MEM18002B

Use power tools and hand held operations

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Unit Resource Manual

Manufacturing Skills Australia Courses

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Aims of the Competency Unit:

This unit covers using a range of hand held power tools and fixed power tools for hand held operations for a variety of general engineering applications.

This unit applies to loosening and fastening items or components and shaping, finishing, cutting, grinding metallic and non-metallic materials and/or tool bits to size and shape.

This unit should not be selected if the power tools used are dedicated to an operation or machine, e.g. nut-runner, air drill, power driver, etc.

For using hand tools, see Unit MEM18001C Use hand tools.

Unit Hours:

18 Hours

Prerequisites:

None.

Elements and Performance Criteria

1.	Use power tools	1.1	Power tools are selected appropriate to the task requirements.
		1.2	Power tools are used for a determined sequence of operations - which may include clamping, alignment and adjustment to produce desired outcomes - to job specifications which may include finish, size or shape.
		1.3	All safety requirements are adhered to before, during and after use.
		1.4	Unsafe or faulty tools are identified and marked for repair before, during and after use according to designated procedures.
		1.5	Operational maintenance of tools, including hand sharpening, is undertaken according to standard workplace procedures, principles and techniques.
		1.6	Power tools are stored safely in appropriate location according to standard workshop procedures and manufacturers' recommendations.

Required Skills and Knowledge

Required skills include:

- reading and following information on standard operating procedures
- following verbal instructions
- selecting power tools appropriate to the task
- using power tools safely
- using clamping/securing devices
- identifying power tool defects
- maintaining power tools using appropriate techniques
- sharpening tools/tool bits within the scope of this unit
- storing power tools according to manufacturers'/ standard operating procedures.

Required knowledge includes:

- application of different power tools
- clamping/securing methods
- adjustments/alignments to a range of power tools
- common faults and/or defects in power tools
- procedures for marking unsafe or faulty power tools for repair
- routine maintenance requirements of a range of power tools
- tool sharpening techniques for a range of power tools
- storage location and procedures of a range of power tools
- hazards/control measures associated with power tools
- use and application of personal protective equipment
- safe work practices and procedures

Lesson Program:

Topic	Skill Practice Exercise
Topic 1– Clamping:	MEM18002-SP-0101
Topic 2 – Power Drills:	MEM18002-RQ-0201 MEM18002-SP-0202 MEM18002-SP-0203
Topic 3 – Grinders:	MEM18002-RQ-0301 MEM18002-SP-0302 MEM18002-SP-0303
Topic 4 – Nibblers & Shears:	MEM18002-RQ-0401 MEM18002-SP-0402 MEM18002-SP-0403
Topic 5 – Power Saws:	MEM18002-RQ-0501 MEM18002-SP-0502 MEM18002-SP-0503 MEM18002-SP-0504
Topic 6 – Sanders:	MEM18002-RQ-0601 MEM18002-SP-0602 MEM18002-SP-0603
Topic 7 – Planers:	MEM18002-SP-0701
Topic 8 – Routers:	MEM18002-SP-0801 MEM18002-SP-0802
Topic 9 – Operational Maintenance:	MEM18002-SP-0901
Practice Competency Test	MEM18002–PT-01

Contents:

Topic 1– Clamping:

Required Skills:

- Identify different types of clamping systems.
- Use clamping systems to secure workpieces.

Required Knowledge:

- Safe working practices and procedures.

1.1 Introduction:

There are several methods for securely restraining workpieces before using a power tool to modify or finish the piece. The main factor is the power tool that is going to be used, the material being worked, and the shape of the job. Some methods for securing metal cannot be used for timber and vice-versa.

Over tightening of the clamping system can damage the workpiece.

1.2 Clamps:

A clamp is a fastening device to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. In the United Kingdom and Australia, the term cramp is often used instead when the tool is for temporary use for positioning components during construction and woodworking; thus a G cramp or a sash cramp but a wheel clamp or a surgical clamp.

There are many types of clamps available for many different purposes. Some are temporary, as used to position components while fixing them together, others are intended or permanent. In the field of animal husbandry, using a clamp to attach an animal to a stationary object is known as "rounded clamping". A physical clamp of this type is also used to refer to an obscure investment banking term; notably "fund clamps". Anything that performs the action of clamping may be called a clamp, so this gives rise to a wide variety of terms across many fields.

Rules for clamping:

- Always use a piece of scrap wood between each jaws of the clamp and the workpiece to prevent damage.
- When a clamp is positioned, close the jaws until the clamp feels tight, when gluing, some will be squeezed out around the joint, a sign that it is tight enough.
- Clamping pressure should be applied at right angles to the glue line otherwise slippage may result.
- Do not over tighten, if the fit is accurate only moderate pressure is required, the purpose of a clamp is only to maintain uniform pressure between the two surfaces, not to force them to fit.

1.2.1 Bar Clamp:

A bar clamp is a tool used when working with timber; it has cast iron jaws made with a heat-treated steel bar which steel adds to the overall strength of the clamp; it is also possible to have a nickel-plated steel screw with a swivel pad and a hardwood screw handle.

Figure 1.1

A woodworking bar clamp can be used in a number of ways; if the project calls for gluing two pieces together, the clamp is used to keep them held tightly together to ensure a proper connection and is important because many types of glue tend to bubble. If the pieces are not held together tightly, the bubbled glue can cause a break in the connection between the pieces.

When using a bar clamp to glue together two pieces of timber, it is important to tighten the clamps carefully in order to distribute the pressure evenly throughout the area. It is also important to alternate the direction of the clamps in order to keep the seal properly together; while doing this, it is necessary to measure the diagonals to keep the work square. If the project is not square, the clamps need to be loosened and readjusted. Fortunately, this type of clamp can easily be adjusted as needed. After the work is securely clamped down, however, best practice is to reinforce the joints with finishing nails.

A bar clamp can also be used when screwing or nailing two pieces of timber together. One that is properly placed makes it possible for the user to hold the pieces of timber in place while working on them.

Bar clamps are manufactured in many different sizes, therefore, it is important to select one that is the right size for the project. The length is measured by its jaw opening, which represents its capacity for holding the workpiece. The large, parallel jaws in a bigger clamp distribute even pressure across the entire surface, which prevents bowing, as well as the need to turn and lift the work.

Most bar clamps also feature encased clamps, which add to the strength and stability of the tool. The casing of this type is also non-marring and glue-resistant. This clamp is best when working with a finished surface or softer timber or plastics.

1.2.2 "C" or "G" Clamp:

C-clamps are not a new invention and have been around for hundreds of years. A C-clamp derives its name from its appearance; this type of clamp may sometimes be called a "G-clamp", or, just a plain "cramp". The main portion of the clamp is shaped like the letter "C" or a "G". One end of the "C" is flattened, while the other end has a hole drilled through it. A long threaded rod passes through the hole, usually considered to be the top of the C-clamp. The end of the threaded rod close to the other end of the "C" is also flattened. The two flattened ends are adjusted to hold the material to be clamped by turning a handle to secure the clamp.

Figure 1.2

C-clamps are usually made of cast iron or steel. The tool can be used in various ways, from holding two pieces of material together while the adhesive sets, or, in securing material for cutting or welding. Woodworking is the most common use for C-clamps. If the material being clamped can become scratched or easily marked, a protective layer should be added between the C-clamp and the material to reduce the chance of damage. When the clamp is closed, the protective layer absorbs the abuse, while the material it is protecting stays securely in place. These clamps can come in numerous sizes to fit various project needs. For example, a larger heavy-duty C-clamp might be useful to a professional welder, while someone who enjoys woodworking as a hobby might only need a small 100 mm C-clamp.

One drawback to the tool is the strength required to use it; to tighten and secure the clamp, the handle is turned manually which can be a problem for those who suffer from arthritis or other dexterity issues. The shape of the clamp also limits how it can be used. A C-clamp must be placed on the edges of the material to be secured, since the curve of the "C" limits how deep the clamp can go. Alternatives to the C-clamp, such as bar clamps and vise grips, may be better suited for particular jobs.

1.2.3 Hand Screw Clamp:

Hand screw clamps are ideal for clamping timber, metal, plastic and other materials and are available in a complete range of sizes. These traditional timber clamps hold tightly over broad areas, provide greater reach and a wider distribution of pressure than other clamps. The angle between the jaws can be adjusted to fit the work. The jaws hold odd shapes easily, are capable of overlapping, and provide protection against marring of finished surfaces. The versatility of hand screw clamps also allows for specific, concentrated clamping pressure where required.

Figure 1.3

The Jaws are made from seasoned hard maple, selected straight grain; properly oiled and individually inspected, finished and tested. The Spindles and Nuts are made from cold-drawn steel with special double-lead threads; machined for quick adjustment, strength and durability. The Handles are made from seasoned hardwood; designed for comfort and assembled with heavy-duty steel ferrules.

1.2.4 Miter Clamp:

A miter joint is a joint made by cutting two pieces at 45° angles; the result is a joint that fits together to form a specific angle. Many involved in physical trades will be familiar with the basic physics of miter joints for putting together superior products.

Miter clamps are designed to hold miter joints together. The earliest miter clamps are a simple spring in a C-shape with sharpened points that are sprung onto the outside corner of the miter joint.

Figure 1.4

Recent designs are more complicated; a rigid body holds one fixed and one moveable jaw activated by a cam.

1.2.5 Quick Action Clamp:

Quick Action clamps have reinforced-plastic clamping heads with rubber-padded jaws and feature a hand-pumped lever that closes and tightens the jaws, so the clamp can be set with one hand; the clamps are a hybrid, featuring both a pump lever to advance the jaws and a hand screw, for final tightening. A small button or lever instantly releases clamping pressure. Quick-action clamps come in many sizes as well as lengths, from the 100 mm to 1250 mm long.

Figure 1.5

Various quick acting clamp brands and models offer different features: some may have a built-in power reel that automatically closes its jaws lightly when the release button is pressed while most clamps allow their jaws to be reversed on the bar, for spreading work. Some have a dial that reverses the direction of the jaws when the lever is pumped, while another may feature a small pump lever that opens the jaws wider.

1.2.6 Quick Grip Clamp:

One hand operated clamp (operates like sealant guns) ideal for quickly and easily clamping all kinds of workpieces. Simple single finger release.

While the handle section is a bit bulky, which would likely prohibit clamping in tight quarters, the one-handed clamping action is ideal for situations where the user needs to hold stock in place with one hand while applying the clamp with the other hand.

Figure 1.6

1.2.6 Sash Clamp:

Sash clamps are simple clamping devices that are often used in woodworking, carpentry, and similar professions. The clamps are used to hold two pieces of timber or other materials together while an adhesive is allowed to create a seal between the materials. Clamps of this type come in a variety of sizes, making them ideal for a number of different applications.

A typical set of sash clamps usually includes sash clamp devices. Each clamp in the set is made from a combination of metals. Typically, the bar area of the clamps will be constructed with steel, while the head and sides of the devices are created using iron. This combination tends to wear very well, making it possible to effectively use the clamps in a number of different settings, without fear of damage to the devices.

Figure 1.7

In actual use, sash clamps are normally slid into position after the glue is applied to the two sections of timber. An easy approach is to rest the bottom of the glued section on one arm of a clamp, then place a small piece of scrap timber on the top area of the materials being joined. At this point, the bar is tightened until the head at the end of the bar comes to rest against the scrap material, effectively holding the two pieces together while the adhesive dries. Normally two sash clamps are used for this operation, with one clamp positioned on each side of the glued materials.

Sash clamps can be employed in several different settings. Cabinetry shops and other establishments where wooden furniture is constructed often make use of these devices as part of the manufacturing process. Around the house, sash clamps can be used to make repairs on furniture, or as part of the tools used by hobbyists who enjoy woodworking. Because the clamps come in many different sizes, it is possible to purchase sets that are ideal for both small and large projects.

1.2.7 Spring Clamp:

A spring clamp is a common carpenter's tool that is able to hold two or more solid objects together by generating a tremendous amount of force for its comparative size. The clamp obtains this high amount of pressure because of the tightly wound coils within its center that automatically force both sides of the device to pinch inward to a centralized space, and the tension can be released when one firmly grips the handle and applies a counter-pressure that will allow the spring to expand. Spring clamps are available in a great number of sizes and can substantiate varying degrees of tension, so the average workshop normally stocks several of them within its inventory.

Figure 1.8

A spring clamp is most commonly found within woodworking establishments to provide a firm grip while a glue or solvent attaches two or more pieces of timber together, but perhaps a better example for the novice user would be jumper cables that can be used to connect two vehicles' batteries when one has lost its charge. Each spring clamp is connected to the respective battery posts to ensure a stable grip that will allow the transfer of electricity, and after the task is completed, the handles can be squeezed to release them. The coil spring clamps for this particular application generate enough force to crush many types of plastic or timber, which is why a spring clamp set normally is designed for a very specific task.

Spring clamps are commonly used for a number of household projects and can be used for tasks such as holding an opened potato chip bag closed or securing a large piece of mechanical machinery, such as a table saw. The type of design is normally favored over other types of gripping devices because there are not any adjustments that have to be made in order to ensure that the proper force is applied; this makes them much quicker to secure in place and often less likely to fail. One downside to using a spring clamp is that it can be unintentionally knocked loose when several heavy items are being moved within the general area where it is being used, so whenever safety is an issue, a bar clamp or quick clamp might be a more sensible option.

1.2.8 Vise Grip:

Vise-Grip is a registered brand and may be classed as specially-designed pliers that are made to clamp the workpiece with a single squeeze of the tool by the user, eliminating the need to maintain a constant pressure on the pliers' handles. They're found in practically every toolbox, regardless of whether their owner is a woodworker, mechanic, blacksmith or sheet metal worker.

Figure 1.9

Regular pliers and most variations consist of two identical handles with jaws at their ends; the handles are connected by a nut that acts as a fulcrum. When the handles are squeezed together, the jaws press against each other, gripping a workpiece or anything else between them. Some pliers include cutting blades in the jaw mechanisms, facilitating wire cutting. Hand pressure must be maintained to keep the workpiece secure, however; if pressure is relaxed, the workpiece might slip, and if pressure is released, the pliers will lose their grip altogether.

Pliers are used today primarily for turning nuts and grasping items. Before the invention of vise-grip pliers, though, they were also used to hold workpieces when the use of a regular vise was impractical or impossible. Welding and riveting were just two of many such jobs.

Vise-grip pliers differ markedly from regular pliers. The two handles are not identical, and the thicker of the two is usually held uppermost in the user's hand. The distance between the jaws when in the "closed" position is regulated by a screw in the base of the thick handle. This is adjusted based on the size of the workpiece to be gripped; when properly adjusted and the jaws are squeezed onto the workpiece, the vise-grip pliers grip and hold fast without the need for continued pressure on the handles. The original design required the user to pull the handles apart to release the grip, but in 1957, an "easy release" lever was added to the narrow handle that required only a slight squeeze.

The basic design of the classic vise-grip pliers has barely changed since the introduction of the easy release lever in 1957. Different sizes and shapes are available for the many different applications they're suited for, but the underlying concept remains the same. It wasn't until the early 21st century, in fact, that changes were made to the vise-grip. In addition to coating the handles with a foam cushion, the release lever was upgraded to a fast release feature that allows users both to grip and release with a single hand.

1.3 Vises:

Two types of vise can be used, an engineering vise or a woodworking vise. It should be noted that there are two common spellings of this piece of machinery. In the Australia, when referring to a machine vice, the word can be spelt as vice or alternatively vise may be used, either is technically correct depending whether using English or American spelling and grammar.

1.3.1 Engineering Vise:

A machine vise is a device used to hold a work piece when operating a milling machine or a drill press. It is adjustable in many different ways, allowing the work piece to be manipulated into any angle or position required; this type of vise is crucial when a certain angle is required to be repeated on several pieces. The machinist can mount the work piece and adjust the vise to the desired angle and position and the machined finish will duplicate the prior pieces exactly.

Figure 1.10

The workpiece is inserted between the two jaws and the handle rotated to secure the workpiece. Soft thin metal shims can be inserted between the workpiece and the jaws to protect the surface of the workpiece.

1.3.2 Drill Press Vise:

A drill press vise is a device designed to secure a workpiece firmly enough between its jaws that it won't move at all when the drill bit is pressed into it. It's similar to other vises in that it uses a threaded rod to force two jaws together. Some drill press vises clamp to the table itself, while others have systems that use the miter-gauge slot to secure to the table. One notable drawback is that most drill press vises have jaw openings of no more than 150 – 180 mm; larger workpieces must be secured by other means.

Figure 1. 11

Most machine and woodworking shops have a drill press, a stationary power drill that drills holes with a much higher degree of accuracy than a hand drill. To increase its stability, it's usually built within a heavy cast-iron frame that sits on the floor or on a workbench. The workpiece is placed on the work table, and the operator turns a handle to press the rotating drill bit down into the workpiece. The drill bit cuts a hole in the workpiece to whatever depth the operator presses it. If the operator drills all the way through the workpiece, there's a hole in the worktable that accommodates the drill bit when it passes through the workpiece.

There are two ways to secure a workpiece firmly enough to prevent most movement. The first is to use clamps to secure the workpiece to the table, and the second is to use a drill press vise. Drill press clamps are preferable for larger or irregularly-shaped workpieces, but won't work well for thicker or tall pieces, such as when the core must be drilled out of a lamp base. Drill press vises are best suited for these pieces as well as for narrower workpieces that will fit within the relatively narrow space between the vise's jaws.

Figure 1.12 – Drill Press Clamps

A drill press vise is very well-suited for some forms of production work where multiple holes must be drilled. Once the location of the first hole is determined, the vise is set in place and tightened, and the hole is drilled. The vise is loosened and the workpiece is moved so that the next hole location is lined up under the drill bit. At this point, all that's necessary is to ensure that the drill bit is lined up properly and the vise is tightened again. The same concept holds true when drilling holes in multiple identical workpieces; once the drill press vise has been secured to the work table, the work can go quicker because the stationary jaw of the vise acts much like a fence.

1.3.2 Woodworking Vice:

A woodworking vise is a device used to secure pieces of wood for cutting, fashioning, or other types of woodworking. Most modern versions of the woodworking vise are made of metal, though others are made of timber to prevent damaging the workpiece being worked on when being compressed by the jaws of the vise. A woodworking vise will open and close to allow wood of different sizes to be fitted between the jaws of the vise; one jaw is fixed in place, while the other moves in and out on a screw-like system controlled by a turning arm.

Figure 1.13

The difference between a woodworking vise and other types of vises is subtle, but important: many vises feature jaws with teeth that hold pieces of material more effectively, but a woodworking vise does not feature these teeth. Instead, the jaws feature flat surfaces to avoid making indentations in timber when clamped. The surfaces of the jaws are often quite broad to distribute the clamping load onto a larger swath of the timber rather than in one centralized location, which can risk the likelihood of cracking or otherwise damaging the workpiece. Some metal woodworking vises feature blocks of timber within the jaws to further prevent the metal from damaging the timber.

Much of the process of woodworking is done indoors at a work bench, so a woodworking vise is often designed to mount to a work bench or other solid surface. In some cases, the fixed jaw side of the vise is actually part of the bench, and the moving jaw is set flush with the top of the bench itself. This allows the workpiece to be secured close to the surface of the woodworking bench for more stability and ease of use. Other vises are mounted to the top of the bench or the side of the bench with two jaws independent of the table itself.

Vises are not always mounted to tables or workbenches. Some handheld vises feature two jaws fixed to one or two screws operated by one or more handles, and the jaws can clamp down on one or more pieces of timber. Such clamps are usually used for lighter duty jobs, since they are less secure than vises that are mounted to a table. Handheld vises may be used, for example, to clamp two pieces of timber together during the gluing process to allow the glue to cure without the pieces of timber moving.

1.4 Jigs & Fixtures:

Some machining operations only require the job to be held in position in the chuck and turned with no other device being required to hold the job or to guide the tool on the machine. Alternatively, some operations require the tool to be guided by means of another device, while other jobs may be required to be held in position on the machine by means of another device. The device which guides the tool is called a jig and the device which holds the job in position is called a fixture.

Jigs and fixtures are special purpose tool which are used to facilitate production (machining, assembling and inspection operations), when work piece is based on the concept of interchangeability according to which every part will be produced within an established tolerance. Jigs and fixtures provide the means for the manufacturing of interchangeable parts since they establish a relation with predetermined to tolerance between the work and cutting tool; they eliminate the necessity of a special set up for each individual park. Therefore, a jig may be de-fined as a device which hold and position the work, locates or guides the cutting tool relative to the work piece and is not usually fixed to the table and are normally lightly in design and construction.

A fixture is a work holding device and position the work; but doesn't guide locate or position the cutting tool; the setting of the tool is done by machine adjustment and a setting blocker using slip gauges. A fixture is held or clamped to the machine table; they are generally heavier in design and construction. Jigs are used on drilling, reaming, tapping and counter boring operations while fixtures are used in connection with turning, milling, grinding, shaping, planning and boring operations.

The use of jig and fixture makes possible more rapid and more accurate manufacturing at a reduction of cost.

1.4.1 Jigs:

The most-common jigs are drill and boring jigs, and are fundamentally the same. The difference lies in the size, type, and placement of the drill bushings. Boring jigs usually have larger bushings; the bushings may also have internal oil grooves to keep the boring bar lubricated. Often, boring jigs use more than one bushing to support the boring bar throughout the machining cycle.

In the workshop, drill jigs are the most-widely used form of jig. Drill jigs are used for drilling, tapping, reaming, chamfering, counter boring, countersinking, and similar operations. Occasionally, drill jigs are used to perform assembly work; in these situations, the bushings guide pins, dowels, or other assembly elements.

Jigs are further identified by their basic construction. The two common forms of jigs are open and closed. Open jigs carry out operations on only one, or sometimes two sides of a work piece. Closed jigs, on the other hand, operate on two or more sides. The most-common open jigs are template jigs, plate jigs, table jigs, sandwich jigs, and angle plate jigs. Typical examples of closed jigs include box jigs, channel jigs, and leaf jigs. Other forms of jigs rely more on the application of the tool than on their construction for their identity and include indexing jigs, trunnion jigs, and multi-station jigs.

Specialized industry applications have led to the development of specialized drill jigs; for example, the need to drill precisely located rivet holes in aircraft fuselages and wings led to the design of large jigs, with bushings and liners installed, contoured to the surface of the aircraft. A portable air-feed drill with a bushing attached to its nose is inserted through the liner in the jig and drilling is accomplished in each location.

Types Of Drilling Jigs include template jigs, plate type jigs, open type jig, channel jig, leaf Jig and the box jig.

8.4.1.1 Template Jig:

The template jig is the simplest type of jig and is simply a plate made to the shape and size of the work piece with the require number of holes. The template jig is placed on the work piece and the hole will be made by the drill which will be guided through the holes in the template plate should be hardened to avoid its frequent replacement; this type of jig is suitable if only a few part are to be made.

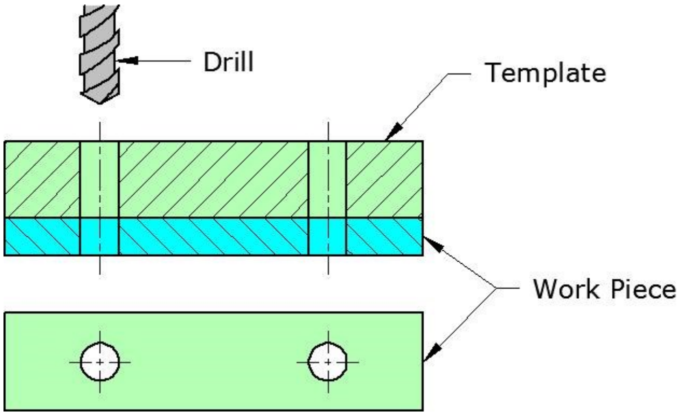

Figure 1.14 – Template Jig

1.4.1.2 Plate Type Jig:

The plate type jig is an improvement of the template type of jig. In place of simple holes, drill bushes are provided in the plate to guide the drill. The work piece can be clamped to the plate and holes can be drilled. The plate jig is utilized to drill holes in large parts, maintaining accurate spacing with each other.

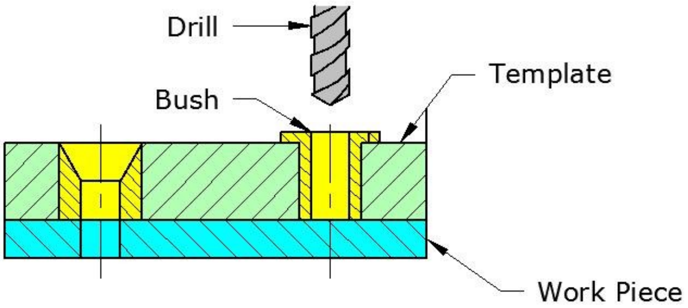

Figure 1.15 - Plate Type Jig

1.4.1.3 Open Type Jig:

In this jig the top of the jig is open; the work piece is placed on the top.

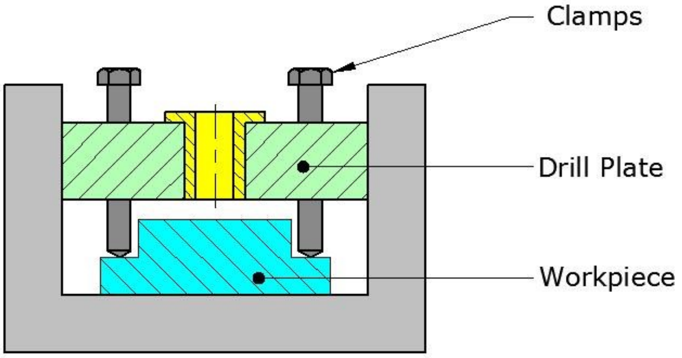

Figure 1.16 – Open Type Jig

1.4.1.4 Channel Jig;

The channel jig is a simple type of jig having channel like cross section. The component is fitted within the channel is located and clamped by locating the knob. The tool is guided through the drill bush.

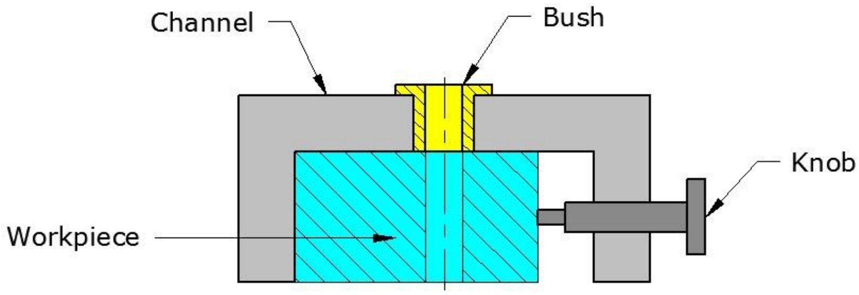

Figure 1.17 – Channel Jig

1.4.1.5 Leaf Jig:

The leaf jig is similar to the open type jig in which the top plate is arrange to swing about a fulcrum point so that it completely clears the jig for easy loading and unloading of the work piece. The drill bushes are fitted into the plates which are also known as leaf, latch or lid.

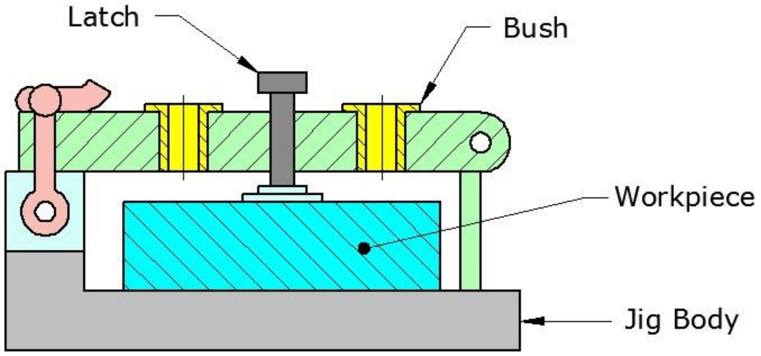

Figure 1.18 – Leaf Jig

1.4.1.6 Box Type Jig:

When the holes are to be drilled in more than one plane (surfaces) on the work piece, the jig has to be provided with equivalent number of bush plates. For positioning the jig on the machine table, the feet have to be provided opposite each drilling bush plate. One side of the jig will be provided with a swinging leaf for loading and unloading the work piece; such a jig would take the form of a box with the jig being as light as possible.

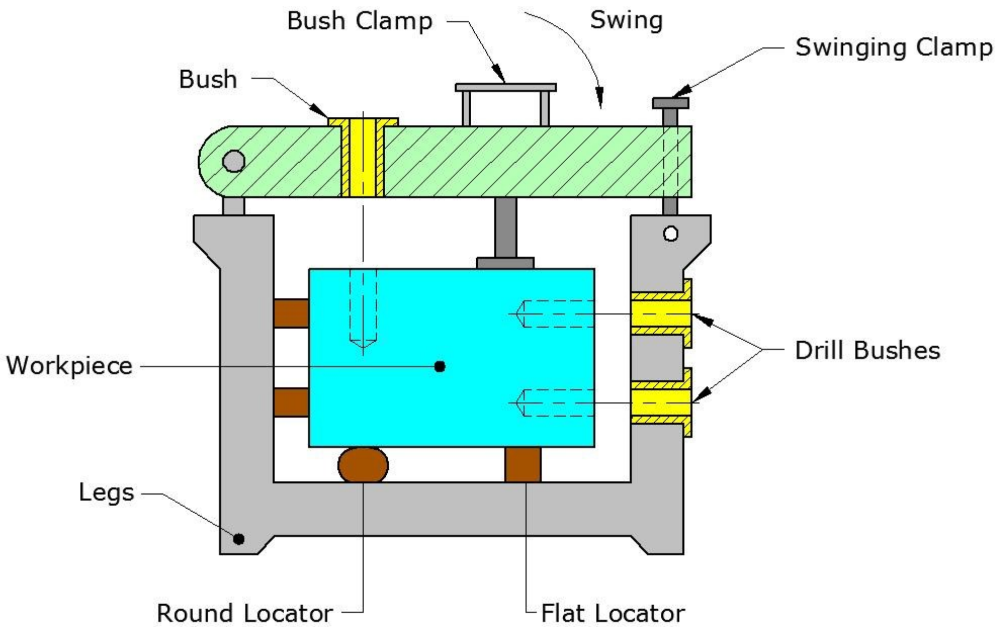

Figure 1.19 – Box Type Jig

1.4.2 Fixtures:

Fixtures have a much-wider scope of application than jigs; the work holders are designed for applications where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, centre finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixtures, and grinding fixtures. Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of a tool to a workpiece.

Fixtures are most often identified by the machine tool where they are used. Examples include mill fixtures or lathe fixtures, but the function of the fixture can also identify a fixture type as can the basic construction of the tool. Although a tool can be called simply a mill fixture, it could also be further defined as a straddle-milling, plate-type mill fixture. Moreover, a lathe fixture could also be defined as a radius-turning, angle-plate lathe fixture. The tool designer usually decides the specific identification of these tools.

1.4.1.1 Base:

A heavy base is the most important element of a milling fixture. The base is a plate with a flat and smooth under face from which the complete fixture is built up from the plate. Keys are provided on the under face of the plate which are used for easy and accurate aligning of the fixture on the milling machine table by inserting the keys into one of the T-slots in the table. The keys are usually set in keyways on the under face of the plate and are held in place by a socket head cap screw for end key. The fixture is fastened to the machine table with the help of two T-bolts engaging in the T-slots of the work table.

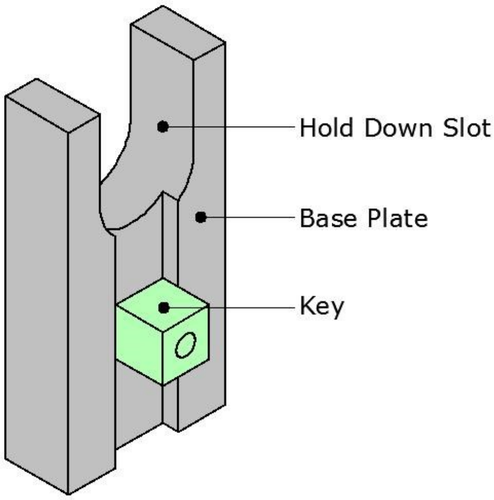

Figure 1.20 - Base

1.4.2.2 Setting Blocks:

After the fixture has been securely clamped to the machine table, the work piece is correctly located in the fixture and has to be set in correct relationship to the cutters and is achieved by the use of setting blocks and feeler gauges. The setting blocks are fitted to the fixture. Feeler gauges are placed between the cutter and reference planes on the setting block so that the correct depth of the cut and correct lateral setting is obtained. The block is made of hardened steel and with the reference planes (feeler surfaces) grooved. In the correct setting, the cutter should clear the feeler surfaces by at least 0.8 mm to avoid any damage to the block when the machine table is moved back to unload the fixture. The thickness of the feeler gauge to be used should be stamped on the fixture base near the setting block.

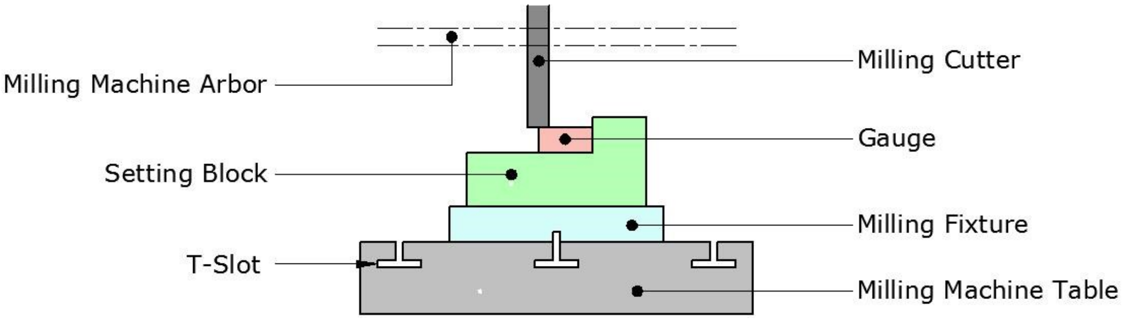

Figure 1.21 – Setting Block

1.4.2.4 Lathe (Turning) Fixtures:

The standard work holding devices or fixtures for lathe are:

- Three and four jaw chucks
- Collets
- Face Plate
- Mandrels
- Milling Vice

If the job can be held easily and quickly in the above mentioned standard devices, then there is no need for special work holding devices. However many jobs particularly casting and forging, because of their shapes cannot be conveniently held by any of the standard devices; it then becomes necessary to build a special work holding device for the job. Such a device is called lathe fixture.

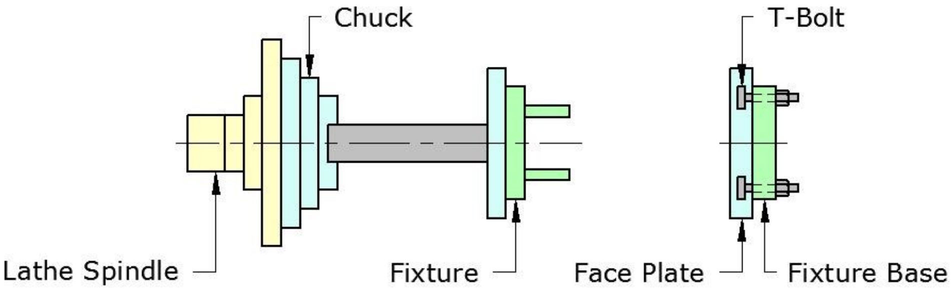

Figure 1.22 – Lathe Fixtures

A lathe fixture consists of a base, location and clamping devices. A lathe fixture can be fixed to the lathe either by holding in the chuck jaws or fixing to a face plate.

The basic design principles for turning or lathe fixtures are:

- To avoid vibration while revolving, the fixture should be accurately balanced.
- There should be no projections of the fixture which may causes injury to the operator.
- The fixture should be rigid and overhang should be kept minimum possible so that there
- Clamps used to fix the fixture to the lathe should be designed properly so that they don't get loosed by centrifugal force.
- The fixture should be as light weight as possible since it is rotating.
- The fixture must be small enough so that it can be mounted and revolved without hitting the bed of the lathe.

1.4.2.5 Grinding Fixtures:

The work holding devices for grinding operations will depend upon the type of the grinding operation and the machine used.

<u>Fixture for External Grinding:</u>

A mandrel is the most common fixture used for grinding external surface of the work piece; a mandrel is hardened and is held between centres of a machine. The mandrel is a spindle or an axle used to secure or support material being machined or milled The mandrel is used for internal chucking or round work piece with bores. The work piece is located and held on the mandrel with the help of the bore so that the external surface may be machined truly concentric to the bore. The various types of mandrel are:

Taper Mandrel:
In this type of mandrel, the outer chucking surface is given a slender taper of about 0.5mm per meter.

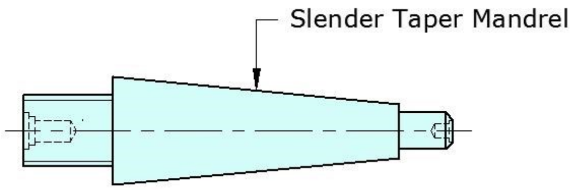

Figure 1.23 – Grinding Fixtures

Straight Mandrel:
It differs from the taper mandrel in that it has straight or un-tapered chucking surface.

Combination taper and straight:
In this type of mandrel, a portion of the outer diameter of the mandrel is straight and the rest of the is tapered.

<u>Fixtures for Internal Grinding:</u>
For grinding internal surfaces of simple circular work piece, the chuck may be used as a standard work holding device. It required special jaws can be provided for the chuck. However, for many components special fixtures may have to be made which are designed on same lines, as the lathe fixtures.

<u>Fixtures for Surface Grinding:</u>
The work piece can be held for machining on a surface grinder in the following ways

- It may be clamped directly to the machine table or to an angle plate and so on,
- It may be held in a vice.
- The work piece may be held by means of a magnetic chuck or a vacuum chuck. Here the
- The work piece may be held in a special fixture.

Skill Practice Exercises:

Skill Practice Exercise MEM18002-SP-0101
Select and clamp a range of various objects and materials as selected by the teachers, mentor, instructor or supervisor.