

# Tools and Equipment

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## Introduction

Having the proper tooling enables instruction and reinforces the “right tool for the job” concept with your students. An important SLO for students in agricultural mechanics courses is learning proper tool names, proper tool use, care of tools, as well as safe tool use.

Tool inventories are valuable especially for teachers taking over a facility. Knowing what you have is important to planning instruction. Inventories should include the tool, quantity, and condition (see sample form). In addition to initial assessment of tooling, taking an annual inventory at the end of the school year will allow you to order replacements before they are needed for instruction. The tool inventory can easily be kept in a spreadsheet and updated. Tools should be of high quality, as they will last longer. Selecting the types of and to some extent, the brands of tools used in industry will be a good investment.

The quantity of a tool will depend on budget, class size, how you will organize your instruction, and space to store them. To maximize instruction you will want to avoid bottlenecks caused by lack of tools. For example if you have a project that requires a drill press, you may want to have more than one if students have to wait to use it. The lists below should be used as a guide for what typical tools might be needed. Tool quantities are a suggested starting point but should be modified by your individual circumstances. For example if you have a welding class of 20 and students all do GMAW welding at the same time you would need 20 GMAW welders. However if half do SMAW welding and half do GMAW welding then you would only need 10 GMAW welders.

## Curriculum, Student Learning Outcomes, and Tooling

In an ideal world curriculum (i.e., projects) are driven by the desired student learning outcomes (SLO). Tooling would then be determined by the needs to deliver the curriculum. In reality tooling is limited by budget and space (facilities). The teacher will need to find a balance between needs and resources. In some cases curriculum can be tailored to the existing tooling with no change in the SLO.

## Classes of Tools

You can separate tools into some groups for management, budgeting and purchasing.

Small hand tools are essential and are the most frequently replaced. Initially these tools may be purchased as sets, but will need annual replacement as individual tools. Budgeting a regular amount for this purpose is recommended. Experience will help determine the correct amount. Examples of these tools are screw drivers, end wrenches, drills, and taps.

Portable power tools require regular replacement as they wear out or are damaged. The cost of these tools can usually be part of an operating budget. While these tools are more expensive items than small hand tools the budget can be combined in to a “general tool replacement” budget item. Examples of these tools are angle grinders, portable drills, and circular saws.

Stationary tools are the largest and most expensive tools. They are commonly purchased separately with special funds and may be inventoried separately. Typically you should plan on replacement as they wear out, but the lifespan of these tool should be long with proper maintenance. Example are table saws, hydraulic shears, brakes, and drill presses. In some cases obsolescence is a factor that warrants replacement. An example of this might be replacement of a radial arm saw with a power miter saw (commonly found in industry).

## Mirroring Industry

In an ideal world your shop should use the same types tools used in the current industrial setting. This may be unrealistic for reasons such as space and budget. However the teacher should keep current on the trends in industrial tooling and plan replacements appropriately. Consider removing outdated tools such as compass saws. Note that this does not suggest removing hand tools that have commonly been replaced with a power equivalent. Many hand tools are still commonly used. Learning to use hand tools correctly also addresses SLOs related to craftsmanship and are a good introduction to the use of power tools. An example to consider is that gas welding is not used much in industry anymore but the physical motion mirrors TIG welding and the process still has a place in repairs on the farm. An advisory board can be helpful to review your tooling and make suggestions for updates.

## Tool Specification and Performance

Hand tools quality is fairly straight forward as long as you stick to name brands. Generally a premium quality tool is not required. However poorly constructed hand tools should be avoided as they will not last and in some cases may be a hazard to use. When evaluating hand tools look for: Quality of the steel, manufacturing details like the fit of the parts, and finish.

Specifications for power tools should consider the following:

- Type of power required. Most shops are wired for 120 volts and 240 volts. Many shops also have three phase service. 120 volt service should only be used for portable tools and small stationary tools. 240 volt service should be used for stationary tools and three phase is preferred.
- Capacity. Many tools have a maximum capacity. For example a brake is limited to a maximum thickness and width, a table saw has a maximum rip capacity and a maximum thickness (blade diameter), a bandsaw has a maximum throat and cutting height capacity.
- Size. The physical size of the tools may be a concern (footprint)
- Duty cycle. A duty cycle is how much you can run the tool with out overloading it. It is given as a percent. For example a 30% duty cycle would mean that you can run it 3 minutes out of 10 minutes. Welders commonly have a duty cycle of less than 100%.
- Construction of the tool. Some things that might apply are the types of bearings used, materials such as cast iron vs cast aluminum.
- Service and parts availability is an important concern. Is local service available? Does the manufacturer provide parts? Consider a large tool may be in service for 20 years.

- Safety features. Proper guarding is particularly important.

When determining minimum specifications, you must consider how the tool will be used. Performance is generally tied to the size of the motor. Portable tools often can be compared by looking at the amperes of the tool. The larger the number the more power it can produce. Stationary tools are driven by motors. Motors are rated in horsepower (hp). A 10" table saw with a 2hp motor will perform better than one with a 1 hp motor.

If you are comparing tool options or asking for bids you need to have clear specifications to insure you purchase a tool that will work well in your shop. You should expect that tools with better features will cost more. Many tool companies have a "consumer" brand which are marketed to homeowners and hobbyists. These brands should be avoided as they will not hold up under shop conditions.

## Battery Powered Tools

As battery technologies have improved so have the number of portable battery powered tools available. Battery powered tools will cost more than the corded versions and have higher maintenance costs. While drill/drivers are probably the most common tools used around shops you should consider angle grinders, impact wrenches, circular saws, jig saws, routers, and sanders. These tools have an advantage of not having to provide power to the work site and don't require extension cords which can be a trip hazard in the shop. There is a downside to these tools in that the batteries have a finite life and need to be replaced on a regular basis. The teacher should budget for this as the batteries can be as expensive as the initial tool purchase.

Current battery technology for power tools uses lithium ion technology. Voltages range from 12V up with the most common being in the 18-20 volt range. Batteries are rated in amp hours and the higher the amp-hours the longer it will run on a charge. Smaller capacity batteries are lighter and work well for tools like sanders and drivers. Larger batteries work well for tools that draw more power like grinders and circular saws.

A battery charging station should be setup in the shop and have enough capacity (chargers) to provide a charged battery at all times. Charger also have a capacity. Fast chargers are desired. Most manufactures have fast charging stations that can accommodate multiple batteries. Consider purchasing batteries and chargers separate from the tool and purchasing "bare" tools.

It is strongly suggested to standardize your battery powered tools to one system so all batteries are interchangeable.



Dewalt multi-battery charger

## Planning for Tool Acquisition

Tool acquisition is an ongoing process driven by changing instructional need (new classes) and replacement needs. A starting budget number for replacement might be 10% of your current tool value. Keep in mind that replacement costs are generally higher than the original cost.

## Purchasing

Initially purchasing tools in sets may be economical (and simpler), but replacements will need to be individually purchased. For example, you might purchase a simple set of sockets and end wrenches for an engine class. Over time, pieces will be lost or broken and you should be able to purchase individual items to replace them.

Manufacturers may provide special discounts to educators for their tools. These may be substantial and are available directly from the manufacturer or through dealers. Large items like welders and stationary tools are commonly considered capital assets and may need to be tracked in a separate inventory. This is especially true when such items are purchased with special funding such as grants. Larger tools commonly will need service beyond what you may be able to provide. Such items are best purchased from local suppliers who can provide the service.

Do not forget to factor in purchase expenses such as shipping, setup, and power hookup. For large tools freight can be a major expense. Complex machines may require professional assembly and adjustment. The cost of running power may be complex. Factors that must be explored before purchase are:

- Does the shop have adequate service (capacity)?
- Does the shop have the right kind of power (ex. single vs. 3 phase)?
- Does the power panel have space for additional circuit breakers?
- How complex will it be to install power to the location of the tool. This may be as simple as running some conduit or as complex as sawing the concrete floor.

## Accessories and Consumables

When purchasing tools don't overlook accessories. For example if you purchase a hydraulic shear with a punch you will need a set of punches. Depending on the source of funds it may be easier to order accessories with the original purchase. Often accessories are less expensive when purchased with the initial purchase.

Consumables also may be purchased with a piece of equipment. For example a selection of band saw blades with the purchase of the band saw.

## Replacement Parts

Items such as saw blades, welding tips, GMAW gun liners, and drill bits should be kept in stock. These wear out or are broken frequently. You will learn from experience how many to stock. Purchase extra with the initial purchase.

## Welding Gasses

Initially you may wish to rent bottles (pay demurrage) as this is simple for the teacher. For larger programs, purchasing bottles should be considered. Some companies offer a purchase/exchange program where you "buy" the bottle, but they will simply exchange it like a rental bottle but you save the monthly demurrage costs.

## Tool Storage

Control of tools should be a high priority as they are necessary for daily instruction. Proper storage should allow:

- Easy tool access for students during class.
- Secure storage to prevent theft and "borrowing".
- Quick inventory.

There are many great systems developed by teachers. A common method to hang tools on racks for easy access and inventory and enclose with a lockable cover. Tool storage can be organized by task (ex. plumbing, small engines) so access is limited when class is not engaged in the task.

Tool rooms are useful for tools that are used infrequently. The drawback to tool rooms is generally that they are hard to supervise and keep organized.



A good example of custom tool holders. These were plasma cut then bent in a brake.



An example of a good idea (lockable storage). However mounting above a workbench not only reduces the workbench space, but also invites dumping of tools.



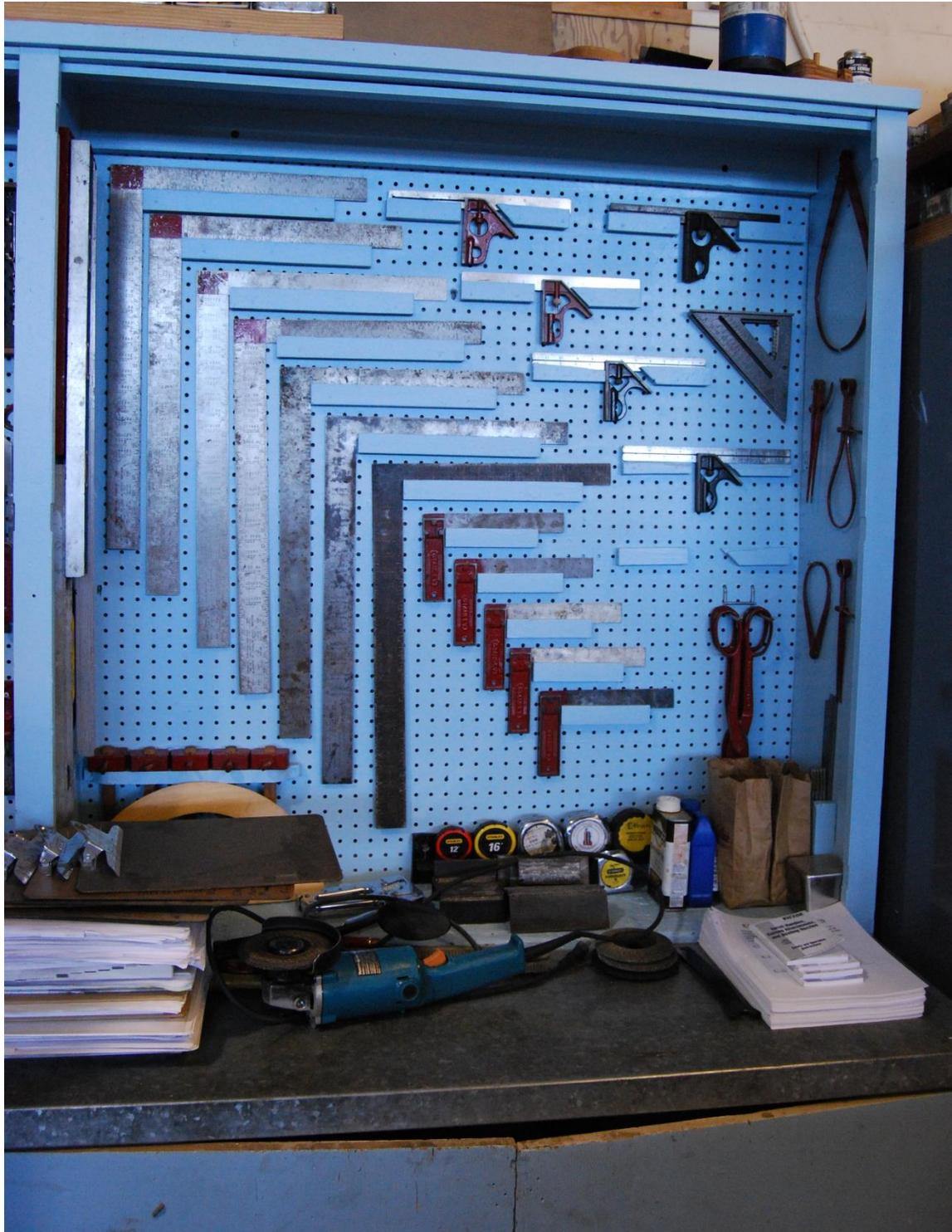
Portable drill holders made from ABS pipe. Note the storage of the cords.



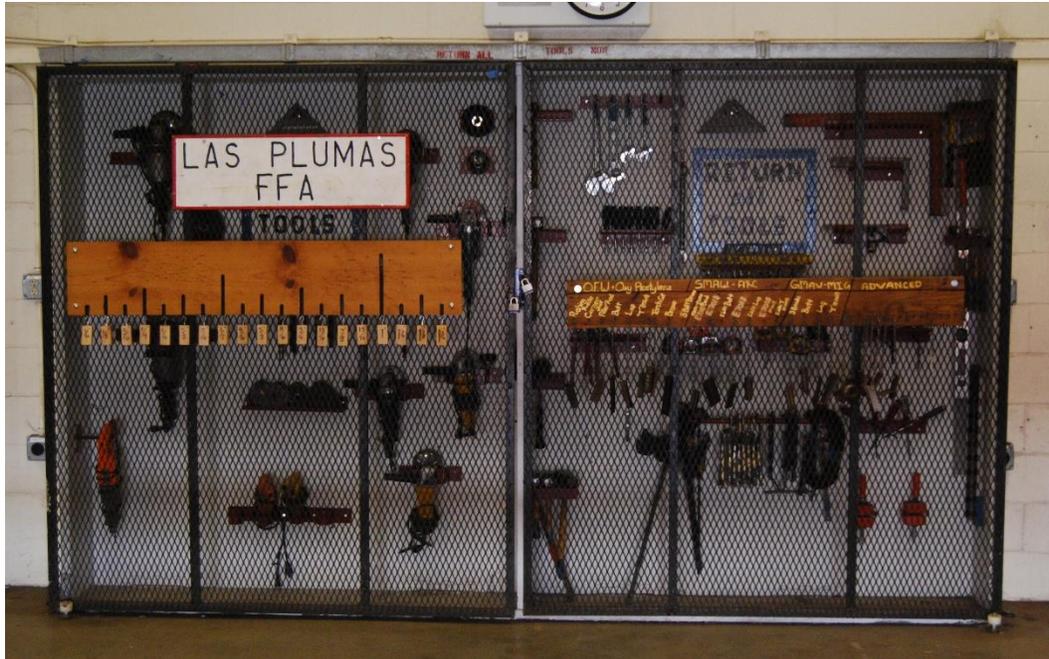
Pegboard can be used to hang tools. It is flexible. Hooks can be glued with a hot glue to prevent falling out and tool outlines can be drawn around tools.



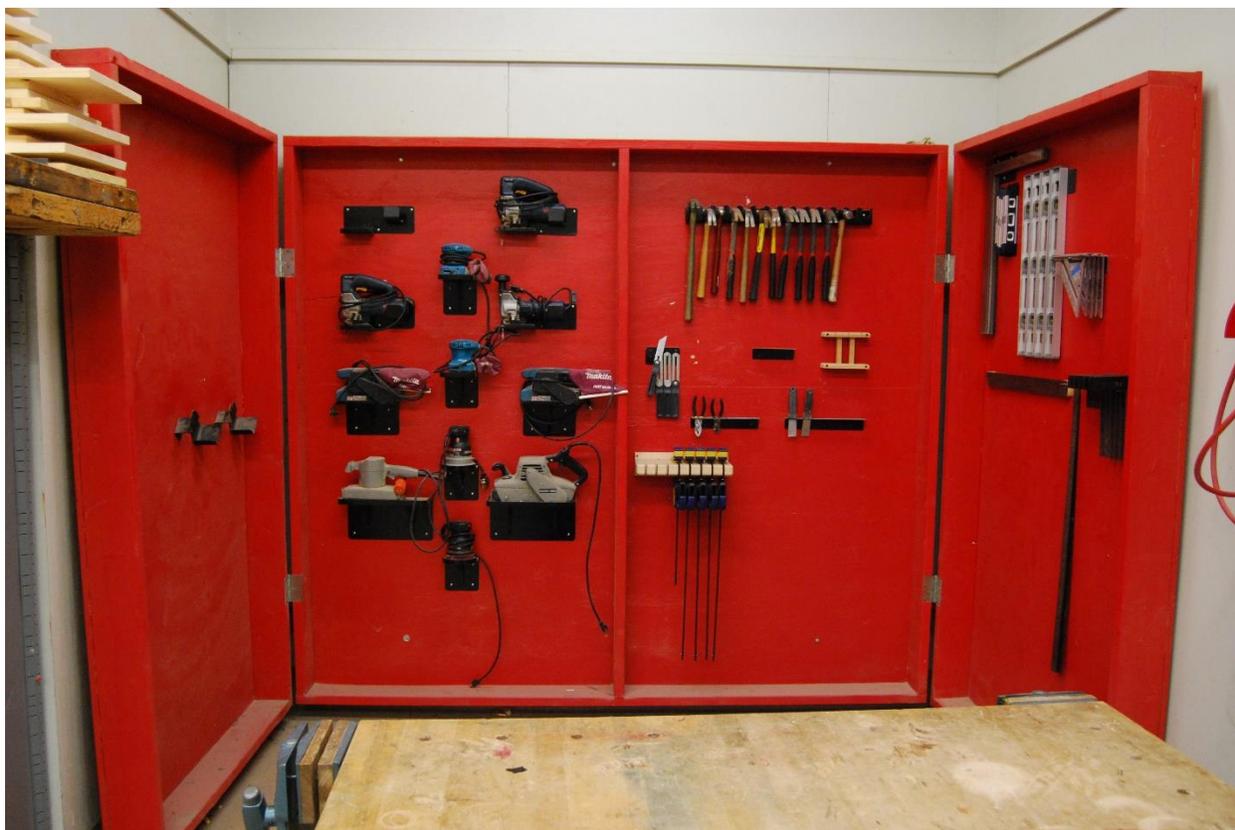
A nice cabinet for welding related tools. It is lockable and notice the castor that supports the door.



An example of storing like tools together (in this case measuring tools).



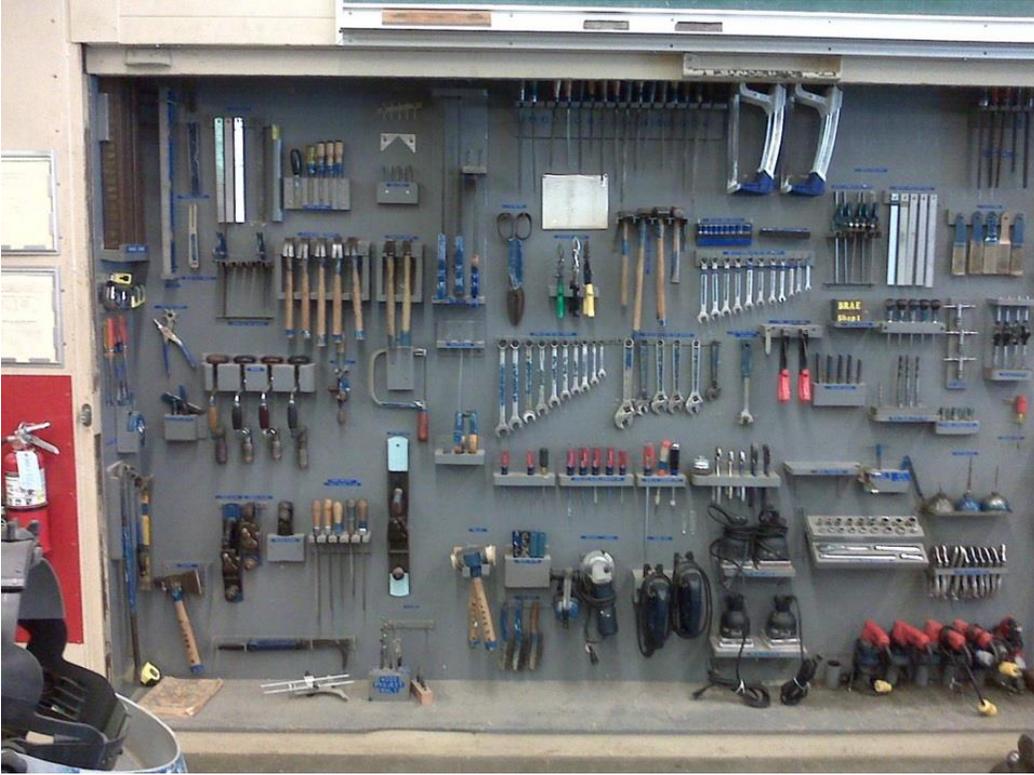
This type of tool storage is desirable since you can see what is stored even when locked.



A lockable storage unit. Note that this design allows for storage in the cabinet doors.



An example of “caddy” storage. Very useful for specific projects. In this case electrical. Caddy is stored away when not needed. Easy to inventory as every slot should be filled. Hint: If you are using this type of storage and have a missing tool place tape over the slot until it is replaced.



A good example of general tool storage with a vertical door. The vertical door does not take space.



Use of pegboard for storage. The advantage is that you can use purchase brackets and easily move items around. Note the use of a roll up door for security and some custom brackets.



A small cabinet just for electrical tools.



Cabinet with wood brackets and expanded steel doors.

## Tool Maintenance

Instructors should plan on regular inspection and maintenance of tools. In many cases this task will fall to the instructor, but in some schools this is performed by maintenance personnel. Determine what will be your responsibility. Prioritize these tasks if they cannot be done immediately. Safety concerns like broken guards) must be addressed first.

Unsafe equipment should be disabled so it cannot be used. According to OSHA, lockout/tagout (LOTO) protocols are “specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.” While students are not employees this is a good general practice in any shop. Unsafe equipment must be tagged and should be locked out. A number of devices can be used to prevent plugging in a machine or turning on the breaker.



Examples of Lockout Devices

## Tool Lists

Tools lists are somewhat subjective and will vary depending on the preferences of the tool user. The lists below are not intended to be comprehensive, but rather a starting place for the skills listed. The lists below are broken down by skill area and type of course but there is some overlap. You will need one set of tools per class. If classes are offered simultaneously you will need to consider duplicate tools.

### Basic Agricultural Mechanics Skills

Most introduction to agricultural mechanics courses will contain a series of projects in different skill areas.

#### Measuring

Measuring and Layout skills occur in almost all of agricultural mechanics. Different tools are used for different materials, but there is much overlap and the tools listed below are common to many areas.

Description	Quantity	Notes
Steel Tape	1/2 students	12' tapes are fine for shop projects, 25' tapes are better for construction.
Combination square	1/student	This tool can be used for layout of most small shop projects. Hint: always buy the same model as they get taken apart and parts lost. Having interchangeable parts is useful.
Framing square	5	Purchase with rafter tables if you plan to teach framing
Rafter Square	5	Commonly called a "speed square"
Dividers	2-4	Rarely used in class, but have for ID
Inside Calipers	1	Rarely used in class, but have for ID
Outside Calipers	1	Rarely used in class, but have for ID
Steel Rule (4')	1	
Sheet metal gauge	1	
Screw pitch gauge	2	1 standard, 1 metric (keep with tap/die set)

## Metalworking

Metalworking includes working of mild steel, sheet metal as well as threading skills. Foundry and blacksmithing skills are not included.

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Hydraulic Shear	1	
Cut-off saw	1	
Box Brake	1	
Cornice Brake	1	
Foot shear	1	
Roll (sheet metal)	1	
Beverly Shear	1	
Bender		(Hossfeld)
Machinist Vises	½ students	
Ball Been Hammer	10	
Black smith hammer	2	
Tinner's hammer	2	
Snips, straight	1/4 students	(10" are better for smaller hands)
Snips, duck bill	1/4 students	
Snips, compound	1	(a set of left, right, strait)
Scribe	1/student	
Dividers	2	
Spot Welder	1	
Drill Press	1-2	
Tap/Die	See Note	(1 complete set, plus extra handles and taps in specific sizes for projects)
Twist Drills	See Note	(1 set plus extras in specific sizes for projects)
Anvil	1-2	
Bench Grinders	4	Some for tool sharpening and some for tool shaping. Generally 1", but a 2" is useful for larger projects
Oxy-Fuld with Heating Tip	1	For bending

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Files (mill & bastard, round, flat, semi)	10	Keep an assortment
Cold Chisel	2	½" is a good size.
Pop Rivet Tool	2	
Portable Drill/Driver	2	
Hack Saw (32 tooth)	6	
Hack Saw (32 tooth)	6	
Standard screwdriver	6	
Phillips Screwdriver	6	
Slip joint pliers	6	
10" adjustable wrench	4	
12" adjustable wrench	4	
15" adjustable wrench	1	
Locking "C" pliers	10	
Combination Square	10	
Sheet metal rule (4')	1	

## Welding

Description	Quantity	Notes
GMAW (MIG) Welder	10	Multi process power supplies should be considered. Gas can be manifolded into welding booths.
SMAW Welder	10	
GTAW (TIG) Welders	2	
Oxy-Fuel Welding	10	(welding and heating tips)
Oxy Fuel Cutting	2-4	
Plasma Cutting	2-4	
Helmet (shade 10)	1/student	SMAW/GMAW
Helmet (shade 12)	2-4	GTAW
Shade 5 goggles	1/student	(Oxy and Plasma)
Rod Storage Oven	1	
Arc Welding Booths (ventilated)	10	
Oxy-Fuel Welding Stations	10	Usually a manifold
Cutting Stations	2-4	
Protective Clothing	1/student	
Welding Gloves	1/student	
Slip joint pliers	1/student	
Chipping Hammer	1/GMAW station	
Wire Brush	1/GMAW station	
Locking welding clamps	10	(a selection of styles)
Hydraulic shear	1	(coupon cutting)

\* Oxy fuel welding and brazing is less common now and may not be part of the curriculum. Omit if not needed. Oxy-fuel cutting is still important.

## Woodworking

For small projects.

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Table saw	1-2	Typical 10" is fine. Many schools will want to consider Saw Stop® or similar safety technologies. If you want to use a dado blade regularly it is recommended to have two saws so you don't need to change blades and guards frequently. Purchase extra carbide blades. Typically 40-60 tooth.
Band Saw	2	Purchase blades typically in ¼", 3/8", and 1/2" width for wood (course teeth).
Drill Press	1-2	Bench sizes often work well. Should be dedicated to wood use as drill presses used for metal will be oily.
Power Miter Saw	1-2	Consider purchasing with a stand.
Portable planer	1	Great tool for making cutting boards. Portable so it can be stored away when not in use.
Stationary Sander		
Claw Hammer	20	A mix of straight and curved claw. 16 oz is desirable, but a few 12 oz will be preferred by some students.
Impact Driver (battery)	2-4	
Screwdriver/Drill (battery)	2-4	
Framing Square	2-4	
Combination Square	10	
Smoothing or Jack Plane	2-4	
Slotted Screwdriver	2	
#2 Phillips Screwdriver	5	
Nail Set	5	Sets of 3 or 4 sizes
Wood rasp	2	
Sanding blocks	4	(can be made from 2x4 with sandpaper stapled to the block)
Belt Sander	1	
Palm Sander	1-6	

Steel Tape	10	
Pipe clamps	10	
Wood clamps	10	
Paint brushes	20	
Putty knife	10	
Woodworking Vise	5	
Woodwork Bench	5	
Forstner Bits	1-2 sets	
Spade bits	1 set	
Drill Index	1	(may want more 1/8" bits for pilot holes)
Counter Sinks	1 set	

## Plumbing

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Pipe Dies and Handle	1 set	(1 set plus extra die and handle for project sizes)
Pipe Reamer	1	
Pipe Cutter	1	
Pipe Threading Machine	1	
12-14" pipe wrench		
Hack Saw (24 tooth for PCV, 32 tooth for copper)	2	
PVC Cutter	6	
Propane Torch	3	
Copper fitting brushes	6	
Water pump pliers	3	
12" Adjustable wrench	3	
PEX Crimp Tool	1	(needs to match rings)

## Electrical

Electrical tools for almost any wiring project using NM cable or conduit. The VOM can be used to learn circuit testing of AC or DC circuits and continuity. DC circuit and continuity testing are useful skills in teaching small engines and farm power troubleshooting.

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Wire strippers	10	
Diagonal Cutter	2	
Lineman's Pliers	2	
Slotted Screwdriver	6-10	
#2 Phillips Screwdriver	6-10	
NM Cable Cutter	1-2	
NM Cable Stripper	6	
16oz Claw Hammer	2	For installing drive clamps/NM cable Staples
Wiring practice boards	1 per student	Many options are available.
Water Pump pliers	2	
Needle Nose pliers	6	
Circuit Tester (plug in)	1	Used for testing student project boards, plugs into DR)
VOM/Multimeter	See Notes	1 for demo. If students test circuits you will need more. Commonly you may have "stations" and one per station.
EMT Bender	1-2	(for EMT practice, recommend using ½" EMT)

## Concrete

For small concrete projects like stepping stones and small sidewalks. For pouring larger slabs see the optional equipment

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Claw hammer	6	Assembling Forms
Rafter or Combination Square	6	
Steel Tape (25/30')	6	
Engineer's Hammer	4	(for setting form stakes)
String	Roll	(for setting forms)
4' Level	2	(for setting forms)
String Level	2	(for setting forms)
Hand Floats	6	
Steel Trowel	6	
Edging Trowel	4	
Square nose shovel	2	
Mortar hoe	2	
Contractors Wheelbarrow	2	
Concrete mixer	1	
Power miter saw/circular saw	1	(cutting forms)
Screed board	6	(make yourself from 2x4)
Tamper	1-2	Larger tamps are needed for larger projects. For small projects like stepping stones you can get 12" tamps.
<b>For larger projects consider</b>		
Steel form stakes		
Level & Rod	1	For setting form grade
Metal screed	1	
Bull float & handle	1	
Rolling Tamp?	1	
Fresno trowel & Handle	1	

## Woodworking -- Advanced

Consider these tools if teaching a “woodshop” course in addition to the woodworking tools. This is not a complete list of possible tools but will enable building a large variety of projects such as cabinets and furniture.

Panel Saw	1	
Shaper	1	
Stationary 6” Belt / 12” Disc Sander	1	
Stationary planer	1	24” minimum
Jointer	1	
Biscuit Jointer	2	
Mortise Drills	1	
Tenon Jig	1	
Pocket hole jig set	1-2	
Spray booth	1	An approved booth with spray equipment
Dust collection system	1	Attach to all stationary tools
Flammable materials cabinet	1	For storing finishes
Stationary Dowel Drill	1	

## Building Construction

For construction of wood structures, the emphasis is on hand and portable tools. If building on site a covered utility trailer should be considered. If projects like sheds are built in the shop or nearby shop tools can be utilized, but students should be equipped with the tools commonly used in the building trades.

Description	Quantity	Notes
Framing Hammer	1 per student	
16oz Claw Hammer	5	
Drywall Hammer	5	
Shingle Hammer	5	
Cat's Paw	5	
Utility Knife	5	
Nail Bags	1 per student	
25-30' x 1" steel tape		
Framing Square	5	
2' level	2	
4' level	1	
Rafter square		
Chalk Line	5	
Plumb Bob	2	
Level, tripod, and Rod	1	Laser preferred, but a builders level will work
Circular saw (worm drive)	5	
Circular Saw (battery)	2	Battery tools should use same battery, commonly can be purchased in sets
Impact Driver (battery)	2-5	
Screwdriver/Drill (battery)	2-5	
Reciprocating Saw (battery)	1	
Jig Saw (battery)	1	
Power Miter Saw	2	
Table Saw	11	(portable for field work)

Staple Gun	2	
Hammer Tacker	3	
Pneumatic Nail Guns	1-2 each	(finish, 8D, 16D)
Air hose	1 per tool	
Portable air compressor	1-2	
Hand Saw	2	
Nail Set	3	(set of 4)
Wood Chisels	3	(set of 4)
Carpenter's pencils	2 per student	
Lumber crayon	5	
Crow/Pry bars	5	
Caulking Gun	5	
Jack Plane	2	
Concrete Tools		See Concrete
Electrical Tools		See Electrical
Plumbing Tools		See Plumbing
Mechanics Tool Set		A basic set for installing tiedowns, etc.
Hard Hats	1 per students	Primarily if construction is going on overhead like roof framing
Step Ladders	6	6' and 8'
20' Extension Ladder	1	For roof access
50' 12ga extension cord	3	
Safety Harness	2	For roof work

## Metal Fabrication

In addition to welding tools, this tools set will allow fabrication of larger projects.

Description	Quantity	Notes
GMAW Welders	6	(movable in shop)
Angle Grinder	4	
2" bench grinder	2	
Hydraulic Shear	1	
Cut-off saw	1	
Horizontal band saw	1	
Plasma Cutter	2-4	(portable)
Locking welding clamps	20	An assortment of styles
Framing Square	5	Aluminum
Magnetic corners	10	
Steel tape	10	
Mechanics Tool Set	1	A basic set for installing lights, hitches, etc.
Crimping Tool	1	Need to stock common solderless connectors. Can start with a set. Primary use is for trailer wiring.
Drill Press	1	
Drill index (1/64-1/2")	1	
Hole Saw Set	1	
Portable Drill (1/2"	2	
CNC Plasma Cutter	1	4'x4' minimum
Large drill press (Morris Taper)	1	Optional
Morris Taper drills 1/2"-1"	1	Optional

## Farm Surveying/Land Measurement

Equipment suitable for doing differential leveling, setting grade stakes, setting forms, measuring irrigation slopes, and learning about GPS. Survey grade (RTK) GPS is very expensive, but it is in common use for surveying and land leveling.

<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
Laser Level & Tripod	4	
Direct Elevation Rod	4	
300' tape	4	
Chaining pins	30	
Level & Tripod		(old technology)
Philadelphia Rod		(old technology)
GPS	10	(wide range of options depending on desired SLO)

## Small Engines

A typical tool set for repair and maintenance of small gasoline engines. Plan to purchase 1 engine for every 2-3 students. Since older engines use inch size tools and newer engines use metric size tool both are listed. If the instructor is starting from scratch purchase of complete sets may be economical.

Description	Quantity	Notes
<b>Tools set - 1 per engine</b>		<b>Sets may be kept in toolboxes or in portable tool racks. Typically 2-3 students per engine.</b>
Combination end wrenches (8-14 mm)	1	
Combination end wrenches (3/8"-3/4")	1	For older engines.
Slotted Screwdriver	1	
#2 Phillips Screwdriver	1	
Torx screwdriver set	1	
"C" clamps	2	To clamp engine to work bench
3/8" drive sockets (8-14mm)	1	May wish to purchase a 3/8" drive set.
3/8" drive sockets (3/8"-3/4")	1	May wish to purchase a 3/8" drive set. Older engines are not metric.
3/8" drive ratchet	1	
3/8" extensions (3", 6")	1	
Allen wrench set		
16 mm spark plug socket (3/8" drive)	1	
3/8" inch pound torque wrench	1	
1/2" drive flex handle	1	
1/2" drive sockets (15mm-22mm)	1	
Strap Wrench	1	
Flat feeler gauge	1	
Round spark plug gauge	1	
Needle nose pliers	1	
Slip joint pliers	1	

Gasket scraper	1	
Nut driver set	1	metric
Parts Trays	2	Old muffin pans work well for this
<b>Class Tools</b>		<b>Shared by all students</b>
3/8" foot pound torque wrench	1	
Digital Caliper	2	
Micrometer set	1	0-1",1-2", 2-3"
19620 B&S Fuel Removal Tool	2	
19368 B&S Spark Tester	2	
19070 B&S Ring Compressor	2	
Flywheel knock-off tool	1	
Funnel	2	
Oil Pan (for draining fluids)	2	
1 gallon Fuel container	1	
Tachometer	1	
Leak Down Compression Tester	1	
VOM/Multimeter	2	

## Farm Power / Machinery (operation)

Description	Quantity	Notes
Slotted Screwdriver	2	
#2 Phillips screwdriver	2	
½" drive socket set (metric/standard)	2	
Combination end wrench set	1	(3/8"-1 ¼")
Engineers hammer	1	
Selection of hitch pins		
Lynch Pins	10-20	
12" adjustable wrench	2	
15" adjustable wrench	2	
18" pipe wrench	2	
Air Compressor	1	
Air Hose	1	
Air Impact Wrench & Sockets	1	
Air Chuck	1	
Jack stands, chocks, & blocks		2-4 stands, block, and tire chocks
Floor Jack	1	
Bottle Jack	1	
Tire Pressure Gauge	4	
Needle nose pliers	2	
Slip joint pliers	2	
Jumper Cables	1	
Battery Charger	1	
Oil can or funnel	1	

### Farm Power (Overhaul)

The basic tools needed in addition to the above for working on machinery. The quantity is highly variable and depends largely on class size and organization. If students work in groups then a basic set of tools should be provided for each group.

Description	Quantity	Notes
Gasket scraper	4	
½" Torque wrench (foot pounds)	2	
3/8" Socket Set	*	Standard & metric, includes deep sockets
½" Socket Set	*	Standard & metric, includes deep sockets
Combination end wrench set	*	(3/8"-1 ¼", 8mm-22mm)
Engine hoist	2	
Engineers hammer	4	
Ball Peen Hammer	10	
Retaining ring pliers	2	(inside & Outside)
12" adjustable wrench	*	
15" adjustable wrench	*	
18" pipe wrench	2	
Jack stands, chocks, & Blocks	4 min.	
Floor Jack	2	
Bottle Jack	2	
Air Compressor	1	
Air Hose	1	
Air Impact Wrench & Sockets	1	
Air Chuck	1	
Needle nose pliers	*	
Slip joint pliers	*	
Pin Pinch Set	2	
Flat feeler gauge	*	
Round spark plug gauge	*	

Digital Caliper	4	
Micrometers	1 set	(choose sizes based on engine sizes)
VOM/Multimeter	2	
Compression Tester	2	
Tachometer	2	
Timing light	1	(Gas engines)
Spring compressor	2	
Gear puller	2	
Ring compressor	2	Choose size based on engines
VOM/Multimeter	2	
Oil drain pan	1	Large capacity
Parts Trays	2 per engine	Old muffin pans work well for this

\* Sets

## Painting

Note that painting equipment such as spray guns have been omitted from woodworking and metal fabrication. These types of projects are commonly finished with a spray gun. You may be required to have a spray booth to use this equipment and operator should use a respirator. If you plan to spray paint yourself check with local requirements before ordering equipment.

If you cannot comply with local regulations to spray projects consider using a local business for finish work.

Hand painting (including spray cans) or staining is usually not a problem. Be sure to have appropriate PPE and good ventilation for students depending on the material being applied.

## Inventory Form

The following form can be created in a spreadsheet and kept updated electronically. The list can be sorted by location for easy use. Save each inventory separately to have a record of tools. Use the inventory to plan tool purchases.

Tool	Quantity	Condition				Location	Desired Qty
		Good	Fair	Replace	Unsafe		
Slip Joint Pliers	9	7		2		Cabinet 1	12
Hack Saw	6	6				Cabinet 1	6
Strait Snips	6	4	2			Cabinet 1	8
2" bench grinder	2	1			1	Metal Shop	1

## Tool Manufacturers (as of 1/1/2022)

The list below is not comprehensive and is provided as a starting point. While web sites may list prices teachers are urged to contact local dealers and manufacturers for educational discounts

Manufacturer	Type	Web Site
Craftsman	Hand Tools	<a href="https://www.craftsman.com/">https://www.craftsman.com/</a>
Delta	Power Tools	<a href="https://deltamachinery.com/">https://deltamachinery.com/</a>
Dewalt	Power Tools	<a href="https://www.dewalt.com/">https://www.dewalt.com/</a>
Greenlee	Tap/Die	<a href="https://www.greenlee.com/">https://www.greenlee.com/</a>
HyperTherm	Welding	<a href="https://www.hypertherm.com/en-US/">https://www.hypertherm.com/en-US/</a>
Jet	Power Tools	<a href="https://www.jettools.com/us/en/home/">https://www.jettools.com/us/en/home/</a>
Klein	Electrical	<a href="https://www.kleintools.com/">https://www.kleintools.com/</a>
Lincoln	Welding	<a href="https://www.lincolnelectric.com/en">https://www.lincolnelectric.com/en</a>
Makita	Power Tools	<a href="https://www.makitatools.com/">https://www.makitatools.com/</a>
Marshalltown	Concrete	<a href="https://marshalltown.com/cat-1228-concrete">https://marshalltown.com/cat-1228-concrete</a>
Miller	Welding	<a href="https://www.millerwelds.com/">https://www.millerwelds.com/</a>
Milwaukee	Power Tools	<a href="https://www.milwaukeeetool.com/">https://www.milwaukeeetool.com/</a>
PlasmaCam	Welding	<a href="http://www.plasmacam.com/">http://www.plasmacam.com/</a>
PowerMatic	Woodworking	<a href="https://www.powermatic.com/">https://www.powermatic.com/</a>
Proto	Hand Tools	<a href="https://www.protoindustrial.com/">https://www.protoindustrial.com/</a>
Saw Stop	Table Saw	<a href="https://www.sawstop.com/">https://www.sawstop.com/</a>
Stanley	Hand Tools	<a href="https://www.stanleytools.com/">https://www.stanleytools.com/</a>
Victor	Welding	<a href="https://www.esabna.com/us/en/products/brands/victor/index.cfm">https://www.esabna.com/us/en/products/brands/victor/index.cfm</a>

## Associated Files

Tool ID Manual (PDF)

Tool Lists (Word)

Tool Inventory (Excel)

Activity (Excel)

### Activity

Assume that you want to start a small engines course. Download the spreadsheet for the activity. Using the Craftsmen and Briggs and Stratton web sites determine the cost for the small engine tool list if the following conditions are true:

- Course will have 20 students and students will work 2 per engine (10 tool sets).
- Assume Craftsman and Briggs and Stratton will offer a 15% educational discount.
- Assume tax will be 8% and shipping 10% (or use actual numbers).
- In addition to the tools estimate the cost of 10 small engines.
- The estimated costs for gaskets, fuel, oil, and replacement parts is \$20/engine per year.

Complete the spreadsheet and write a one page justification for the course including an estimated initial budget (tool purchases) and operating budget (ongoing costs).

Description	Quantity	Vendor	Cost	Amount	Notes
Combination end wrenches (8-14 mm)					
Slotted Screwdriver					
#2 Phillips Screwdriver					
"C" clamps					
3/8" drive sockets (8-14mm)					
3/8" drive ratchet					
3/8" extensions (3", 6")					
16 mm spark plug socket (3/8" drive)					
3/8" inch pound torque wrench					
1/2" drive flex handle					
1/2" drive sockets (15mm-22mm)					
Strap Wrench					
Flat feeler gauge					
Round spark plug gauge					
Needle nose pliers					
Slip joint pliers					
Nut driver set					
Tool box (for above tools)					

