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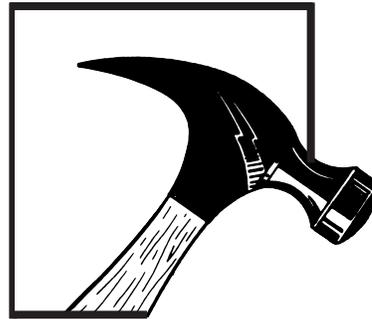
HAND Tools



CHAPTER FIVE:

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HAND Tools



■ Advances in tool design continue to come in the area of ergonomics.

Some manufacturers have developed hand tools specially designed to meet the needs of female and senior d-i-yers. Woodworkers and hobbyists can be attracted to your store by offering a selection of specialty tools such as chisels, planes and cutting tools.

Quality remains an important consideration for most hand tool purchasers, and d-i-yers are increasingly seeking out tools that have professional-grade quality. Still, most customers are looking for a project-specific tool and it's up to salesfloor employees to guide them to the right mix of price point and quality for the scope of their project.

Many manufacturers are now designing more sophisticated advertising and marketing campaigns that target the professional tool user. In the past, many tool manufacturers relied on a product's proven brand name to gain acceptance among pros.

While brand isn't the only consideration for pros, it remains an important one when planning a tool purchase.

It's also important to note that hand tool purchasers are younger than total homeowners in general. In fact, the 25- to 44-year-old age group accounts for three of every four hand tool purchasers, according to research from the Home Improvement Research Institute.

Training programs should stress the proper uses for hand tools. Many tools, when used improperly, can pose a serious risk of injury to the user, so it is vital that salesfloor employees be aware of the potential hazards of improper tool use. Specific safety tips are detailed in this section and more hand tool safety materials are available from the Hand Tools Institute, (914) 332-0040.

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HAMMERS

Most common home-use hammers are nail, rip, finishing, ball peen, tack, hand drilling, sledge and soft face. Quality features include:

- Forged steel heads for strength and durability;
- Heat-treated heads for strength, toughness and wear resistance—should be heat-treated differently on face (striking area), at eye (where handle is inserted) and on claws.
- Finish-ground face with a crowned surface that is canted slightly toward the handle to center handle blows.
- The chamfer or bevel on the striking face should be approximately 10 percent of the diameter of the poll to reduce chipping.
- Double-beveled nail slot to resist chip-out when pulling large nails.
- Claw slot that narrows close to head to grip and pull small nails.
- Well-formed claw points capable of getting under embedded nail heads.
- Hickory, solid or tubular steel, fiberglass, graphite or steel I-beam handle firmly attached to head.
- Handle should be ergonomically shaped and cushioned for secure grip and comfort.
- Fiberglass, graphite and steel I-beam hammers should have a jacket of materials such as polycarbonate to provide overstrike protection.
- Warning and use message affixed to the hammer.

Nail Hammers

The two basic nail hammers are curved claw and straight claw. A **curved claw hammer** is used most often in a home for general carpentry and household chores. It should be used only with non-hardened, common or finishing nails. The curved claw offers leverage in removing nails and can also cradle a 2x4.

A **straight claw (ripping hammer)** is more likely to be used by professionals to rip apart nailed wooden components. It is a slightly heftier tool, used for heavier carpentry, fram-

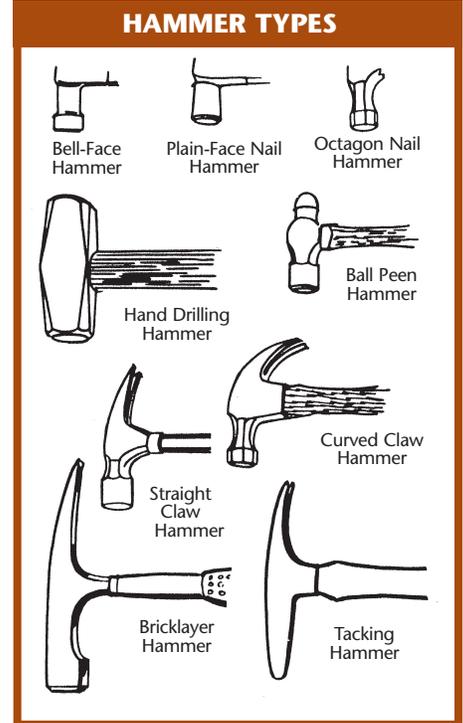
ing and ripping. It should also be used only with non-hardened, common or finishing nails.

Common head weights are 7 oz. for light-duty driving; 10 oz. and 13 oz. for cabinet-makers and householders; 16 oz. for general usage and 20 oz. for heavy crating or framing. All sizes are available with curved claw, while the straight claw comes in 10-, 12-, 16-, 20-, 24-, 28- and 32-oz. weights.

Straight claw hammers are now available with milled or checkered faces to grip the nail head and reduce the effect of glancing blows and flying nails.

Two innovations in the field of nailing hammers are hammers with interchangeable striking faces and hammers that hold nails. The interchangeable striking faces allow one hammer to be used for several different applications. The striking face finishes include milled and checkered. The hammer with a nail-holding notch makes it safer and easier to start a nail and also extends the reach of the user.

Nail hammers may have handles made of a number of materials—wood, fiberglass, graphite, solid steel or tubular steel. Each offers a different combination of stiffness for efficiently delivering the force of the blow to the target and shock absorption to reduce



HAMMER TYPES

shock and stress on the user's hand, wrist and arm. Wood flexes and offers some degree of shock absorption. Stiffer materials such as graphite or steel deliver the full force of the blow but require cushioning in the jacketing and grip to provide long-term user comfort.

Steel handles are the heaviest, while wood-handled hammers are the lightest and least expensive.

Nail hammer handles are available in a variety of lengths from 13" to 18".

Ball Peen Hammers

Ball peen (ball pein) hammers are used with small shank, cold chisels for cutting and chipping work, rounding over rivet ends, forming unhardened metal work and similar jobs not involving nails.

The striking face diameter should be approximately 3/8" larger than the diameter of the head of the object being struck.

The hammer is designed with a regular striking face on one end and a rounded or half ball or peen on the other end taking the place of a claw. The hammer face is heav-

HAMMER SAFETY TIPS

Hammers are arguably the most abused, most misused of all hand tools. Injuries can be caused by trying to strike too heavy a blow with a lightweight hammer, by using a damaged hammer and by using the wrong style of hammer for the task. Pass on the following safety tips to customers:

- Eye protection should be worn at all times when working with striking tools. Bystanders should also wear eye protection.
- Use the correct tool for the job. Injuries can be caused by trying to strike too heavy a blow with a lightweight hammer or by using the wrong style of hammer for the task.
- Always strike the surface squarely—avoid glancing blows.
- Do not use claw hammers (or hatchets) on concrete, stone or hardened metal objects.
- Never use a hammer with a chipped, battered or mushroomed face, a cracked claw or eye section or a loose or cracked handle.
- Remind customers not to hold the hammer too tightly. They should grasp it lightly but firmly; gripping the bell end of the handle for heavy hitting and the slight flare at mid-handle for lighter blows.

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ier than the peen end. Hammer sizes range from 2 oz. to 48 oz. Twelve and 16 oz. are most popular.

Hand Drilling Hammers

Hand drilling hammers, weighing between 2 lbs. and 4 lbs., are easy to handle with a powerful punch. They have short handles and are recommended for pounding hardened nails into concrete or for using with tools that drive nails and pins into concrete or brick. They are the only hammers to use with star drills, masonry nails, steel chisels and nail pullers. A larger striking surface, generous bevel and special heat-treating minimize the chance of chipping the striking face.

Sledgehammers

Sledgehammers are used for extremely heavy jobs where great force is required. They have long handles ranging from 14" to 36" and heavy heads that weigh from 2 lbs. to 20 lbs. Sledges can be double- or single-face. Many sledgehammers are now available with lighter, balanced, reinforced plastic handles for easier use and better weight distribution.

Mallets

Mallets have rubber, plastic, wooden or rawhide heads and are used to drive chisels or hammer joints together. With the exception of wooden mallets, sizes are specified in either head weight or diameter, such as 2-1/4". Wooden mallets are specified by head diameter only.

There are a variety of mallet shapes and sizes for specific tasks. A carpentry mallet with an angled head provides a natural strike resulting in less wrist and arm fatigue. A shop mallet with an octagonal head is used for flat strikes, while a pestle-shaped mallet with a round horizontal strike is generally used with a chisel or other carving tools. A rawhide mallet is used in furniture assembly, shaping soft sheet metals or any task that requires non-marring blows.

Specialty Hammers

Specialty hammers include riveting hammers to set rivets; setting hammers to close

and open seams and dress edges in tin work; straight and cross-peen hammers for riveting, stretching and bending metal; scaling and chipping hammers for general chipping in welding and cleaning torch cuts; brick hammers for cutting and setting brick and tile hammers to set tile.

Others include soft-face hammers for assembling furniture and wood projects and setting dowels (won't mar the surface with the blow); dead blow hammers that contain lead shot for additional power and reduced tendency to bounce (many feature non-marring and non-sparking striking faces); magnetic tack hammers for furniture upholstery; drywall hammers that score, sheet and set nails for drywall work and finishing hammers for cabinet making, finishing and other fine carpentry and light chores.

PLIERS

Pliers are designed to hold, turn and cut objects. Pliers vary in length from 4" to 20". Some pliers are available with factory-applied, plastic-coated handles, providing an attractive appearance and comfortable grip. However, these pliers should not be relied on for electrical work.

Pliers fall into two broad categories: solid-joint and slip-joint, either of which may have cutters.

Slip-joint pliers are of two designs: multiple hole and tongue and groove. The slip or adjustable joint enables the tool to adjust to the size of the object being held.

Solid-joint pliers have a joint fixed with a solid pin or rivet and are not adjustable.

Cutting pliers can be side, end or diagonal types. Side cutters have a cutting blade on one side only and are available in long-, curved- and short-nose types. End cutters have cutting blades on the end and are used to make sharp, clean cuts close to the surface on wires, bolts and rivets. Diagonal cutters have two cutting blades set diagonally to the joint and/or handles. Some cutting pliers are made with a spring in the handle to open them automatically after each cut, providing ease and comfort for the user.

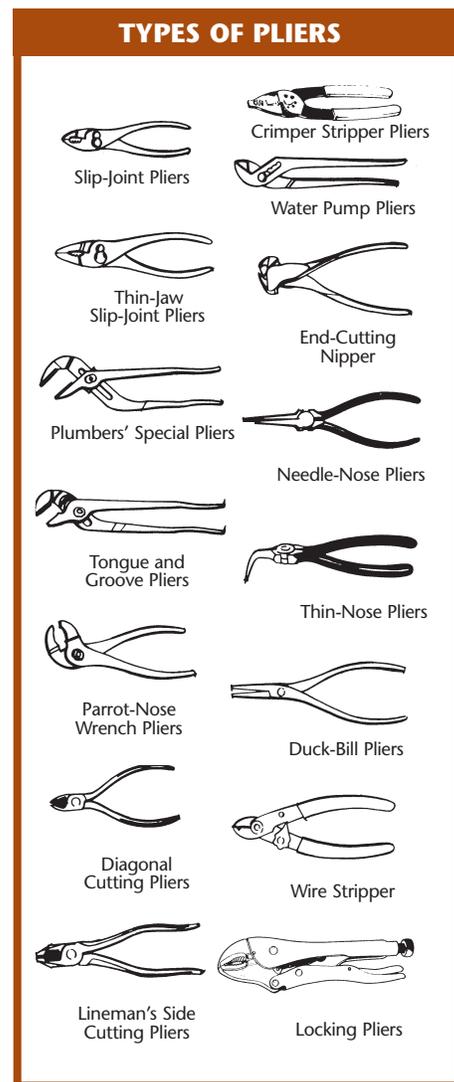
Other pliers commonly found in home improvement stores include:

Regular slip-joint pliers—General utility pliers with two jaw-opening adjustments. Some have a shear-type wire cutter.

Thin jaw slip-joint pliers—Like slip-joint, but made with a slim nose to reach into tight places.

Multiple slip-joint or box-joint pliers—General utility tool with up to eight adjustments, allowing for jaw openings up to 4-1/2", either multiple hole or tongue and groove. Straight and curved jaws are available. Most common is 10" water pump pliers.

Crimper stripper pliers — Multi-purpose electrician's pliers to crimp solderless con-



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nectors, strip most common gauge wire, cut and hold or bend wire. They also have sheaving holes that cut common sizes of screws without deforming threads.

Needle-nose pliers — Also called long-nose pliers, they have a pointed nose for reaching places with restricted clearance. May have side cutters. A standard item for most electrical and electronics work.

Thin-nose pliers — Also called bent-nose pliers, since the nose is bent at about an 80-degree angle for reaching around objects.

Duck bill pliers — have long, tapered, flat noses for work in restricted areas. Used by jewelers, telephone workers and weavers.

Wire strippers — Feature adjustable stops to cut insulation without damaging wire.

Midget pliers — Include straight, chain, round, end-cutting, diagonal-cutting and flat-nose pliers in extra-small sizes.

End-cutting nippers — Feature powerful leverage for sharp, clean cuts close to the surface on wires, bolts and rivets.

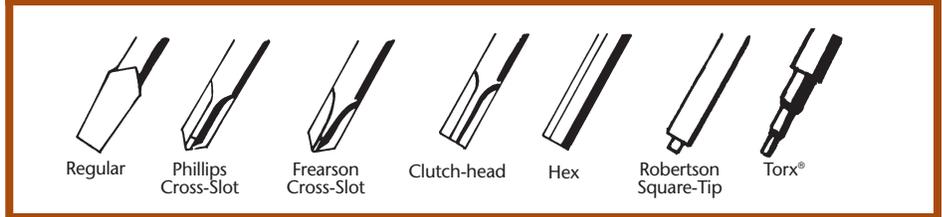
Lineman's or electrician's pliers — Heavy-duty, side-cutting pliers designed for all regular wire-cutting needs. Have gripping jaws in addition to cutting edges. High-leverage lineman's pliers have rivet placed closer to the cutting edges to provide more leverage.

Fence pliers — Pull and cut staples in fencing. Feature two wire cutters and heavy head for hammering.

Locking pliers — Adjustable, vise-type locking pliers can be locked on to a workpiece, leaving both hands free. They are versatile tools that can be used as pliers, a pipe wrench, an adjustable wrench, wire cutters, a ratchet or a clamp. Locking pliers are available in various sizes and shapes: curved jaw with wire cutter, straight jaw, long nose with wire cutter and bent nose with wire cutter. The locking principle also applies to locking clamps, which come in 4", 6", 11", 18" and 24" sizes.

Some locking pliers use a mechanism that allows one-handed release; others require two hands to disengage. In addition, many locking pliers provide a wire-cutting function, some from a full range, others from a restricted range of jaw settings.

STANDARD TYPES OF SCREWDRIVER TIPS AND SCREW RECESSES



SCREWDRIVERS

Screwdrivers are generally classified as slotted, Phillips head or Robertson (square recess) head, with all three types available with round or square shanks.

Quality screwdrivers are judged by the kind of metal in the blade, the finish and amount of grinding on the tip. Material used in the handle, and bar attachment to the handle are other quality indicators.

If blade metal is poor quality, it will chip and crumble under pressure. If the tip is improperly ground and flares too much, it will rise out of the screw slot. If the blade is not attached firmly to the handle, it will eventually loosen and slip in the handle.

Screwdriver Tips

A wide range of screwdriver tips are available: regular, cabinet, Phillips, Frearson, Torx®, clutch-head, hex and square-tipped.

Regular or slotted tips are used with large, heavy screws. The tip is flared so it is wider than the driver bar. Quality drivers with regular tips should be accurately ground for uniformity. Blades should not taper too sharply from the tip because an improperly tapered tip has a tendency to rise out of the screw slot.

Cabinet tips are similar to regular tips, but they have no flare. They are straight for use with small screws and countersinking screws where regular tips with a flare would mar the wood or material on the side.

Phillips head drivers are used on cross-slotted screw heads with modified, U-shaped slots of uniform width. Sizes range from 0 to 4, with 0 being the smallest.

Frearson screw heads are similar to Phillips. They have cross-slots, but they are

V-shaped slots with tapered sides. While a cross-slotted driver will fit many sizes of the type of screw for which it is intended, it is best to use drivers of the proper sizes.

Torx® drive system provides six lobular drive surfaces mated from lobes of the driving and driven elements. Drive surfaces have vertical sides that permit the maximum torque application to assure reliable clamping force.

Clutch-head tips have four points of contact. They lock into the screw head when turned counter-clockwise. The driver is unlocked by turning it in the opposite direction. Because of the many contact points, the tip will not damage the screw head.

Hex (hexagonal) tips are used in repair work in the electronics field, particularly in radio and television repair. They are used to tighten socket set screws and usually come in sets. Some sets are attached to and fold into a metal carrying case. Other variations include T-shaped hex tools with vinyl grips and L-shaped keys for greater torque power.

Square-tipped (Robertson) screwdrivers have become more common recently because of increased do-it-yourself decking projects. The screwdrivers have a square head and range in sizes from 0 to 3 and jumbo. The square head on the driver helps grip the screw on all four sides to provide maximum torque.

Multi-bit screwdrivers allow the user to have a number of different types of tips in one tool. Some products keep the interchangeable bits in a self-contained unit.

Offset screwdrivers are designed for removing and inserting screws in places where it is impossible to use a straight shank screwdriver. They are available in many combinations of slotted and Phillips head tips and with ratchet type mechanisms.

Some screwdrivers are designed with mag-

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SIZE OF DRIVERS TO USE FOR DIFFERENT SIZE SCREWS

SCREW NUMBER	0	1	2	3	4	5	6	7	8	9
REGULAR BLADE WIDTH	3/32"	1/8"	1/8"	1/8"	5/32"	3/16"	3/16"	7/32"	1/4"	1/4"
CROSS-SLOT BLADE	No. 0		No. 1			No. 2				

SCREW NUMBER	10	12	14	16	18	20	24	7/16	1/2	9/16
REGULAR BLADE WIDTH	5/16"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"
CROSS-SLOT BLADE	No. 3				No. 4					

netized tips, convenient when guiding screws to holes or otherwise inaccessible areas. They also retrieve dropped screws and nuts. Others have split-points that can be expanded in width to fill the screw slot and hold screws when guiding into inaccessible areas. A spring clamp that fits over the screw head, holding the bit in the slot, serves a similar purpose. There are even screwdrivers that feature lights on the handles to allow the user to work in dimly lit areas.

Screwdriver Handles

Handles are generally made of wood or plastic. Some screwdrivers offer "dual durometer" handles that combine two textures for a non-slip grip, even when hands are wet. Top-quality wooden handles have a bolster on the screwdriver bar that helps hold the bar to the handle. The one-piece bars in heavy-duty wooden handles extend through the handle and are headed over on the end with a metal cap.

Plastic handles should be made of fire- and heat-resistant materials. If properly designed, they give excellent grip. Rubber or vinyl is often used as a non-slip or insulating cover on plastic handles.

Specialty Screwdrivers

This group includes offset screwdrivers, used in places impossible to reach with ordinary drivers, screwdrivers with external

screw-gripper or screw-holder blades to start screws in hard-to-reach spots, and offset screwdrivers with ratchets.

Hex Nut Drivers

Hex nut drivers are similar to screwdrivers, but have a hex opening more like wrench sockets than screw tips. They are used to drive or remove small hex nuts or bolts and in confined areas such as electronic equipment, car ignitions and plumbing jobs. They come in several sizes and styles, with a fixed-size or variable-size "socket" at the end.

Spiral-Ratchet Screwdrivers

A spiral-ratchet screwdriver uses a mechanism similar to a push-pull drill. It has an adjustable chuck to permit interchanging of different tips and points. Ratchets drill and remove screws. Pushing straight down on the handle provides driving action.

High-Torque Ratchet Screwdrivers

These screwdrivers feature a 360-degree ball as a handle with a ratchet mechanism that eliminates the need to grip and regrip during the driving process. The wider gripping surface generates more torque than conventional screwdrivers. The amount of additional torque varies with the model. These high-torque ratchet screwdrivers come with interchangeable blades.

DRILLING TOOLS

Braces

Braces guide auger bits and drills. Attaching a screwdriver bit converts them into powerful screwdrivers.

Drilling is done by turning the handle or center section in a circular motion. Pressure for drilling is given by bearing down on the head of the bit brace with the heel and palm of the hand. The head on the best bit braces is mounted on ball bearings so that it will turn freely from the rest of the brace.

Most braces incorporate a ratchet control that permits the user to make half-circles when there is no room for a full circle.

Push Drills

A push drill, similar in appearance to a push-pull screwdriver, operates by a push-pull movement using a spirally threaded shaft and chuck to hold the bit. Push drills are best for light jobs. Most have space in the handle for storing extra drill points.

Hand Drills

Hand drills are limited to light work. They feature adjustable drill chucks to permit easy changes of drill points from 1/2" to 1/16". Drilling action comes from turning a hand crank on the side of a drill frame.

Bits

Bits (drill points) have a variety of uses with braces and drills. Each bit and drill is designed for a particular use and should be used for its intended job.

Bit diameters are usually marked by a single number—the numerator of a fraction. For example, an auger bit, which is marked by 16ths of an inch, with a number 8 would stand for 8/16" or 1/2". Twist bits are usually marked in the same manner by 64ths of an inch. Thus a No. 8 bit would stand for 8/64" or 1/8".

Countersink bits widen holes so flathead screws may be flush mounted below the surface for a finished appearance.

Expansion bits take the place of many larger bits. They are adjusted by moving the cutting blade in or out by a geared dial or

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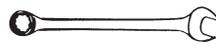
TYPES OF WRENCHES



Open-end Wrench



Box Wrench



Combination Wrench



Adjustable Wrench



Short Offset
Box Wrench

by a lock screw to vary the size of the hole. They are mounted below the surface for a finished appearance.

Carbide-tipped bits are used for drilling into masonry surfaces. They feature two machined-in spiral threads, one for each cutting edge, to provide passageways for all dust and cuttings from the bottom of the hole. Diameters of carbide tips are the same as the full diameter of the body. A carbide-tipped bit can be used in electric drills, drill presses or hand drills for drilling holes in brick, tile, cement, marble and other soft masonry materials.

Twist-drill bits are used in both wood and unhardened metals to make clearance holes for bolts, screws, etc., and to make holes for tapping. Only bits marked HS or HSS are suitable for drilling in metals. Common sizes run from 1/16" to 1/2" diameter by 64ths.

Auger bits are most commonly used with a brace for drilling holes in wood. Their length varies from 7" to 10". Dowel bits are short auger bits from 5" long. Long (ship) auger bits range from 12" to 30".

Spade bits are used in electric drills and drill presses for fast drilling of holes in wood. Electricians use them for drilling clearance holes for wire in floor beams. Bits have a forged, flat paddle with a point and cutting edges on one end and fit a 1/4" drill on the other. Bits are heat treated and cutting angles finish ground. Common sizes run from 3/8" to 1-1/2" in diameter, in 1/16" progression, and are about 6" long.

Power bore bits have a working end similar to auger bits and, like spade bits, are used in conjunction with power drills. Power bore bits produce a smoother hole than spade bits and are used for fine work, such as cabinet making.

Step bits have a graduated design so that variously sized holes can be cut without changing bits. Bits are designed for use with power drills and have self-starting tips elimi-

nating the need for center punching. They can be used on all materials, but are especially designed for use on metals.

Circle Cutters

Circle cutters cut circular holes in sheets of metal, wood, plastic, hardboard, brass, copper, mild steel, aluminum or composition materials.

The cutter features a regular center drill with a cutting tool mounted on an adjustable bar. Diameter of the circle is regulated by a set-screw adjustment on the cutting bar. Downward pressure is applied as the regular bit pulls into the material and forces the cutting tool down in a slowly lowering circle.

Ground, hardened cutting tools assure clean, even cutting in a variety of materials. Cutting edges available on hole cutters include high-speed steel bi-metal, carbide grit and diamond grit. Each cutting edge is designed to work best on specific materials. Bi-metal for metal, wood, plastic, etc.; carbide for tile, brick, fiberglass and hard composites; diamond for glass, ceramics and other abrasive materials.

Due to the unbalanced load inherent in the design of these tools, for safety's sake, they must be used only in drill presses or drill stands and never with a handheld drill.

Awls

Awls are used to make screw-starting holes when lightly tapped by hand with hammer or soft-face mallet. Awls are also used for scribing along a straight edge to produce a sawing or layout line on wood or soft metal.

WRENCHES

Wrenches can be classified as general use or plumbing wrenches (which are described in the plumbing chapter).

Top-quality wrenches are forged from fine-grade tool steel, machined to close tolerances, hardened and tempered for long service life. Most types are sold individually and in sets of various sizes.

Because most imported products are made to metric specifications, a set of metric wrenches has become a must in many home workshops.

A wrench's main function is to hold and turn nuts, bolts, caps, screws, plugs and various threaded parts. Applying excessive torque will strip or damage those threads, so quality wrenches are designed to keep leverage and intended load in safe balance.

Users should not put "cheaters" on wrenches to increase leverage. The proper size wrench should be used. Too large a reach will spread the jaws of an open-end wrench or damage the points of a box or socket wrench. When possible, a wrench should be pulled, not pushed.

Open-end wrenches provide gripping power on two sides of the head with another side open so the wrench can be placed on a nut, which might not be accessible to a closed or box wrench. Open-end wrenches have different size openings on each end and should fit the nut exactly to prevent mutilating the nut edges.

Box (box-end) wrenches have enclosed heads and provide more leverage by completely enclosing the nut. Some are offset to provide knuckle room and clearance over obstructions. They range in size from 4" to 16" long and are available with either 6- or 12-point rings.

Combination wrenches have a box and an open end on opposite sides of the same wrench. Both ends are usually the same size. They are used for working on machinery and are the most popular of all fixed-end wrench styles. Also available is a reversible ratcheting combination wrench that allows the user to quickly tighten nuts

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and bolts without lifting the wrench off and repositioning it after each rotation.

Adjustable wrenches come in two styles: locking and non-locking. Non-locking styles feature an adjustable end opening with little provision made for slippage. The locking style also has an adjustable-head, but uses a locking mechanism to secure jaws in desired position, eliminating the need for constant readjustment. When properly adjusted to a nut or bolt, it will not slip.

Pipe (Stillson) wrenches screw pipes into elbows or other threaded devices. Jaws actually bite into the surface to hold it for turning. They should never be used on plated pipe installations because they will badly scar the finish. Aluminum pipe wrenches are popular among professionals because of their lighter weight, but they are more expensive. (More information on pipe wrenches is available in the Plumbing Supplies chapter.)

Socket wrenches combine an offset handle with a male drive piece that has a spring-loaded bearing to lock on various size sockets. They can be used at almost any angle since handles may be attached to the head by a jointed hinge device. Many socket wrenches have a ratchet handle, making reversing possible in confined spaces.

The most common type is the detachable socket wrench, with square drive for hand use. Common square drive sizes are 1/4", 3/8" and 1/2", and these are normally used in conjunction with a ratchet wrench. Sockets are available with 6-, 8- and 12-point gripping ends, in a full range of inch and metric sizes.

A socket wrench combined with a ratchet wrench makes the job of tightening or loosening nuts and bolts faster and easier than conventional wrenches.

Flare nut wrenches are flared to fit hex fittings.

Hex-key wrenches are short, L-shaped tools designed to turn bolts or screws with hexagonal heads. They also come in sets of different-sized wrenches.

Ratchet wrenches are available in 1/4", 3/8" and 1/2" drive sizes and are used with socket wrenches. They are available with a round or teardrop-shaped head and contain a reversing mechanism to facilitate tighten-

ing or loosening a fastener. Ratchet wrenches are available in a variety of handle shapes and lengths.

Accessories that can provide a drive means to socket wrenches include flex handles, speeder handles and T-handles. Extensions of various lengths and universal joints can be used with ratchet wrenches and socket wrenches to work on fasteners in hard-to-reach locations.

Locking wrenches are among the most versatile hand tools found in the home or shop. Through a locking action, jaws can be locked in a holding position with pressure up to 1 ton. They can also be used as hand vises, holding clamps, pipe wrenches and hand-vise pliers. They are available with both curved and straight jaws.

Torque wrenches are designed to permit an operator to determine applied torque on bolts, nuts and other fasteners. They measure torque in ounce-inches, pound-inches and pound-feet, as well as metric measure. However, many manufacturers express torque in foot-pounds (rather than pound-feet) since this nomenclature is more familiar to the average tool user.

Two basic hand torque wrenches are audible signal and visual display. The audible signal type signals applied torque by momentarily releasing the wrench for a few degrees of free travel. The release is usually accompanied by a click sound, which gives the wrench its popular names: click torque wrenches or clickers. Torque value is set to a micrometer scale on the handle or preset by an adjusting screw in the handle cavity.

The visual display type indicates applied torque on a dial or electronic display. Some models have memory pointers that remain at the maximum reading attained until manually reset.

For low-torque application, torque screwdrivers are usually used. They are available in either the release or indicating type. The most widely used torque wrenches have square drives to use standard detachable sockets. Both ratcheting and non-ratcheting types are available. Torque wrenches are used in various operations where proper torquing of nuts, bolts and other fasteners is critical, for example, assembly and inspection of gear

trains and bearings, setting of clutches and brakes, overhaul and experimental work.

Proper uses:

- Always work with clean threads free of corrosion.
- Follow the product manufacturer's instructions for specific torque loadings, particularly whether recommendations are for dry, oiled or plated threads.
- Avoid overtightening a nut or bolt with a conventional wrench before applying a torque wrench.
- When not in use, set at lowest torque.
- Never use it as a hammer, pry or conventional wrench.
- Avoid dropping. If dropped, check accuracy on a torque tester.
- When using adjustable wrenches, do not over-torque by applying torque past the release point. Learn the feel of the release rather than relying on the sound.
- Read torque values on indicating torque wrenches by looking at the dial at 90° to its surface.
- When in frequent or continuous use, periodically check calibration accuracy.

Metric measure torque wrenches are available in Newton meters (N.m), meter kilograms (mkg) and centimetre kilograms (cmkg) with N.m becoming the more universally accepted calibration. Many torque wrenches are available with dual scales for conventional and metric measurements.

CUTTING TOOLS

Chisels

Chisels are grouped according to the material they cut, either wood, metal, stone or brick. The two main types are wood and cold.

Quality **wood chisels** have large, ergonomically shaped handles for a comfortable, sure grip and better control. Blades should be of high-quality carbon, heat-treated steel with precision-ground cutting edge. In addition, woodworking chisels should have crowned steel strike caps to help center the blow.

One type of wood chisel—the **butt chisel**—has a short blade that ranges from

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about 2-1/2" to 3" long. It is used by pattern makers, cabinetmakers, carpenters and do-it-yourselfers for carving and paring, particularly in tight spots. It can be used with hard-faced hammers.

A **firmer chisel** is square-sided and has a longer blade, usually from 3-1/2" to 6" and is used mainly for cutting deeply into wood. It should be used with soft-faced hammers.

Paring chisels are for light-duty, detailed work such as trimming cabinets.

Cold chisels have several styles—**flat** (the most widely used), **cape**, **diamond-point** and **round-nose**. They should be used only for cutting and chipping cold metal (unhardened steel, cast and wrought iron, aluminum, brass, copper), never masonry.

Bricklayer's chisels should be used when cutting masonry. Cold chisels should be struck only with a hand drilling, ball peen or similar heavy hammer with a face diameter approximately 3/8" larger than the struck tool head.

Chisels have wood or plastic handles. Wood handles are available in both tang (the end of the blade or tang fits into the handle) and socket type (a projection from the handle fits into a socket in the blade). Plastic handles fit only tang construction.

Like chisels and planes, gouges are used for removing material from a block of wood, plastic or metal. Gouges come in two primary types: inside and outside gouges.

All steel chisels and punches (not wood chisels having wooden or plastic handles) are subject to chipping that can cause bodily injury much the same as steel hammer faces. Therefore, applicable safety standards require the warning "Wear Safety Goggles" on each tool. Nearly all domestic manufacturers comply by stamping those words into the shank.

Utility Knives

Utility knives are designed to cut heavy materials such as carpet, flooring, roofing, cardboard cartons, laminates and plastic. Blades can be replaced by disassembling the handle or ejecting them by depressing a spring-release button on the handle. Some knives swivel open to permit blade replacement.

Bolt Cutters

Heavy-duty cutters cut bolts, threaded rods, cables and other metals from 1/16" to 5/8" thick. They are made from drop-forged tool steel from 12" to 36" long. The longer cutters have greater strength. Special leverage joints allow great pressure to be applied with minimum effort.

End-cut cutters operate similarly to end-cut pliers, with special jaws available to cut special metals.

Snips

Snips are designed for cutting sheet metal, sheet brass, copper, plastic cloth and many other materials. They are available in five main types:

Straight or regular—Used for all straight cutting jobs.

Combination—More versatile than regular snips; used for straight and moderately irregular cuts.

Duckbill or circular—Used for cutting circles or other curved designs.

Aviation or compound leverage—Come right-handed, left-handed or straight. Used for cutting curves or straight. Cut easier because of compound leverage.

Offset snips—Have offset handles to keep hands above work. They are designed especially for long, inside cuts and are available for right or left cutting.

PLANES

Planes are used for trimming, beveling, fitting and shaping wood, and smoothing rough spots left by sawing and drilling. Quality is determined by the steel used in the cutter, cap iron, sole and body of the plane. The cap iron should be of hard steel so adjustment screws will not strip. Hard steel cutters hold an edge longer.

Another factor in quality is precision manufacturing. The sole of the plane should be perfectly flat and the mouth opening narrow and precisely ground for the plane to shave wood flat without splitting the grain.

There are three broad groups of planes: bench planes, block planes and specialty planes.

Bench Planes

The main variable among bench planes is length. They range from 7" smooth planes to 24" jointer planes.

Smooth planes are lightweight and used for all-around work. **Jack planes** are longer (12" to 15") and heavier than smooth planes, have more cutting capacity and are used for planing rough surfaces. **Jointer (joiner) planes**, the longest and heaviest, are used to shape edges of boards so two boards may be joined together to make a close fitting joint.

Bench planes are adjustable; the best have lateral, as well as fore and aft cutter adjustment and a movable frog to vary the mouth opening.

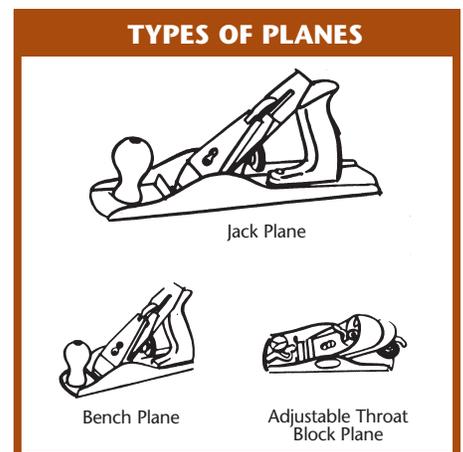
Block Planes

A block plane is the smallest, simplest plane, used for light work, smoothing the end grain of boards and shaping small pieces of wood. It uses a single cutter blade, set at a low angle in the frame to permit better cutting. It is available in both adjustable and non-adjustable models. Adjustable planes feature steel screws, usually on the end of the plane, to vary the cutter height.

Some block planes have an adjustable mouth to vary chip thickness. A very narrow mouth is best for fine finishing, while a wider mouth allows quick stock removal on less critical work.

Specialty Planes

Rabbet planes, used widely by cabinetmakers and do-it-yourselfers, cut rectangular recesses out of the edge of boards and make



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grooves in flat surfaces.

Router planes are used to finish common wood cuts such as dados or grooves in areas inaccessible to a regular plane. Like other planes, they have adjustments to control size and depth of cut.

Circular planes are made with a flexible steel bottom that can be adjusted to plane on concave or convex surfaces.

Surface-Forming Planes (also called a file) cut rapidly and smoothly on wood, aluminum, copper, etc. It will not clog because shavings pass through holes in the body and out the top. It is made of die-cast aluminum, has high-quality steel cutting blades and is available in circular and regular patterns.

Used to shape wood in carpentry or wood sculpture, they also work well shaping plastic auto body fillers. The blade design makes them much safer than most cutting tools and easier to use than a conventional plane.

MEASURING DEVICES

Squares

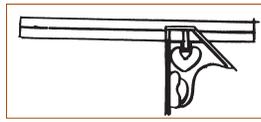
Used to check and mark right angles, squares are defined as steel or aluminum, try and combination. Combination squares will also measure 45-degree angles. If it has a degree scale, it can determine any angle.

Framing squares, also known as **carpenter's squares**, are L-shaped and made from one piece of material (steel or aluminum), with the long end (body) usually 24" and the short end (tongue) 16". Similar squares are available in other sizes (8" x 12").

Squares may also have tables or scales, the most common being rafter and Essex tables. These provide information on how much lumber will be needed on a job, as well as information for roof framing.

A **try square** or **tri square** is an L-shaped tool used as a guide for pencil markings of cuts and to check the edges and ends of boards to see if they are square. It is also used to determine whether a board is the same depth for its entire length. Try squares have broad 6" to 12" blades set at right angles, with wood, plastic or metal handles.

A **combination square** combines the best features of the steel and try squares. It has a



grooved blade and head that can be adjusted to many loca-

tions on the 12" blade to provide different measurements. The head usually contains one level vial and a scratch awl for marking. One edge of the handle has a 45° angle for use as a miter square.

Some combination square sets are available with an attached protractor that is movable throughout 180° for setting the blade at any angle within that range. Combination square heads (handles) are commonly plastic or metal.

Mitre squares measure 45° angles or bevels on one side of the square and 135° angles and bevels on the other side. Also available is a try/mitre square, which features a 45° corner edge.

Sliding bevel squares adjust to any angle and are designed to match angles being cut on the job site.

Centering squares are used to determine the exact center of circles and other measuring angles.

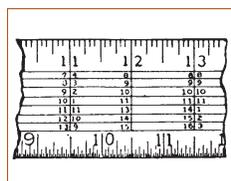
Pocket square is a small triangle with one thick, wide edge. It has different angle measurements marked on its surface and edges. It also works well at guiding power saws along wood.

Clarity and legibility of graduations is a key factor in choosing any type of square.

Modern techniques enable manufacturers to etch graduations into the blade and create high-visibility markings that are durable as well.

Rafter tables, which appear on steel squares, are used to figure lengths and cuts of rafters. The table consists of six lines of figures, with each line's use indicated on the left end of the square. Metric rafter squares are also available.

The **Essex Board Measure table**, which also appears on steel squares, shows board measures of almost all sizes of boards and timbers.



The table consists of six lines of figures, with each line's use indicated on the left end of the square.

Tape Rules

For years tape rules have included two main types: tape reels and retractable steel tapes. In recent years, several types of electronic measuring devices have been introduced.

Tape reels are typically 100' long and designed to measure long distances. They are contained in durable cases and rewound by a crank on the side of the case, with a small hook on the end for hooking onto objects to be measured. Metric tape rules come in lengths up to 10 metres.

Retractable steel tapes or tape measures range in size from 6' to 35' (up to 50 metres), with 12' and 25' the most common sizes. They vary in width from 1/4" to 1-1/4"—wider tapes are easier to use and extend over longer distances.

Because the tape rule is flexible, it provides an easy means for accurately measuring curved surfaces. The concave cross section allows it to be extended unsupported. Contained in the housing of most models are spring mechanisms that release or retract the tape.

Some tape rules include a spring clip for attachment to a belt and many have markings for laying out studs on 16" centers or other specialized markings.

Since blades receive hard wear, replacement blades or complete drop-in cartridge assemblies are offered to fit some tape rules.

For easier reading of complicated measurements, some tapes now include fractional markings on the blades.

Electronic feature tape measures and electronic tape measures are recent additions to this category. Electronic feature tapes are conventional tape measures with electronic features added. One such feature is digital readouts to make measurement readings more precise. Another electronic feature is a voice recorder to make it easier to keep track of multiple measurements. Electronic measuring devices have no blades but instead work on an ultrasonic or laser light principal.

Ultrasonic measuring devices have a range of up to about 60'. The range on the laser tape is up to about 300'. The accuracy rating on the laser tape is to within 1/8". These electronic tapes often include built-in math functions, calculations and memory to store measurements. One of their advan-

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tages is the ability to easily measure linear dimensions to compute a room's square footage, which is helpful for estimating the right amount of wallpaper, paint or flooring needed.

A **chalk line reel** is a coiled string of 50' or 100' contained in a metal (usually aluminum) or plastic box along with powdered chalk in various colours. It is used to mark long, straight lines on floors, ceilings and walls. Replacement chalk and string is available separately.

Folding Rules

Folding rules usually consist of 6" to 8" hardwood lengths connected by spring joints, but are available in steel and aluminum as well. Some have special plastic or epoxy coverings to protect the blade and printed numbers. Better models are painted with clear protective coatings over sharp multi-color printing and highlight commonly used markings for easy reading. Two basic rule styles are inside-read and two-way.

An **inside-read rule** is marked on one edge of the blade so that measurements can be read from inside a window or door frame. When the first section of the rule is unfolded, it enables the user to make accurate measurements without removing it from the surface being measured. It is also popular because it always lies flat on the work surface.

The **two-way, flat-reading rule** is calibrated so that it can be read from left to right at either end of the rule, regardless of which end is unfolded first. Folding rules are available for specialized uses such as engineering, plumbing, masonry and mechanics. These differ from general-use rules in the markings on the rule face.

Extension rules are used to measure closed-in areas such as doorways and window frames where a regular folding rule will not work. Extension rules feature a 6" sliding rule in the first section that can be pulled out to measure distances of less than 6" without moving and marking.

Distance Measuring Wheels

Distance measuring wheels come with a variety of features designed for the many dif-

ferent measuring applications. They are the easiest way for one person to perform measuring jobs that normally require two people.

Features include collapsible handles, gear-driven counters, a variety of wheel sizes, different types of tread materials and optional carrying cases.

The collapsible handle and optional carrying case makes measuring wheels easy to transport and store. The telescoping handles are generally made of aluminum and have either two or three sections. A folding hinge handle provides the same convenience as the telescoping handle.

The gear-driven counters come with four digits for measuring up to 1,000 feet or five digits for measuring up to 10,000 feet. A push button reset returns the counter to zero.

Wheel diameter ranges from 4" to 25". The smaller-wheeled units are suitable for the do-it-yourselfer and while professionals generally use the large-wheeled units. Small wheels are best suited for smooth surfaces, while large wheels work best on rough terrain. Some models also come with a paint marking system.

Measuring wheels come with either one or two wheels. The type of tread material depends on the intended application as well. Harder materials like polyvinyl are used on most measuring wheels, while monprene is often used on larger professional units.

For point-to-point measurements, you can read the distance straight from the counter. For wall-to-point measurements, you have to add the radius of the measuring wheel to the meter reading. On wall-to-wall measurements, you have to add the wheel diameter to the meter reading.

Precision Measuring Tools

This group of tools contains such items as calipers, dividers, micrometers, thread pitch gauges and plumb lines. These items are used primarily by professionals, but are gaining popularity with hobbyists.

Calipers and **dividers** are used for transferring measurements from a model to a part being produced. They can also be used to measure the inside or outside of holes or objects that cannot be reached easily with a

graduated measuring device.

Dial calipers and **micrometers** are used for close tolerance work using drill presses and lathes. These devices can make inside, outside and depth measurements to within .001".

Thread pitch gauges are used to determine the exact thread pitch needed for replacing screws and nuts.

An **ultrasonic measuring tool** is available that instantly measures room dimensions up to 50' away. It features calculator functions for compound measurements, area and volume calculations.

A **plumb bob** or **plumb line** is a small, tapered, pointed weight suspended from cord. It is used to measure true verticality or depth. Chalk line reels can also be used as plumb bobs, but are largely used to mark long lines on floors, walls and ceilings.

Self-leveling laser plumb lines are available that project a vertical laser line onto any surface. The laser line is always visible because it is not covered up with a pencil mark and it is not affected by wind like a plumb bob.

A **carpenter's pencil** is a wide, flat pencil that contains soft lead. It is used for marking measurements in construction projects. Its flat design keeps it from rolling around the job site.

Stud Finder

Stud finders/stud sensors are of two basic types: magnetic and electronic. Stud finders are devices that help locate wall studs, enabling customers to hang pictures, mirrors and shelves securely. Magnetic stud finders do this by detecting the presence of nails or steel studs. Electronic stud finders do the same job, but they find the stud by measuring the density around the stud. Some advanced electronic stud finders will locate wood and metal studs, pipe, conduit, electrical wires and even reinforcing bar or rebar in concrete.

LEVELS

Levels measure true horizontal (level) and true vertical (plumb) either with vials (spirit levels) or sensors (electronic levels). These vial-type mechanisms are incorporated into

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rails of wood, plastic, aluminum or magnesium. The rail or body of the level may be solid, I-beam or box-beam. High-quality levels feature both top- and side-reading windows and non-adjustable vials. Brass or aluminum edges are featured on high-quality wood levels.

Level vials may be adjustable or non-adjustable, straight or bent, replaceable or permanent. Some vials are constructed of a precision-machined block of solid acrylic and are virtually unbreakable. Lasers have been integrated into this tool, providing increased capability, while still employing bubble vials for leveling.

Electronic levels employ sensors rather than vials. One model uses an audio signal or coloured lights to indicate level and plumb, another includes a visual display. More sophisticated models read angles as well as level and plumb and offer a reset button so the level can be recalibrated if dropped.

Laser technology is incorporated into some models, providing the ability to quickly and accurately locate level reference points over long distances. This is accomplished by projecting a beam of light up to 200'. Laser levels feature either self-leveling or manual leveling methods.

Rotary laser levels rotate 360° and project a level reference point on all vertical surfaces within range.

Pocket lasers are also available as a small, lightweight, easy-to-use alternative.

New features for electronic levels include having preset angles commonly used in construction, a self-leveling feature, and offering a graphical display that tells the user the direction and extent to rotate toward level or plumb.

Laser level accessories include a variety of mounting devices such as clamps and magnetic mounts that make setup and use easier and more convenient. Specially tinted glasses can extend the visible range of the laser light.

Better wood levels come with brass edges. These edges prevent chipping and help to protect the frame from distortion due to warping. Better aluminum levels come with top-reading windows, non-adjustable vials

and protective end plates.

Levels are available in lengths up to 10'. Magnetic edges are also available to free the user's hands when used around ferrous metals. Some levels use graduated vials to help determine very shallow slope.

Line levels are used where no flat surface is available. For instance, a line level can be attached to a string stretched between two points, allowing the user to make an accurate comparison of heights between the two points. Chalk lines and plumb bobs are also used to mark the distance or compare heights.

When it comes to calculating angles or dealing with sloped surfaces, some electronic levels can read roof pitches, stair slope and drainage angles, and show them on an LCD display in degrees, percent slope or inches per foot (rise/run).

A **torpedo level**, usually 9" long, is used for obtaining readings in close quarters. Magnetized models and models incorporating a battery-operated light for working with metal pipes and in dark areas are also available. Because of their compact size, mechanics, plumbers, electricians, hobbyists and homeowners often choose torpedo levels.

Carpenter's levels are made of wood or metal (aluminum or magnesium) They employ bubble and spirit vials positioned in the center and both ends to check vertical and horizontal surfaces. Lasers have been integrated into this tool to provide increased capability, although bubble vials are still employed for leveling. Carpenter's levels are typically 24" to 48" long.

AXES AND HATCHETS

■ AXES

Of the two basic axe styles—single and double bit—single-bit axes are most popular. Single-bit axes are used to fell, trim or prune trees, to split or cut wood or to drive wooden stakes.

Single-bit axes are the easiest and safest for an inexperienced woodcutter to use

because they have only one cutting edge. The other end of the head forms a hammer for driving wooden stakes. It should never be used to strike splitting wedges, steel posts, stone or any hard object. Single-bit axes should never be struck by another striking tool.

Double-bit axes, with two cutting edges, perform the same functions as the single-bit versions. Professional lumbermen use these.

Handles

Axe handles are made of hickory and range from 20" to 36" long. The most common is 36". Handles for single-bit axes are curved to help increase leverage. Double-bit axes have straight handles because the handle must be symmetrical with the double-edge head.

Axe Patterns

Axe pattern refers to the shape and type of cutting edge. Some regions use unique names (such as Montreal, Yankee, Michigan, Dayton, etc.) to describe axe types..

There are few cutting differences among head patterns. Customers have particular preferences by style and historic acceptance in their localities.

Belt Axes

Belt axes have light, camp or utility use. These single-bit models are equipped with a sheath for wearing on a belt. The Boy Scout axe is the most familiar belt axe.

Log-Splitting Axes

Log-splitting axes can split most wood types in one stroke. Rotating levers in the head convert each downward stroke into a direct outward force, preventing the blade from sticking in the log. Some models feature

REPLACEMENT HANDLE SAFETY

The American National Standards Institute Inc. (ANSI) requires that replacement handles for striking tools must be equivalent to the original in size and quality. It is important that the eye of a replacement handle should never be smaller than the eye of the tool head. A handle eye that does not fit can produce a loose assembly that can present hazards.

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handles of high-impact plastic molded around a fiberglass shaft, making them virtually unbreakable.

■ HATCHETS

Hatchets are a combination tool, part hammer and part axe. Some hatchets, such as half hatchets or carpenters' hatchets, are for general use; others, such as flooring, lath and shingling hatchets, are used for special tasks like laying hardwood floors and installing drywall or gypsum board.

The striking face is intended for pounding on nothing harder than common nails. It should never be struck with another hatchet or a hammer.

The grade of steel in the head, material in the handle and how it is attached and type of tempering and sharpening determine quality.

Splitting Mauls and Wedges

Wedges are made of steel, aluminum and plastic. Steel wedges are forged from a solid piece of high-carbon steel and may be heat-treated. Aluminum and plastic wedges are designed primarily for use with chain saws and crosscut saws to hold the kerf apart to prevent binding.

A woodchopper's maul is similar to a sledgehammer, but one end of the head is wedge-shaped. That end is used to make a starting notch. A wedge is inserted and struck with the hammer end of the maul head.

An axe can also be used to make a starting notch and a maul used to drive the wedge. Wedges should be struck with a sledge or woodchopper's maul having a larger striking face than the head of the wedge. Never strike the steel wedge with the cutting edge of the maul.

Safety goggles should be worn when using these tools. In addition to possible chipping of the tool, if it is misused, flying wood chips could strike the eye of the user or someone nearby.

SAWS

Hand Saws

Handsaws have 14" to 26" blades. Fineness of cut depends on the number of cutting teeth (points) per inch and tooth shape. The higher the number of points, the finer the cutting. A coarse crosscut saw with seven or eight teeth per inch is best for fast, rough work or for use on green wood. A fine-tooth crosscut saw with 10 or 11 teeth per inch is best for smooth, accurate cutting on dry, seasoned wood.

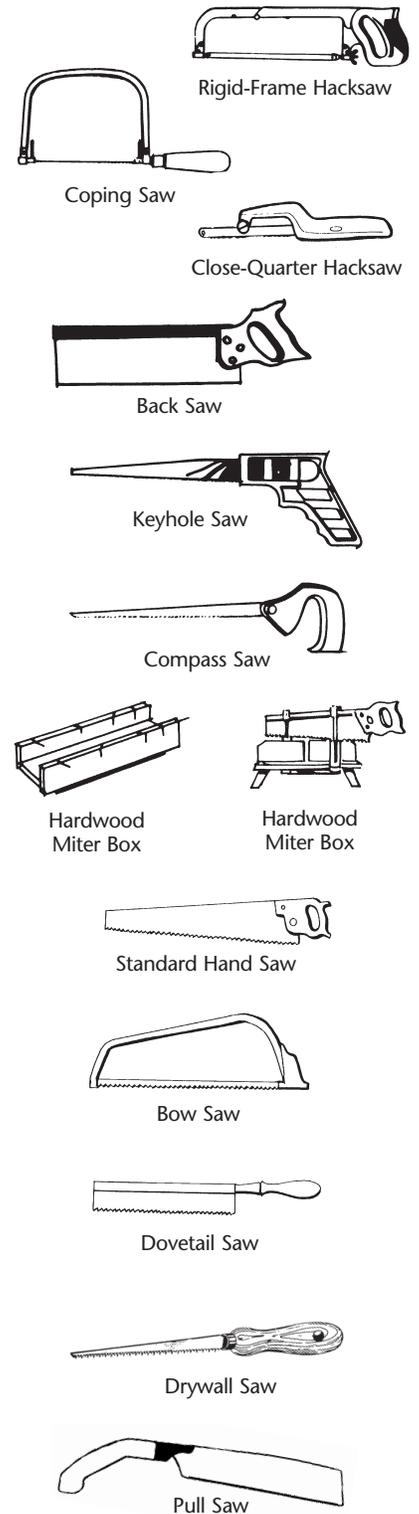
Some handsaws are available with special "aggressive design" teeth—three cutting edges instead of the conventional two. They cut on both the forward and backward stroke, thereby cutting several times faster than saws with traditional teeth. They may also have the teeth induction-hardened to help keep them sharp longer.

Saws also come with a wide range of handle styles, but the three most common are **pistol grip**, **closed handle** and **straight handle**. Pistol grip handles are used primarily on smaller saws that have thinner blades. Closed handles are incorporated more often on larger saws and help to add support to the larger blades. Drywall saws and other small-bladed saws often use straight handles that are in line with the saw's blade.

Most saws require minimal maintenance other than oiling of the blades to prevent rust. They should be hung up by their blade or handle since blades have a tendency to bend when stored flat.

- Quality features in saws include:
- Tempered alloy blades. Lower-grade steel quickly loses its sharp edge but is easy to sharpen.
 - Rust-resistant or Teflon™-coated blade finish. Teflon™-coated hand saws reduce many binding and residue buildup problems inherent to wood cutting. Reduced friction or drag makes for smoother, easier cutting.
 - Hardwood or sturdy plastic handle. Special aluminum or plated steel nuts and bolts to fasten blade to handle.

TYPES OF SAWS



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KEEP CUTTING TOOLS SHARP

Six basic rules apply to redressing chisels and other tools with a cutting edge:

1. Always wear safety goggles.
2. Tool must be returned to its original shape.
3. Discard any tool with cracks or chipping.
4. Temperature must be kept low.
5. A medium- or fine-grit whetstone file should be used.
6. Wheel direction should always be from the cutting edge toward the body of the tool. This directs heat away from the cutting edge.

Cold chisels are generally hardened about 1-1/2" back from the cutting edge and about 3/4" back from the head. Redressing should be kept within these limits. The correct cutting edge bevel may vary from 55° through 90°. For all around use, 70° is a good compromise. Soft metal bevel may be as low as 55° and hard steel bevel as high as 90°.

- Taper-ground blades, thicker at the cutting edge, to prevent binding in the cut.
- Bevel-filed teeth evenly set in two alternate rows, one row to the right of center, one row to the left; produces a groove or kerf slightly wider than the thickest part of the blade; prevents or reduces binding while sawing.

Rip Saws

A rip saw has large, chisel-shaped teeth, usually 5-1/2 teeth per inch, and is made to cut with the wood grain. Blade lengths measure from 24" to 28". Teeth are cross-filed to ensure that the chisel point is set square to the direction of cutting for best performance.

This saw is best held at a 60° angle to the surface of the board being cut. The ripping action of the saw produces a coarse, ragged cut that makes the saw unsatisfactory for finish work.

Crosscut Saws

Most commonly used crosscut saws are 10- to 12-point for fine work and 7- or 8-point for faster cutting. Ten teeth per inch is considered general purpose. Teeth are shaped like knife points to crumble out wood between cuts. Best cutting angle for this saw is about 45°. Blade lengths range from 20" to 28", with 26" the most popular.

Hacksaws

Hacksaws are fine-toothed saws designed to cut metal or plastic. The saws consist of

a blade held in a steel frame with relatively high tension.

High-tension models (with tension to 32,000 p.s.i.) are also available. High tension holds the blade more rigidly straight, which enables the user to make fast, straight cuts. Blade life is also increased. Look for a quick-release blade change mechanism, tension guide and rugged frame on these models.

Blades come in several designs, such as coarse-, medium-, fine- and very fine-toothed. Regular or standard blades are used for general-purpose cutting; high-speed or bi-metal blades for cutting hard, extra-tough steel.

The medium blade has 18 teeth per inch and is good for cutting tool steel, iron pipe and light angle iron.

A fine blade, which has 24 teeth per inch, cuts drill rod, thin tubing and medium-weight materials.

The very fine blade, with 32 teeth per inch, is used for extra thin materials, light angle irons, channels, wire rope and cable. As a guide to selecting the right blade, find out what material will be cut; then suggest a blade that will have at least three teeth in contact with the material.

Frames vary in style and price. Most can be adjusted to hold various blade lengths. Some have both horizontal and vertical positions for blades. Others provide blade storage.

A close-quarter (or utility) hacksaw holds and positions a hacksaw blade so it

can be used effectively in narrow spaces and slots.

Compass or Keyhole Saws

Compass saws cut curved or straight-sided holes. Saw blades are narrow, tapered nearly to a point to fit into most spaces. Blades come in three or four styles that can be changed to fit the job. Some models have induction-hardened teeth for longer life without sharpening.

Keyhole saws are small compass saws with finer teeth that can cut metal. Turret head keyhole blades can be rotated and locked in several positions for easier cutting in tight, awkward spots.

Coping Saws

Coping saws cut irregular shapes, curves and intricate decorative patterns. They consist of a thin blade and a C-shaped steel tension frame. The removable blade is typically 6-1/2" long.

Backsaws

A backsaw is a thick-bladed saw with a stiff, reinforced back to provide the rigidity necessary in precision cutting. It varies in length from 10" to 30" and is found in tooth counts from seven to 14 teeth per inch. They are used with miter boxes to cut miters.

Bow Saws

Bow (buck) saws consist of a tubular steel frame and a saw blade for fast cutting of all woods. The bow saw's frame is important, since the thin blade, usually 3/4" wide, must be held under high tension for fast cutting. Advantages of this general-purpose saw are its all-around utility and light weight.

In 21", 24" and 30" lengths, bow saws normally have teeth placed in groups. Within each group, distance between teeth varies, ensuring a smooth, vibrationless cut. Wide gullies provide ample space for sawdust to accumulate without binding the saw. In the 36", 42" and 48" lengths, the most popular toothing pattern provides for two cutter teeth to each raker tooth. This combination of teeth ensures

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maximum cutting ability in these longer lengths, regardless of wood hardness.

Some bow saws are designed to hold hacksaw blades as well as standard bow saw blades. These multi-purpose saws can be used to cut wood, metal or plastic.

Specialty Saws

Wallboard or drywall saws resemble a kitchen knife in design. They will cut plasterboard in the same fashion as a keyhole saw and are used for sawing holes for electric outlets and switchplates. The saw is self-starting with a sharp point for plunge cuts. It may also have induction teeth for longer life without sharpening.

Veneer saws are specially designed for sawing thin materials such as wood paneling. The blade is curved downward at the end, with cutting teeth on the curved part of the back to saw slots or grooves in the panel with minimum damage. Standard saw lengths are 12"-13", with 14 teeth per inch.

Rod saws are a form of hacksaw-type blade, used in regular hacksaw frames and capable of cutting through most hard materials—spring and stainless steel, chain, brick, glass and tile. The blade consists of a permanently bonded tungsten carbide surface on a steel rod. Because the blade is round, it can cut in any direction.

Pull saws are similar to most traditional saws except the teeth are designed to cut with a pulling motion. Pull saws cut wood faster and with less effort because of the thinner and more flexible blade. The saws feature teeth diamond-ground on three cutting edges. Because of the flexibility of the blade and the minimal set to the teeth, the saws are excellent for flush cutting. Mini pull saws that cut sharply on the pull stroke are used for precision carpentry.

Retractable and folding saws come in a variety of designs and are engineered for the blades to either retract or fold back into a plastic or wooden handle.

Flooring saws are designed to precision-cut floorboards and baseboards. These short, crosscut saws feature a curved cutting edge on the bottom.

Information on saws used for outdoor

purposes such as pruning can be found in the Lawn & Garden section.

Mitre Boxes

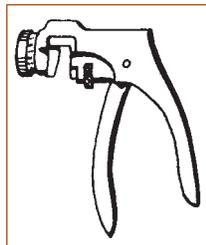
Mitre boxes are used to help cut exact angles for wood trim and rafters. Better models provide a mechanism for a back-saw. They are made of plastic, hardwood or aluminum.

Quality boxes provide more accuracy for deep cuts and have exact adjustments and calibrations. They have length gauges to aid in duplicating pieces and stock guides to allow for proper cuts on intricate moulding. Other features to look for are roller bearings in the saw guide and grips that hold the saw above work so both hands can be used to position the piece.

Some boxes feature magnetic mount guides. The magnets grasp and hold the saw to the mitre box saw guide or hold the saw blade to the plane of the saw guide. This helps assure an accurate mitre cut without impairing the saw stroke.

Saw Sets

Most saws become dull with use and need periodic filing and resetting. A saw set is used to reset or bend teeth back to



their original position so teeth will make a cut wider than the blade to avoid binding in the cut or kerf.

Most sets are made with a pistol grip and designed so the saw teeth are visible during setting. A good saw set should have enough calibrations to ensure an even set to each tooth. Saw sets can be used on back, hand and small circular saws with 4-16 points.

FASTENING TOOLS

Clamps

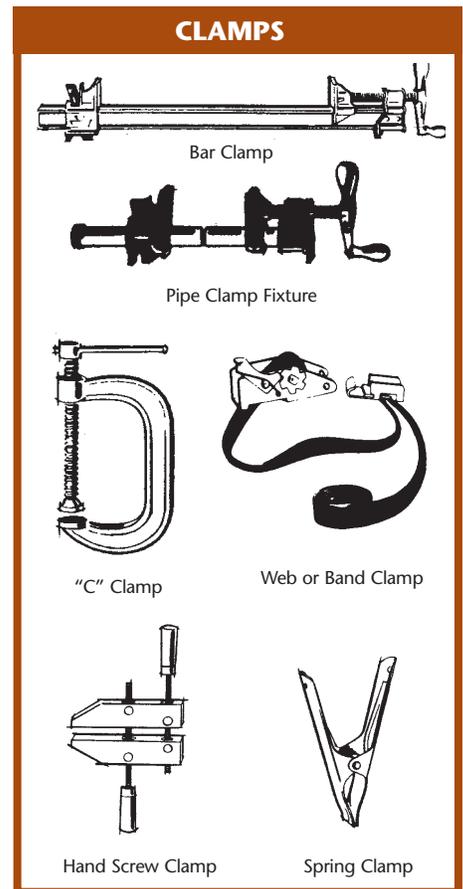
Clamps are used in a number of different applications to hold items in place or secure items. Most clamps are constructed from wood, steel, cast iron, high-impact plastic or

glass-reinforced nylon, and some have rubber or nylon straps.

The most significant innovation to come about recently in the area of clamps is the development of **one-handed bar clamps**. These clamps work with a pistol grip and allow the user to tighten or loosen the clamp by using just one hand on a trigger switch. They are available in jaw openings from 6" to 50" and a variety of sizes.

C-clamps—the most common type of clamp—consist of a C-shaped frame, made of either forged steel or cast iron, into which an adjustable screw is assembled to change the jaw opening. The size of a C-clamp is measured by its capacity—the dimension of the largest object the frame can accommodate with the screw fully extended. Also important is depth of throat, the distance from the center line of the screw to the inside edge of the frame. C-clamps range from 1" to 12".

Bar clamps have a clamping device built on a flat bar (usually steel). The



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WHAT NOT TO DO

Here are some hand tool safety tips to pass on to customers:

- Don't use torque wrenches to pry apart components.
- Don't use leverage extension on a wrench handle.
- Never pull on a loosely adjusted wrench. Be certain the wrench fits the nut tightly.
- Don't hammer on a wrench. Wrenches are to be used with muscle power only.
- Pipe wrenches are for turning and holding. Don't use them for lifting or bending.
- Never expose pliers to excessive heat.
- Don't hammer with pliers.
- Never cock or tilt an open-end wrench.
- Don't bend stiff wire with your plier tip.
- Don't bend heavy bars on light-duty vises.
- Don't use pliers on round shanks or handles of screwdrivers for adding turning power.
- Don't use sheet-metal cutting snips to cut heavy wire. There are tools for this purpose.
- Don't use screwdrivers to pry anything apart.
- Don't use a tool box, chest or cabinet as an anvil or for a similar purpose.
- Don't use a screwdriver as a punch or chisel.
- Don't use a screwdriver to test for current.
- Never use a striking tool or struck tool with a loose or damaged handle. Replace or secure properly.
- Never use any struck tool with a mushroomed, chipped or damaged head.
- Never strike chisels or other hard objects with a nail hammer as the hammer may chip and cause eye or other bodily injury.
- Never strike one hammer with another or with a hatchet.
- Never use a hot chisel for cutting stone, concrete or cold metal.
- Never strike a metal object with the striking face of an axe. The axe striking face should only be used to drive soft objects, such as wood or plastic stakes.
- Never use a bricklayer's hammer to strike metal or other tools.
- Don't use brick chisels on metal. They are strictly for masonry.
- Never drive one maul by striking with another maul, sledge or other striking tool.
- Never use a drift pin as a punch.

Source: *Hand Tools Institute*

length of the bar determines the capacity of the clamp, which is the dimension of the largest object that can be accommodated between its clamping jaws. "Reach" is the distance from the edge of the bar to the end of the clamping jaws. Screw pressure applies the final clamping load. Bar clamps are used for clamping large objects, making them popular with woodworkers and hobbyists.

Pipe clamps can be mounted to standard threaded or unthreaded pipe. Clamping can be performed from one end or both, and jaws can be positioned at the ends or anywhere along the pipe. Pipe clamps can also be quickly converted from a clamp to a spreader.

Threadless pipe clamp fixtures are designed so ends of pipe don't need threads. A hardened steel set screw holds the head

firmly on the pipe, but is easily loosened. The 3/4" size has a crank handle, and depth from screw center to pipe is 11/16". The 1/2" size has a crosspin handle, with depth from screw center to pipe of 7/8".

A **handscrew clamp** consists of two hardwood clamping jaws adjusted to the work by two steel screw spindles assembled into the jaws. The jaws adjust to a variety of angles and come in a wide range of sizes. They are used for clamping wood, metal, plastic and fabrics. Handscrew adaptors can be used to convert handscrews into miter clamps. Also available are handscrew kits so woodworkers can make their own jaws.

Corner clamps are designed to hold miter or butt joints at a 90° angle. They can be used for gluing picture frames, cabinets, moulding and trim.

A **spring clamp** consists of two metal jaws to which clamping pressure is applied by use of a steel spring. They are designed for use with thin materials. Spring clamps are versatile enough for home, hobby or professional use indoors or outdoors, holding round or odd-shaped objects. They typically come with 1", 2" or 3" jaw openings.

Web clamps (also called band clamps) apply even clamping pressures around irregular shapes or large objects and hold tight by means of a spring-loaded locking fixture.

A **hold-down clamp** is the screw portion of a "C" clamp, designed to be secured onto any surface, with the screw used to apply clamping pressure.

Edging clamps are used for installing moulding and trim on furniture and countertops, holding work at right angles, and for welding or soldering. They are designed to hold edging strips, moulding and trim firmly when fastening to the edge or side of work, leaving hands free.

Welding clamps are a unique type of bar clamp ideal for quick tacking and other welding jobs. Available in 6" and 18" jaw openings.

Heavy-duty **press screws** can be used for deep-reach surface clamping. Available in three different lengths, they can be useful for gluing, welding or other assembly applications.

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Vises

The size of a vise is measured by both the jaw width of the vise and the capacity of the vise when the jaws are fully open.

Bench vises are designed for light work in the home, garage and farm. They come in stationary and swivel models, milled and ground jaws, machined to ensure proper operation.

Woodworking vises feature jaws made of wood from 6" to 10" wide. Some woodworking vises have a fast-acting screw arrangement for the rapid positioning of the movable jaw prior to clamping. Smaller vises have continuous screws and are light and easy to clamp on a workbench or sawhorse. A hinged pipe vise is used to hold pipe in position for threading and cutting.

Home workshop or **utility vises** have jaws ranging from 3" to 6". Better models feature swivel bases so the vise may be turned to the best angle for each particular job. Some utility vises either have cast-in pipe jaws or permit special curved-face pipe jaws to be inserted between the regular jaws to add versatility.

An **angle vise** can be adjusted to a flat position and used as a regular vise. Marked adjustments permit the user to obtain any desired angle. The vise can also be locked into any position with a thumb screw, and bolts can be tightened for permanent positioning.

A **clamp vise** is a combination fixed and portable vise, featuring a bottom clamp for easy attachment to workbenches, sawhorses or tables.

Glue Guns

Electrically operated glue guns consist of a heating element, nozzle and glue chamber. Glue or caulking sticks are put in the chamber, where they are melted by heat and released through the nozzle. The adhesive cures by cooling. Subjecting the adhesive to heat again can break the bond.

Cordless models are also available. Some models require the operator to maintain pressure on the glue stick with his thumb. Others are self-feeding. The trigger mechanism on some models closes the nozzle to prevent dripping.

WHAT'S THE DIFFERENCE

SOLDERING—Process similar to brazing but with lower temperature filler material. Temperature is generally below 430° C (mostly between 200° and 320° C). A soldered joint is not as strong as a brazed joint.

BRAZING—Joining two metal parts, not necessarily the same metal, using a different material to make the bond. An alloying action takes place between the base metals and the brazing filler metal. This provides a very strong joint, fully as strong as the brazing material itself. Nearly all brazing is done at temperatures above 540° C (usually at about 760° C).

WELDING—Joining two pieces of similar metal by heating both parts to their melting point and making them flow together. A tricky, complicated task, generally requiring the use of a combustible gas with pure oxygen or an electric arc. In welding steel with an oxygen/gas torch, it is hard to make a strong weld without removing the carbon from the steel and making it more brittle.

FLUX—In both soldering and brazing, the joint must be clean in order to secure a proper bond. Therefore, both parts should be cleaned with emery paper or steel wool or ground clean before making the joint. Flux is used in soldering or brazing to complete the cleaning process and seal out air. This prevents the base metals from oxidizing and makes a good bond.

There are a variety of glues available—both with a gun and in replacement packages including heavy-duty type for wood joints requiring about 60 seconds drying time and lightweight for paper, etc., with shorter drying time.

Caulking/sealer sticks provide waterproof protection for cracks and joints.

Rivet Tools

Rivets can be used in place of screws, nails and other fasteners in many applications. Rivet tools use "blind" rivets, so-called because they can be set from one side without "bucking" at the back.

They are usually purchased in sets containing one or two interchangeable nosepieces that set 1/8" steel or aluminum rivets or 3/16" aluminum rivets. Sets with fixed nosepieces are capable of setting only 1/8" steel or aluminum rivets.

Many rivet tools feature self-storage of the extra nosepieces. Other features include sliding latches to lock handles closed for storage, spring opening handles to make constant usage easy and epoxy finishes to protect the tool.

Stapling Tools

There are four types of hand stapling machines: desk stapler, pliers-type hand stapler, staple gun and hammer tacker.

Desk staplers and **pliers-type staplers** are both anvil-in-base units. The pliers-type machines are used in heavy-duty work, although lightweight units are on the market.

Unlike anvil-in-base staplers, staple guns shoot staples with a one-hand lever operation. Some guns now shoot nails as well as staples. One new design features a handle that is squeezed toward the front instead of the rear, making it easier to use and control. Staple guns are good for jobs requiring material to be held with one hand and fastened with the other.

Guns of several weights are available and used for lining closets, installing insulation, tacking ceiling tile or fastening roofing paper.

Specially designed guns are made for fastening low-voltage wire. Other guns fasten wire and cable. Some guns shoot flared staples without an external anvil to staple insulation around pipes and ducts.

Staple guns are useful for jobs such as attaching new window shade material to an old spring roller, recovering furniture, installing new webbing on chairs, making a garden trellis, attaching weather stripping and tacking chicken wire to a fence stake. A staple gun can be fitted with a variety of staple sizes and attachments for specialized applications.

Electric and cordless staple guns are also available. They have the same uses as the hand-operated guns but the staples are ejected automatically with the pull of a trigger. Some guns are built with a flush front and extended nose for accurate staple placement into hard-to-reach areas. They come with trigger locks to prevent accidents.

Automatic hammer tackers look like a hammer, with the stapling mechanism in the

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head and the staples stored in the handle. The unit is used like a hammer and automatically drives a staple with each blow. Quality features include shatterproof handles, retractable striking edges, magnetized striking portions and double-magazine capacity for quicker reloading. Newer models have been designed to be lighter in weight and easier to handle, improving on older models that were front-heavy in weight.

Similar to a stapler is a **nail gun** that drives and countersinks nails into paneling, carpeting, moulding and insulation with a single stroke. It looks like a heavy-duty stapler but will not scratch, mar or dent work surfaces. Nails are 11/32" in length and come in woodtone colors to match paneling. The nail gun usually comes packaged with a supply of nails and complete instructions for the do-it-yourselfer.

Although there is a wide variety of staple types and sizes, each staple gun will only accept a certain range of sizes and styles.

In choosing the proper staple-leg length for the job, consider two things: the thickness of the material to be stapled and its hardness. Staple leg lengths range from 3/16" to 9/16". In hardwood, 3/16" to 1/4" penetration is sufficient. Softwood requires up to 3/8" penetration. However, if the staple stands away from the work, it is too long for the gun being used. Some staple guns handle round-crown as well as regular staples, while electric staple guns can handle brads for moulding and trim work.

Concrete Fastening Tools

Concrete fastening tools allow pins and studs to be set in concrete and cement block with only a few hammer strokes. The tool itself consists of a plastic or polypropylene handle with a tempered steel rod protruding from the top and running almost through the tool. On the bottom of the tool is a hole into which specially tempered pins and studs are inserted head first.

On each pin and stud there is a washer, about a third to a quarter of the way up from the point. After the head of the pin or stud has been inserted into the fastening tool, a few hammer blows on the protruding steel

rod will set it in position. Pins and studs can also be driven through 1/8" steel and still set in concrete. When properly set, fasteners can hold up to 100 lbs.

A heavy hammer with a head weight of 3 lbs. or more is needed to use this tool.

STORAGE ITEMS

Toolboxes

Steel toolboxes are most popular. Their prices vary according to gauge of steel used, number of trays and whether the box is reinforced in the corners.

Some precision tool users use hardwood chests because the wood absorbs rust-producing condensation. Carpenters' toolboxes are specially designed so carpenters can carry hand saws and framing squares in the same box with other tools. The word "carpenter" differentiates this box from a regular toolbox because of the extra tools it will carry.

Plastic toolboxes are available in a number of styles. Some are suited for light-duty use, while others are comparable to steel in quality. The highest quality plastic boxes are constructed of polypropylene, and some models can hold up to 75 lbs. of tools. The high-quality plastic boxes feature interlocking pinned hinges, tongue-in-groove closure and positive locking latches, as well as padlock eyes and lift-out trays.

Tool Chests

Utility chests store parts, screws, nuts, bolts and other small pieces. These chests are made of either plastic or steel with removable plastic dividers.

Tool Caddies

Plastic revolving tool caddies hold tools and items such as nails, bolts, screws, glue and wire in tiers of circular trays.

The caddies are made of a high-impact plastic and feature a ball bearing base plate, allowing the unit to revolve easily.

Modular Workshops

Modular, mobile workshops are increasing in popularity, as users like their adaptability and functionality. Some models feature

adjustable leveling feet, adjustable height, detachable casters, latching doors, drawers, hooks for hanging tools, dust collection ports, quick-change tool set-up, lock-down hardware and corner tops. They can hold large and small tools, and can be designed to serve as a shop bench, router station or clamping station.

WORKSHOP AIDS

Steel Sawhorse Bracket Kits

Sawhorse kits convert five pieces of square-cut lumber into a sturdy sawhorse; the assembly is secured with nails or wing nuts. Those that require wing nuts allow disassembly with no damage to the wood. The other type provides flanged nail holes for easy nail removal with a claw hammer.

Selling features include ease of assembly since miter cuts are not necessary and sturdiness and convenient storage since most brackets allow legs to fold together.

Medium-duty brackets are not as long as heavy duty. Most require nails to give added strength and rigidity. Light-duty brackets are similar to medium, only shorter.

Sawhorse legs are made of wood, tubular material or fabricated steel. Most require that a nonmetal cross-rail be added (with metal cross-rail there is danger of ruining saw teeth).

Workbench Leg Kits

Workbench kits contain four upright legs, four crosspieces, braces, nuts, bolts and washers. Some include a tool-bench rack to organize small tools. The kit includes plans for building the bench, using a 4' x 8' sheet of 3/4" plywood cut into eight parts.

Specialty Workbenches

There are two types of specialty workbenches. One is a **stationary woodworking bench** with a variety of holes, pegs and vises to hold the work firmly. These are expensive and seldom seen in hardware stores and home centers.

The second type is a **portable specialty bench** that comes as a tabletop or folding bench. The folding benches offer easy storage

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and a firm, broad base. The tabletop benches clamp securely to table or shelf and are ideal for apartment dwellers.

The bench is designed to hold irregular pieces securely. It will hold a round piece of wood, a bicycle, a door, a window casing, etc., so it can be worked on with hand or power tools.

MISCELLANEOUS HAND TOOLS

Ripping Bars

Ripping bars, also known as **crowbars** or **wrecking bars**, are used in construction, demolition and where pulling nails, ripping wood and similar tasks are done. Those with curved ends are also known as gooseneck bars. Because of their length, usually 24" or 30", they have more leverage than hammers, enabling them to pull much larger and longer nails.

Pry bars are smaller and flatter than ripping bars and are not designed for heavy-duty prying. They are useful for removing nails with exposed heads and for prying open paneling or moulding without marring the surface. One bar features an extra curve, which makes it useful for lifting and holding such things as drywall panels in place. They feature beveled notches in each chisel-like end and range in size from 6" to 21".

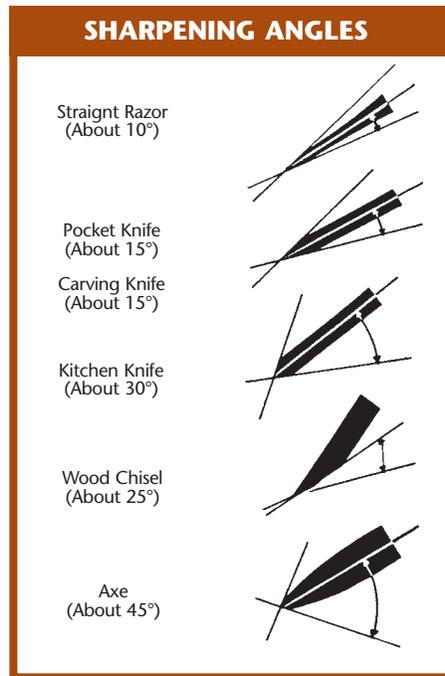
Winches

Quality winches or come-alongs feature baked enamel finishes with plated ratchet locks and high carbon steel pinion gears. Winches are rated by weight capacity, ranging from about 900 to 2,000 pounds capacity. Gear ratios from 3-to-1 up to 5-to-1 are common.

Propane, MAPP Gas and Oxygen Torches

Torches are defined by the uses for which they are designed and by the fuels they use—compressed oxygen, solid oxygen tablets, propane, MAPP gas or butane, for example.

Propane torches light instantly and burn with a clean blue flame. They require no pumping, priming or pre-heating. They con-



sist of a disposable propane fuel tank with a burner assembly that screws on top. The burner has a built-in valve that turns the torch on or off and regulates the size of the flame. They will operate in a variety of positions, but care should be taken when turning the torch upside down as the liquid fuel can get into the valve assembly, creating a potentially dangerous situation.

Propane torches are used for heavy-duty soldering operations and for burning off old paint on exterior siding. For this task, a flame-spreading tip or heavy-duty burner is required.

When equipped with a pointed or chisel-edged cutting tip, these torches can also be used for removing old putty around windows, for installing asphalt tile or for branding designs on wood.

Torches with built-in pressure regulators operate much better in cold weather, for thawing pipes or in the upside-down position.

Brazing torches for the non-professional use propane or high-temperature fuels. High-temperature fuels include MAPP, CleanBurn and propylene.

Welding torches available for the d-i-y market include compressed oxygen, propane or MAPP fuel. Oxygen, propane and MAPP torches generate temperatures

in excess of 2,800° C.

The oxygen/propane, or MAPP, tank-type torches are a convenient project-specific tool to use for light metal repair and cutting and bending on metals.

Oxygen/propane torches are portable and weigh approximately 6 lbs.

Make sure you stress safety tips when selling torches to do-it-yourselfers. For example, do not use a torch to remove paint from the exterior siding of a house. The flames can ignite combustible materials underneath the siding.

Soldering Tools

Soldering guns are used for a variety of chores: hobbies, minor electrical repairs, plumbing and other do-it-yourself home repairs.

They offer advantages over conventional irons—they heat and cool rapidly, are easy to handle and may have several heat levels. Some feature built-in lights to illuminate work. Guns are turned on and off by a trigger switch.

Maintenance is easy and inexpensive because gun tips are relatively low-priced and easily replaced. Complete kits contain guns, extra tips, solder and accessories. Cordless models are available for added mobility.

Solder with an acid core flux is used in plumbing and general-use applications. Solder with plastic rosin core flux is used on electrical work to prevent leakage.

Soldering irons come in four basic groups: line voltage, low-voltage pencils, temperature-controlled and soldering coppers.

They heat and cool slower than guns, and electrically heated irons are rated by watts. The watt rating tells how much heat of a given temperature can be delivered rather than the temperature itself. The tip temperature and the heat recovery capability of the tip being used can also measure an iron's capability.

Line voltage soldering irons and pencils have built-in electrical heating elements and are used for hobbies, electronics, model-making and small household repairs. Larger irons are used for home and shop repairs, sheet-metal work and general soldering.

Low-voltage pencils operate from batteries

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BURNER TIP SELECTION GUIDE

JOB	PRECISION BURNER TIP	PENCIL POINT BURNER TIP	BRUSH FLAME BURNER TIP	FLAME SPREADER	CHISEL POINT SOLDERING TIP
Soldering small fittings or connections		x			
Soldering jewelry or very tiny wires	x				
Soldering electrical connections					x
Soldering flat surfaces					x
Soldering over large areas			x		
Soldering gutters		x			
Starting threaded pipe joints		x			
Thawing pipes		x	x		
Sealing soil pipes		x			
Removing paint			x	x	
Removing putty		x			
Bending metal		x	x*		
Metal sculpturing		x			
Laying asphalt tile			x	x	
Thawing frozen locks		x			
Loosening screws, nuts, bolts		x			
Lighting charcoal		x	x		
Auto body leading		x			
Removing brake linings			x	x	
Separating exdhaust pipes, Auto body springs					
Plywood sculpturing					x
Glass working		x	x		
Antiquing wood			x	x	
* (LARGE AREAS)					

in cars, trucks, boats and aircraft and are used for field servicing of wiring and electronic gear by servicemen and hobbyists.

Temperature-controlled units operate either from special power supplies or line voltage and are primarily used by servicemen or hobbyists. Soldering coppers are irons that must be heated in a flame or by hot coals. Usually quite heavy and bulky, they are used mainly by sheet metal shops and occasionally by plumbers.

Cordless soldering tools feature a butane-fueled catalytic converter that generates powerful, yet safe, flameless heat. Lightweight and portable, they are ideal for field electronics service jobs where electricity may not be available.

Sharpening Stones

Abrasive stones make good add-on sales when a customer purchases a pocket or carving knife, axe, chisel, lawn mower or grass

cutter. Most tools need to be sharpened shortly after purchase because manufacturers generally provide only a medium edge (to prevent shipping damage). Since there are many specialized stones, study manufacturer literature to recommend proper stones for different types of blades.

Blades or tools that cut with a slicing action should be sharpened against the edge. Tools such as scissors or reel-type lawn mowers should be sharpened on the bevel, not on the side of the blade. Never attempt to sharpen a serrated edge—it requires special equipment.

Files

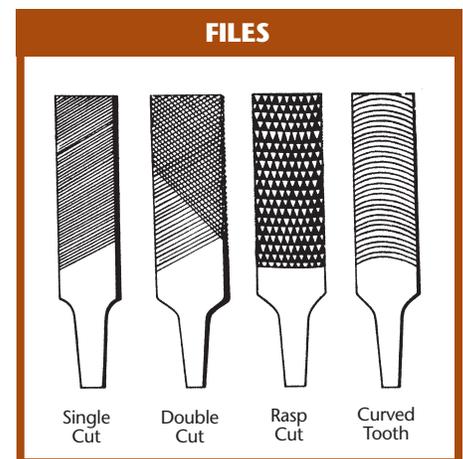
Files are grouped by length, type and shape. Lasting performance and cutting ability determine quality.

Length is measured from the point (square end of file) to the shoulder (where the blade sets onto the tang). Length indi-

cates coarseness, stroke distance and rate of stock removal.

File types are determined by shape: square, round, half-round or flat.

Two other indicators of file shape are taper and blunt. As their names imply,



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taper files taper from shoulder to point while blunt files are the same width for the entire length.

Coarseness and character of teeth determine file cut. Four basic cuts are single, double, rasp and curved-tooth.

Single cut denotes a single row of chisel-cut teeth. These files are used on saw teeth and metals where a good finish is required.

Double cut, used primarily on metals where rapid stock removal is necessary and a rough cut is permissible, has two rows of chisel-cut teeth.

Rasps are used on wood and for rough shaping jobs. Rasp-cut files have individually punched teeth that are entirely separate from each other.

Curved-tooth cut features teeth that are milled in an arc. This cut is used on flat surfaces of soft metals for rapid stock removal and a fairly good finish.

File teeth are further divided into four groups: coarse, bastard, second and smooth. Coarse and bastard cuts are used on heavy work, while second and smooth cuts are used for finishing or more exacting work.

Chain saw files are made for both round-hooded and square-hooded chain saw teeth. For the former, the file must be held level against the bevel of the cutting surface of the tooth at an angle of 25° to 45° with the saw blade. File direction is off the cutting edge, pressing back and slightly up during the stroke. Some chain saw files feature a molded-in filing angle indicator to make uniform sharpening easier.

Nail Sets

Nail sets are used to countersink nails. Nail holes can then be filled with putty, plastic, wood or other filling materials for a smooth surface.

Nail sets are sized by 1/32" and range from 1/32" to 5/32". It is important that the correct size set be used for each size nail to prevent enlarging of a small nail hole by too large a set. The pointed end of the nail set should be cupped or hollowed out to avoid splitting the nail head. Self-centring nail sets are available.

Punches

Punches are used with ball peen hammers to remove pins, align holes and mark locations of holes to be drilled. They are available in a wide range of sizes in both high carbon and alloy steels. They are similar to nail sets in appearance, but do not have a cupped or hollowed end.

Hand punches are considered general-purpose tools for driving out pins and bushings and lining up bolt and rivet holes. They have a relatively blunt taper, with the size of the punch being marked by the diameter of the flat point.

Pin and centre punches are similar to hand punches and are used for the same purposes. They differ only in the shape of their points. Safety goggles must be worn when these are used.

Automatic centre punches are held in one hand and not struck by a hammer. They have a spring-actuated internal drive that pushes the attached punch point into the material to be centre punched. These punches are available in different sizes and with replaceable screw-on points.

Taps and Dies

Dies are used to thread the outside of a rod or pipe to screw it into a threaded hole. They are available in two types: solid and adjustable with either round or hex heads.

Dies with hex heads are used with wrenches or sockets instead of die stocks for close, hard-to-reach jobs and for repairing bruised or damaged threads.

Taps are used to cut screw threads inside holes and to renew worn or stripped threads.

Taps come in three basic styles: **taper**, **plug** and **bottoming**. Tapered taps cut full threads at the entrance and gradually less thread toward the bottom. Plug taps cut full threads to within three or four turns of the bottom. Bottoming taps cut full threads to the bottom of the hole.

Quality dies and taps offer close tolerances, are made of the finest high-carbon tool steel, are carefully heat-treated and will cut clean, accurate threads.

Two numbers indicate tap and die size.

The first number represents the diameter of the screw or bolt; the second number is the distance between the threads.

A variety of metric tap and die sizes are available, particularly useful to those who work on automobiles and motorcycles. Sizes are expressed in millimeters (mm) and decimals. For example: 10 mm x 2.50 tap or die has threads 2-1/2 mm apart and an outside diameter of 10 mm.

Taps and dies are stamped with two or three letters indicating thread series. Special tools needed to work with dies and taps include die stocks and tap and reamer wrenches.

Die stocks are adjustable tools that hold and turn dies. They are made with two handles so cutting can be done evenly and smoothly.

Tap and reamer wrenches are similar to die stocks. They are adjusted by twisting one of the wrench handles to change the opening of the jaws. Jaws on these tools must be hardened to prevent mutilation when using hardened taps.

Tap wrenches feature adjustable chucks and come with sliding T-handles.

Screw Extractors

Screw or bolt extractors remove bolts or screws when they cannot be removed normally. To use most extractors you must first drill the correct size hole in the center of the bolt or screw, then insert the extractor. The threads, which are reversed, bite down into the screw and turn it out. Some extractors feature a built-in drill bit that allows you to drill and extract the screw in one process.

Trowels

Plasterers, concrete finishers, bricklayers and masons use trowels to handle small amounts of mortar and plaster. They should be lightweight and well-balanced.

Brick trowels are used to pick up mortar and spread it for the next course of brick, concrete block or stone. The blade (which carries the mortar), post (which joins tang to blade) and tang (where the handle is inserted) are forged in one piece, with a handle driven into the tang. Width at the

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heel (back end of the trowel) is between 5" and 5-1/2". The most popular brick trowel length is 11".

Two shapes of brick trowels have become almost standard: the Philadelphia pattern with a square heel and the London pattern, which has a rounded heel so the mortar is carried a little farther forward on the blade. Both patterns can be used for laying brick, but the Philadelphia pattern is most popular for blocklaying. It is wider at the heel so it holds more mortar.

Pointing trowels are used by bricklayers for pointing up their work. Pointing and margin trowels are used for patch work and for cleaning other tools. High-quality pointing and margin trowels are forged in one piece and made about the same as a brick trowel. The length of pointing trowels may be from 4-1/2" to 7". Best sellers are the 5" and 6" lengths. Size 5" x 2" is the most popular margin trowel.

Cement trowels or cement trowels are used to finish the surface of the cement to the required smoothness. Troweling action helps compact the surface and adds to the quality and durability of the job. Cement trowels are narrower and longer than plastering trowels. The blade is slightly convex. Blades range in width from 3"-5" and in length from 12"-20". Most popular sizes are 14" x 4" and 16" x 4".

Plastering trowels are used to carry plaster to the wall or ceiling from a hawk when two or three coats are applied. They have a light-

weight flexible blade with an average size of 11" x 4-1/2". They are available with a choice of two handles, either straight or curved (called the camel back style).

Floats are made of aluminum, magnesium, wood, cork or rubber. The most popular with concrete finishers are wood and magnesium. The best-selling sizes in wood are 12" x 5" and 16" x 3-1/2" while the popular magnesium float is 16" x 3-1/8".

Bull floats are used by concrete finishers to float large areas of concrete. The most popular sizes are between 42" and 48" long and are 8" wide. Handle sections either 5' or 6' long can be joined together so that a finisher can reach out 15' to 20' over a slab.

Brick jointers (strikers) are used to strike joints of brick walls for finished appearance. Because it receives hard wear, the tool is heat-treated. Each end is a different size—most popular combinations are 1/2" x 5/8" and 3/4" x 7/8".

Corner trowels are used to form inside and outside corners; the most requested sizes are square and 1/2" radius.

Cement edgers produce a radius at the edge of a concrete slab to minimize chipping, while concrete groovers are used for cutting joints in concrete to control cracking.

Tuck pointers (joint fillers) apply new mortar between old bricks. They are usually 6-3/4" long by 1/4"-1" wide. The best models are constructed of one piece.

HAND TOOL CARE

A rustproof coating is available for protecting hand tools, in or out of storage. The product is wax-based, with a heavy-duty rust inhibitor blended in its formulation. Once applied to a clean, dry surface, the material dries within 30 seconds to a waxy finish. When the blade is ready to be used it must be cleaned off with a solvent (i.e. paint solvent) to remove the wax finish.

Hawks hold plaster before application. They are usually made of lightweight aluminum or magnesium in 13" or 13-1/2" square sizes.

Drywall Tools

Drywall trowels have a slight concave bow in the blade that helps to feather mud and make perfect drywall joints. The tempered, flexible steel blade is securely attached to a lightweight aluminum mounting. A smoothly turned basswood handle ensures a comfortable feel. There are several sizes available—the most popular is 11" x 4-1/2".

Drywall corner trowels are used in applying compound to both sides of a corner at one time. A flexible one-piece blade of stainless steel eliminates tape snagging and rusting. The blade angle is set at a 103° angle, thus giving perfect 90° corners when flexed in use.

Drywall pole sanders are used for sanding drywall joints, especially ceilings and side walls from the floor.

Drywall T-squares feature an arm that measures 16" for locating studs. The blade measures 47 7/8" and the head is notched which enable cutting a 48" board in one stroke. The 2" wide blade enables the user to cut both sides of an outlet box without moving the blade.

Drywall taping knives are also used for taping drywall joints. The tempered blue steel or stainless steel blade bows just right for feathering, but will not take a set. It can be used in covering over nail spots and other indentations in the board.

TYPES OF TROWELS



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CANADIAN IMPERIAL AND METRIC MEASUREMENTS

Canadians generally use a mixture of measurement units.

Liquid volumes are typically based on the metric (SI) system. Temperatures and distances are commonly specified using metric terminology. Weights, depending on the type of product, use either the metric or Canadian Imperial system. Lengths and dimensions of construction products, particularly for residential use, are generally in Canadian Imperial measurements. And

many of the products we use are manufactured in U.S. measurements.

Canadian building codes are written using metric units. But the construction trades, particularly those in residential construction, typically use the Canadian Imperial system. This mixture of measurement systems frequently results in many product manufacturers providing information using both systems. Unfortunately, the approaches used in pre-

senting the “converted” measurements are not consistent. Some information is based on “exact” conversion measurements, whereas other information is based on “rounded” measurements.

From your perspective and in communicating with your customer, it is important to recognize that in some instances the exact conversion is necessary and in other instances a more “rounded” conversion is appropriate.

CONVERSION FACTORS

1 inch (in.)	=	25.4 mm	32 fluid ounces - US (oz.)	=	1 US qt.
1 foot (ft.)	=	0.3048 m	40 fluid ounces - Canadian (oz.)	=	1 Canadian qt.
1 yard (yd.)	=	0.9144 m			
1 mile (mi.)	=	1.609 km	1 fluid ounce - US (oz.)	=	29.6 mL
			1 fluid ounce - Canadian (oz.)	=	22.8 mL
1 ounce - avoirdupois (oz.)	=	28.35 g	1 cup - US (cup)	=	236mL
1 pound - avoirdupois (lb.)	=	0.454 kg	1 cup - Canadian (cup)	=	227mL
			1 quart - US (qt)	=	0.946 L
1 pound per square inch (psi)	=	6.895 kN/m ²	1 quart - Canadian (qt)	=	1.136 L
1 pound per square foot (psf)	=	0.04788 kPa	1 gallon - US (gal.)	=	3.785 L
			1 gallon - Canadian (gal.)	=	4.546 L

Celsius temperature = (Fahrenheit temperature - 32) / 1.8

SOME TYPICAL MEASUREMENTS FOR HARDWARE AND FASTENER PRODUCTS ("rounded" conversions)

Length		Length		Length		Length		Weight	
in.	mm	in.	mm	in.	m	ft.	m	lbs	kg
$\frac{1}{32}$	0.8	$1\frac{3}{8}$	35	48	1.2	7.5	2.3	1	0.45
$\frac{1}{8}$	3.2	$1\frac{1}{2}$	38	60	1.5	10	3.0	10	4.5
$\frac{1}{4}$	6.4	2	51	72	1.8	12	3.7	50	22.7
$\frac{3}{8}$	9.5	4	102	84	2.1	18	5.5	100	45.4
$\frac{1}{2}$	12.7	12	305	90	2.3	25	7.6	750	340
$\frac{5}{8}$	15.9	18	457	120	3.0	50	15.2	1250	567
$\frac{3}{4}$	19.1	24	610	156	4.0	75	22.9	1900	862
$\frac{7}{8}$	22.2	30	762	216	5.5	100	30.5	2650	1202
1	25.4	36	914	312	7.9			5000	2268

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■ The course was first developed by the North American Retail Hardware Association (NRHA) and the Home Center Institute (HCI) under the direction of a project coordinator and a number of authors. Several U.S. based companies provided industry specific information.

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Because local codes and regulations vary greatly, you are reminded to check with local experts and authorities on which codes, regulations and practices apply in your area.

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