

# AMERICAN GUNSMITH

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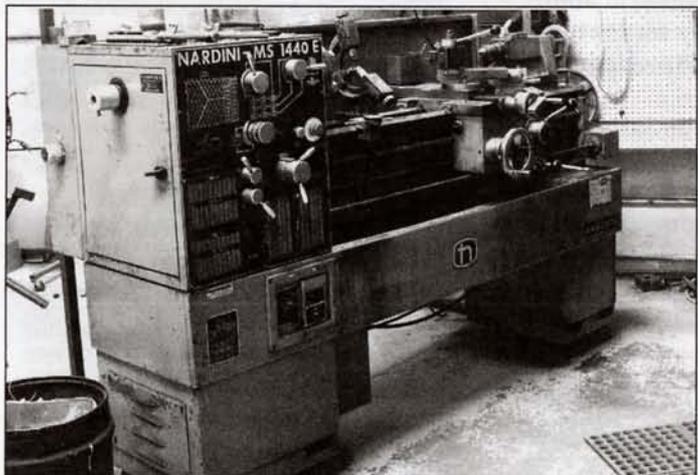
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# Lathes, Mills, Drills

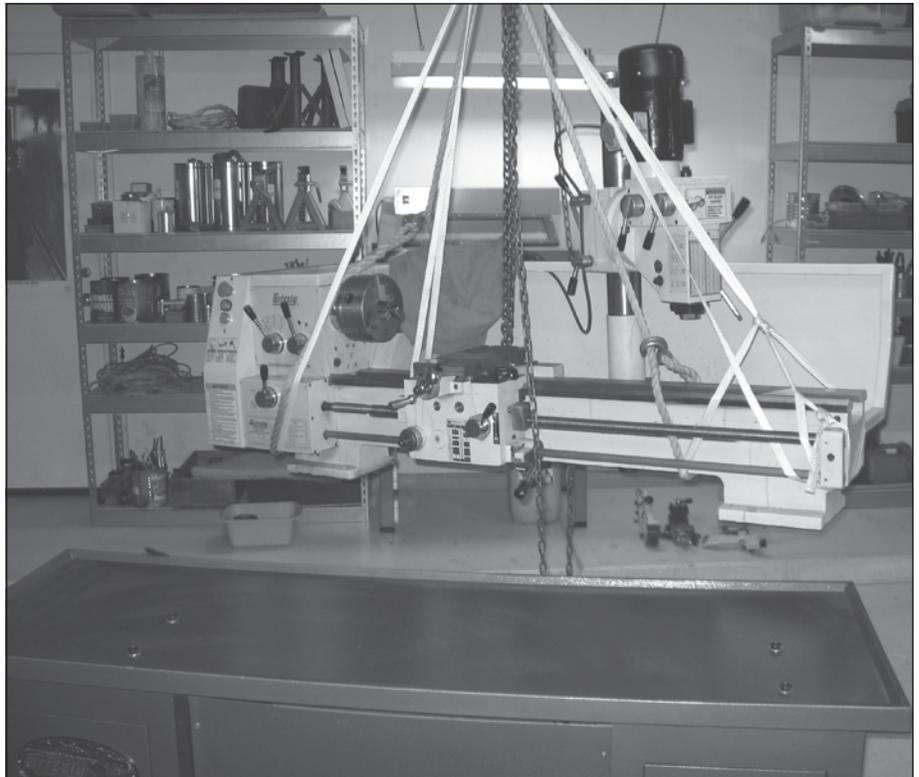
***Part 1: Key Considerations and Used Equipment. Unless you have unlimited funds, buying new or used machinery can be a challenge. Here are some points to consider when making these big purchases.***

*by Richard MacLean*

**T**here are gunsmiths in the far-off Land of Oz who have access to unlimited floor space, three-phase power, high bay entrances and money to buy new Bridgeport vertical mills, South Bend lathes, and Dayton floor drill presses. But for the rest of us who live in the real world, the pitfalls of buying metal working machinery are as numerous as the options. This two part article was written primarily for the home or hobby gunsmith or the professional with a small shop with limited space and funds. Indeed, for the first-time buyer who might be tempted to grab a “great bargain” advertised on the Internet and located halfway across the country this article is a must read. Some aspects covered also may apply to larger shops since many of the points covered are independent of shop size. Commercial facilities mass producing gun parts fall outside the scope, however, since they typically use large CNC machinery and are located in industrial parks set up to handle such equipment.

## Weight, Cost, Power Supply

Before even getting into the range of factors that influence the type of equipment to buy, it is first worthwhile to step back and consider the three factors which, in total, make the purchase of mills and lathes so problematic. First, to state the obvious, they are extremely heavy. New or used, a lathe suitable for rifle work can weigh half a ton, often more. A full-sized industrial vertical mill can weigh more than a ton. They are expensive to ship and set up, requiring specialized equipment or facilities such as an unloading



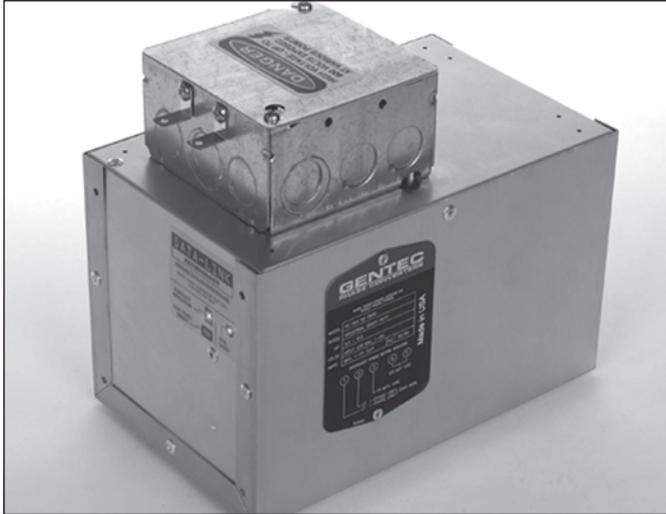
***Above:*** Helpers can manage small machinery of a few hundred pounds, but with industrial-sized equipment a hoist and/or other rigging is a must. You also will need sufficient vertical clearance. Pictured is a Grizzly combination lathe/mill being positioned on its table to be later rolled into place on special dollies.

dock, forklift truck, lift gate, pallet jack, hoist, and so on.

That used \$1,000 “smoking deal” can suddenly become an expensive headache to transport and position in your workshop. Shipping is the most straightforward aspect. If the unit has to be placed on a pallet, or crated and then put in a truck or on a flatbed at the sellers end, the moving costs can escalate rapidly. Some used equipment sellers are set up to handle this operation efficiently, but you will face the challenge at your end. Cross-country shipping trucks

do not necessarily have lift gates and few small shops have a dock. If the unit has to be transferred to a delivery vehicle with a lift gate, that may be an additional charge.

The shipper may refuse to drive on a home driveway for fear of cracking it and may not be willing to place it inside the garage or shop without an extra fee. There is also the issue of lifting it off a pallet, mounting heavy components and placing the unit in its final location. If the floor has to be drilled and the mount hole locations are not known precisely in advance,



it may not be possible to offload and place it in one step. Full-sized mills may be taller than the available door opening, especially if it is shipped and moved on a pallet. The “rigging hardware” (i.e., a forklift truck, straps, and extended forks) may be taller than the ceiling clearance. A shipper will not wait around while you remove the motor to make it fit.

All of these issues can be handled if commercial heavy equipment riggers are used, but this drives up the cost. One such rigger quoted me \$600 to pick up, transport a full-sized vertical mill thirty miles across town, and set the unit in place. That \$2,000 bargain was now \$2,600. It still could have been a bargain, but the important point is that shipping and rigging costs are not insignificant

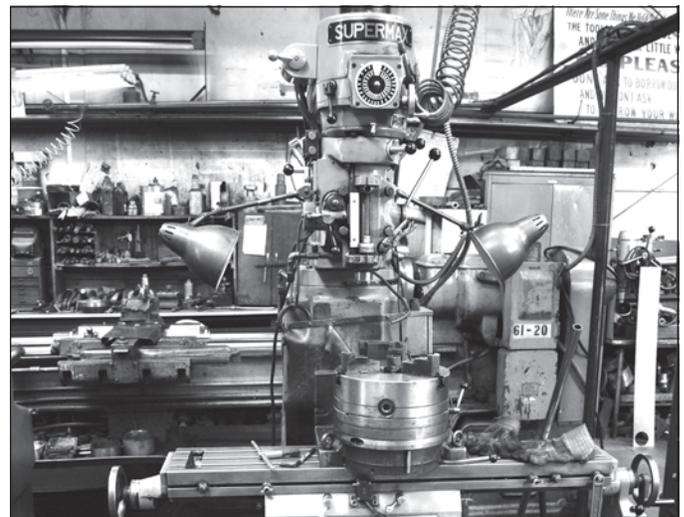
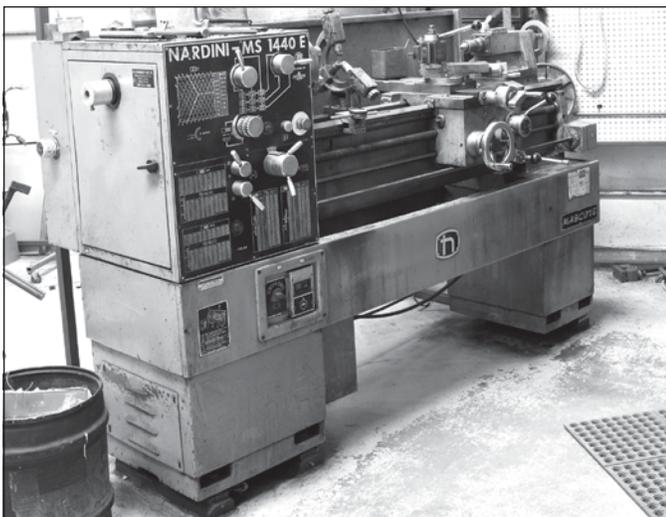
**Above left:** A static units are approximately one-third the cost, but drop HP rating by one-third and you risk burning out your motor under heavy loads. **Above right:** Most used industrial machinery requires three-phased power. Unless you are located in an industrial park you will need a converter.

and must be thoroughly researched prior to purchase.

The second point is cost. As Einstein would say, “It is all about relativity.” Used and even new “economy” equipment is costly, but not inordinately expensive. If it is a \$30,000 unit, then the shipping cost is a relatively minor consideration. But for full-sized, used equipment that can be bought for \$1,500

to \$5,000, shipping and setup can be a major consideration. Even if the seller is willing to refund your money if you are not satisfied with the unit, these sunk costs makes the purchase of used equipment costing a few thousand dollars a much riskier endeavor. It is hard to justify the time and expense to fly across the country to examine a \$2,000 unit, but it would be foolish not to

**Below left and right:** Purchasing used industrial mills and lathes such as these can be a low cost alternative to new machinery. But the “bargain of the century” found on a website auction may turn out to be a nightmare if you don’t do your homework and make the purchase wisely.





*Left: Most small shops do not have a loading dock or a forklift. Be sure to factor in the cost to load and unload equipment onto the shipping truck. This 1,200 pound delivery required a lift gate and pallet jack.*

do so for a used unit costing tens of thousands of dollars.

Finally, access to power is another consideration for those not residing in an industrial park. Used equipment advertised on the Internet through sites such as eBay, Surplus Record, EquipMatching, MachineTools, Used Equipment Network (UEN) and others often contain the horsepower specifications, nothing more. To the novice, a two horsepower motor may not seem like much of a load on his system, but if it is three-phase he may be in for a big surprise when the unit is ready to be wired. Most industrial machinery is three-phase, not single-phase. Three-phase power is more economical and energy efficient with simpler motors running more smoothly. A start capacitor is unnecessary and the individual lines are the same size and carry the same current for a balanced load.

If you do not have access to three-phase power there are three options. First, request your power company supply three-phase power. In most cases, this would be outrageously cost prohibitive for a home workshop. Second, change the motor, however, it can be expensive and tricky finding a compatible replacement motor.

The third, better option is to buy a converter. Rotary phase converters are three-phase motors that take single-phase input current and, with the help of run capacitors, spin a motor under no load (i.e., idling) generating three-phase output current to the machinery. Using a rotary converter,

it is possible to operate the machinery with no loss in power and efficiency. A rotary phase converter is the most flexible and can handle any type, number, and size of load within its rating. For example, a single 7.5 horsepower converter could simultaneously run a mill and a lathe each with 2 horsepower motors, or it could sit and idle with no units running.

Static phase converters generate power to start (i.e., kick over) the three-phase motor. Since three-phase motors do not have start or run capacitors this “boost” is done electronically, but thereafter the motor is actually running on single-phase. Static converters are significantly cheaper but less powerful than rotary units. For example, a five horsepower rotary converter costs approximately \$500 versus \$125 for a static unit, but one-third of the horsepower rating of the motor is lost with the static converter because you do not have all phases. Picture a six-cylinder engine operating only on four. If you overload the lathe or milling unit’s motor you risk burning it out. Static converters should only be used to run a moderately loaded single motor that does not have high initial load applications such as compressors and resistive load units such as welders.

A third type of converter is a transformer-based phase converter. They are tuned for highly loaded equipment such as air compressors and hydraulic pumps and can provide on-demand power with no losses. These are typically priced in between static and rotary phase converters.

Be they single- or three-phase motors, the larger mills and lathes are almost always 240 volts. It is possible to buy some of the smaller-sized new and used units with 120-volt motors, but this comes at a performance cost. Higher voltage motors run cooler and the supply-line sizing is smaller. For the home gunsmith that does not have

240-volt outlets in the garage or shop and must hire an electrician to install an outlet, it is another cost that must be taken into consideration.

### What Type of Machinery?

Next to the Land of Oz is Dara Adam Khel in the northwest frontier of Pakistan where guns have been made with files, drills, hammers and the like for more than a hundred years. There is something that can be said about the value of basic hand tools and machinery such as bench grinders and drill presses. For the rest of us in the modern world aspiring to do more elaborate gunsmithing, one reaches the point where lathes and mills become necessities. There are nearly infinite options, all of which depend on what you want to accomplish. First, some universal rules.

Buy the absolute best you can afford with an eye toward the long term. It is impossible to envision all the possible future gunsmithing projects you might do, so plan for the absolute widest range your budget can afford. If you have it, other projects will come. You might be gunsmithing, but other, non-gun projects invariably will arise. Everything else being equal, equipment that is big and heavy is more likely to produce more uniform cuts. Mass increases rigidity and dampens vibrations. While bigger is generally better, there are exceptions. For example, a six-inch chuck weighs about 25 pounds and a 12-inch weighs about 125 pounds, hardly something one can easily change out alone. Cutting a firing pin on a 14" X 40" lathe would not be as easy and accurate than if you used a small, precision unit. Costs increase almost exponentially as the precision of the machinery or tooling increases. Your tooling should match both the job requirement and the machine’s capabilities since the outcome will be as precise as the weakest link. Power feeds facilitate smoother

cuts than those that are possible to do manually, even with experience. The more specific the task a machine is designed to perform, the better the results and/or the more easily it can be set up to accomplish that task. For example, a lathe can do milling, but the set-up can be difficult and the range of possibilities limited. Finally, do not even think about doing milling with a standard drill press. The bearings are not designed to handle the lateral loads. The chuck mounted with a Morse taper and not positively drawn up and locked in place can dangerously vibrate free.

For the hobbyist gunsmith it is, of course, possible to farm out a specific operation to a machinist or gunsmith with a well-equipped shop to perform a one-time machine operation. But even the simplest of operations can involve a minimum shop “set-up” charge approaching a hundred dollars. The “relativity question” discussed earlier also comes into play here since it does not take too many repeat operations to justify used or new economy machinery.

There is also the question of timing. While you may wait a few days at a regular machine shop, the wait at some gunsmith shops can stretch out for months. This, of course, assumes that you live in an area where such services are readily available. We will not even go into the legal ramifications of machine shops without an FFL working on gun receivers as there have been recent changes in the definition of “manufacturer” of a firearm. This is a complex legal area, and some machine shops may flatly refuse work on gun receivers or even parts under any circumstances. Consult your lawyer since these requirements may vary by locality and it is serious stuff.

Assuming that you want to buy and not have someone else do the work, just what types of equipment do you select? High-quality bench or floor drill presses are not very expensive, so this is first on the list of must-buys along with a bench



**Above:** Before buying used equipment know what you are getting into in terms of excessive wear, missing or broken parts or key accessories. Way grinding and scraping can restore used mills and lathes to their original specifications, but it is extremely expensive and performed on large, specialized industrial equipment such as this 5' x 5' x 20' Gray planer modified with grinding spindles and a milling head capable of holding 0.0001" per foot. Photo source: Gallery Of Machines

grinder/wheel polisher. In choosing a lathe or a mill, first consider the previously mentioned universal rules. If you are certain that you will only work on handguns, then one of the smaller lathes or mills would be just fine. Small is generally cheaper, but again the precision factor comes into play. Some small, precision lathes are relatively expensive, but there are exceptions with the import market. A new 7" X 8" (swing X bed) unit recently listed at \$400, claiming a “spindle accuracy of 0.0004.” More about both buying online and the import market later

If you must choose between a lathe and a mill because of budgetary constraints, consider buying the lathe since you can perform limited milling operations on a lathe, but not the reverse. Palmgren and South

Bend have manufactured lathe milling attachments which clamp on the tool post just like an ordinary tool. Work can always be held the old-fashioned way with angle blocks, vises, and clamps. The book *Milling Operations in the Lathe* by Tubal Cain is a great reference.

### Used Equipment

Unlike hand tools, bench grinders, and table saws, lathes and milling machines are too specialized and expensive to be found at yard sales. Finding one by word of mouth might present one of the best opportunities if, in the process, you can also obtain some detailed background on the unit and the reasons for it being sold. In most cases, buyers have to rely on classified newspaper ads, used equipment brokers, or Internet postings. The Internet has

revolutionized equipment resale since you can sign up on some Web sites and be automatically notified if a unit matching your specifications arrives on the market, literally anywhere in the world. The marketplace is awash with used equipment and the process can be quite reasonable even for some of the brand-name units. That is the good news. The bad news is that not all of this is being created by companies upgrading to more sophisticated and faster CNC units, but by US-based manufacturing moving overseas.

While the abundance of units advertised online may seem encouraging, in reality, the sheer number of choices could be overwhelming if it were not for weight and cost. You just cannot casually buy one, try it out, and ship it back if it does not meet your expectations. Two identical, vintage brand-name machines can differ markedly depending on how well they were maintained and how much they were used, or abused.

First, photographs can sometimes make equipment look much better or worse than it really is. A clean-looking unit may be worn and major components about to break. Conversely, that filthy looking unit may be a gem in the rough. Second, it is easy and cheap to repaint a unit, but rebuilding units can be extremely expensive relative to the purchase price. Replacement parts may not even be available for very old or off-brand equipment. There are more than thirty companies across the country that can grind and scrape ways, but these operations are costly, especially if an entire unit is to be reconditioned. For example, a Series 2 Bridgeport 9"X42" vertical mill can cost as much as \$7,000 for all three axes. On top of that add shipping. This is not to say that professional restoration is out of the question. It all depends on the extent of the wear, the number of axes that may require reconditioning and the final tolerances that are desired. It is best to consult with a remanufacturing specialist such as Derek Hartman at Gallery of Machines in Marathon, New York,

before you buy a specific mill with known wear problems.

Because of the preceding cautions, it is always best to inspect the unit directly. Generally, this means that you are limiting your search to the region in which you work, unless you know a knowledgeable person you trust in the area. There may be exceptions such as buying through a broker with a stellar reputation that will back their units and include some prior agreement on return shipping costs. Some used machinery suppliers, such as the previously mentioned Gallery of Machines, are also remanufacturers. In other words, they can inspect, state the condition and repair a used unit in inventory to the customer's specifications. Of course, you will pay a premium by going through a broker compared to a direct purchase from a private owner.

Ideally, you should not only see the machinery in the shop where it was used, but actually see it in operation through its range of speeds. If gears are chipped or missing, or if the bearings are excessively worn, it will become obvious. Seeing the unit in its original shop also gives an indication of the type of care it may have received. If the place is a mess it is hardly a good indicator that the unit was well cared for. If the unit is in a resellers warehouse you really have no idea of its use and care. I have heard horror stories of mills being routinely used as bearing arbor presses and lathes used as holding devices to straighten shafts mounted between centers and beaten with hammers.

If you cannot see the unit in operation, then the amount of play in the bearings may give some indication. Replacing bearings is expensive. There is also obvious stuff like someone ran the carriage into the chuck. The bed's ways are one of the most critical areas on a lathe and generally wear occurs at the point of most use, namely, near the chuck. A good indicator that wear is not excessive is if the carriage binding screws can be tightened to the maximum near the

headstock and still be moved all the way to the tailstock and if the keyway on the lead screw is uniform along its length. The same goes for checking the half nuts on the apron and the amount of backlash on the carriage and cross slide. If they are way too sloppy and tightening the adjusting screws and nuts cannot fix it uniformly over its length of travel, it may be too worn for the projects you have in mind.

A similar inspection can be done on a mill. For example, it may operate perfectly in the center of a 42-inch table, but bind when at either end of its travel. Again, much of this can be repaired, but repairs such as way grinding and scraping can be expensive, especially considering shipping costs and could potentially overshadow the purchase price. The current owner may or may not be willing to allow you to set up dial indicators to check runout, alignment, and so on. These measurements can be time consuming and try the owner's patience. Not only that, you will need to know what the original specification were, what an acceptable amount of wear is reasonable, and how to take the measurements. Perfect alignment in one axis may or may not indicate alignment in another.

Still, after all these cautions, the thrill of the hunt for that diamond in the rough is a powerful force. A clean up and a coat of paint might transform a mess into a miracle of machining precision. Just go into the search with eyes wide open and be very patient because it could take many months to find something local, especially if you do not live in a heavily industrialized area.

### Coming Next

In Part 2 we will provide guidelines for sizing lathes and mills for gunsmithing work, discuss the current state of the import market, and examine "three-in-one" combination units that can be a practical choice to those who need to perform lathe, milling and drilling operations but are on a budget and have limited space. 