquitous Jet 1236 and its relatives.

Decades ago the 1 inch shank size on tool rests was established for 12″ lathes, and it is clearly inadequate for today's lathes of 16, 20 or 24 inch swing. Yet lathe designers stubbornly cling to this size, with a few notable exceptions such as No. 1 Lathe from Woodworker's Supply and the VB. Powermatic, which had used 1⅛″ for decades, sadly went down to 1″ in the redesign of its large lathes.

Tailstocks

The part of the tailstock which feeds toward the headstock is called the ram. It cannot be called a spindle, because it does not spin. It cannot be called a quill, because it does not have an internal rotating spindle like a drill press. The ram should feed forward when the handwheel is turned clockwise. This occurs because the feed screw has a left hand thread, as do all feed screws on machine tools.

The travel of the ram should be 3 or 4 inches minimum – the more the better. The ram should be keyed to the tailstock casting independently of the locking mechanism, and I see an alarming trend in which the only keying of the ram is the locking screw itself.

Usually the ram is threaded internally, and centers self eject when the ram is retracted all the way. This is probably the best arrangement, but some tailstock rams are threaded on the outside, and are fed by rotating a wheel which is essentially a captured nut. This is an outdated system which is inferior because the threads reduce the accuracy of the fit between the ram and the tailstock casting. Carba Tec and Nova use this system.

Conclusion

A quick check of catalogs found lathes ranging from $85 (Harbor Freight, no brand) to the fabulous VB from England for $9,000. This is range factor of 100. Somewhere in there is a lathe that is right for you. If you are just getting started, consider a midi lathe at under $400, which will give you something to learn on and you can go bigger later. If you are shopping for a lathe, here is a checklist:

Powermatic - Continuing their tradition of massive bed castings, these new generation lathes have great features

1 Variable speed motor with lowest speed no more than 200 rpm.
2 A solid massive one-piece bed (not short sections bolted together)
3 A massive headstock and tailstock with a large footprint on the bed.
4 Standard spindle threads and Morse taper.
5 A massive and rigid tool rest.
6 A robust spindle lock

Notice that the word "massive" occurs frequently on the checklist. Mass is good. If you cannot find a lathe with all these features, consider restoring an old one by adding a VFD (variable speed motor). You will probably get more mass for your money. And that will be the topic of the next article. ■