



ثانوية التكنولوجيا التطبيقية
Applied Technology High School

Mechanical Workshop

Module 3: Marking out and Hand Tools

PREPARED BY

Academic Services

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Module Objectives

After the completion of this module, student should be able to:

1. Identify different marking out tools and their usage.
2. Select the appropriate tool required for marking out.
3. Mark out work-pieces according to the dimensions given in engineering drawings.
4. Distinguish the different hand tools and their uses.
5. Select the correct tool for the task.
6. State the care and safe use of hand tools.

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3.1. Introduction to marking out

Marking out is the process of transferring a design, layout or dimensions from the drawing to a work-piece, and it is considered as the first step in the manufacturing process.

3.2. Common marking out tools

The common tools used for marking out are as follows:

1. Scriber
2. Marking blue
3. Punch
4. Engineer's square
5. Surface plate
6. Surface gauge
7. Angle plate
8. Vee block
9. Spring dividers
10. Ball peen hammer

1. Scriber

Scribers are used in metalworking to mark lines on work pieces prior to manufacturing. They are used instead of pencils as the marks from pencils can rub off easily. Scribers consist of a rod of steel that has been sharpened to a point at one or both ends and they are used to draw shallow scratches on the surfaces of the work pieces.

There are two types of scribers:

- a) One-end scriber as shown in Fig. 3.2 a.
- b) Double-end scriber as shown in Fig. 3.2 b

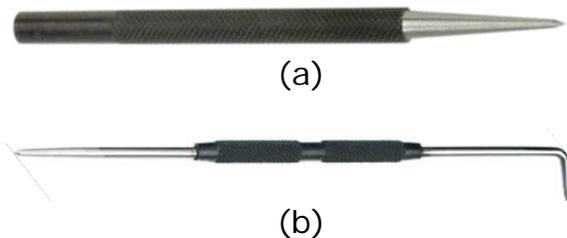


Fig 3.2(a) One-end scriber
(b) Double-end scriber.

2. Marking blue.

Marking blue is a dye used in metalworking to aid in marking out. See Fig. 3.1. It is used to paint a metal object with a very thin layer of dye that can be scratched off using a scribers to show the bright metal underneath. The advantages of using the marking blue are:

- The existing scratches are covered with the dye.
- The new lines have a contrasting background.

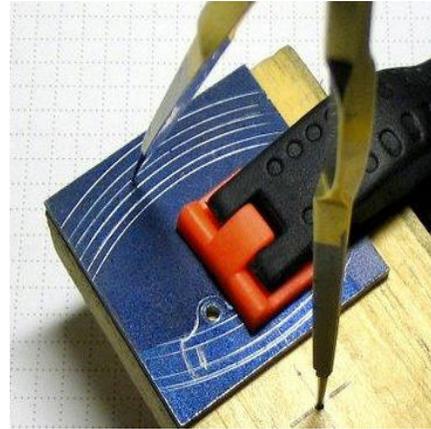


Fig. 3.1: Marking blue layout dye

3. Punch

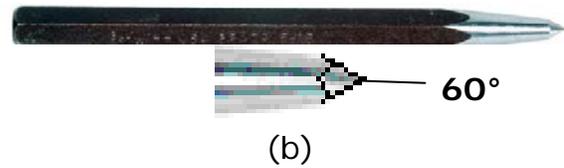
The punch is a hard metal rod with a shaped tip at one end and a rounded butt at the other end, which is usually struck by a hammer. The most commonly used ones for marking out are:

- 3-1 Center punch:** It is used as an aid to drilling operations. The center punch forms an indent in which the tip of the drill fits. A center punch has a point angle of 90° as shown in Fig. 3.3a.



(a)

3-2 Prick punch: It is used to produce a smaller indentation than a center punch, which acts as a useful datum (standard) point in layout operations. A prick punch has a point angle of 60° as shown in Fig.3.3b.



3-3 Letter stamps or number stamps: These are used to print a letter or number into a work piece. See Fig.3.3c.

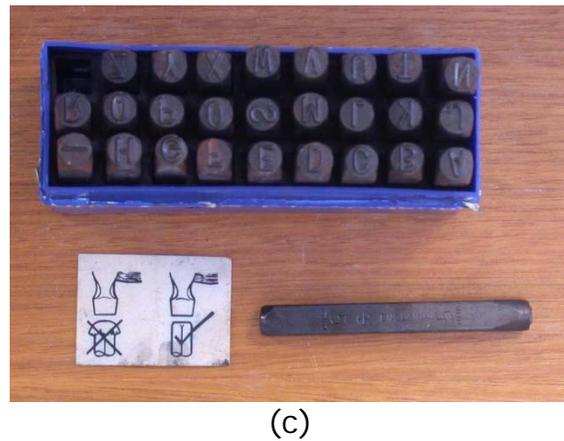


Fig 3.3:
(a): Centre punch
(b) Prick punch
(c) Letter stamp set

4. Engineer's square

The engineer's square shown in Fig. 3.4 is used for checking the straightness of a work piece. It can also be used for marking perpendicular lines onto a work piece.



Fig 3.4: Engineer's square.

5. Surface plate

The surface plate is shown in Fig 3.5. It has a high degree of flatness. The flat surface is being used as a datum surface for marking out and for measuring purposes. It is also called surface table if it can stand on the floor.



Fig 3.5: Surface plate

5.1 Maintaining the surface plate

You should

1. Keep the surface in a good condition.
2. Keep the surface lightly oiled to prevent corrosion.
3. Take care when placing marking out tools on the surface.

You should not

1. Place anything on the surface that would damage it.
2. Drop tools on the surface.
3. Hammer on the surface.

6. Surface gauge

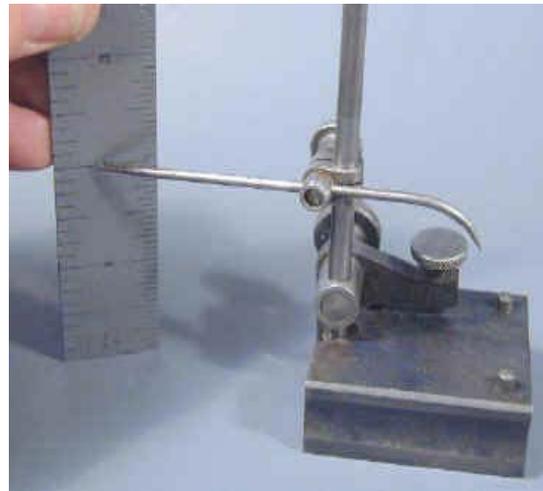
A surface gauge shown in Fig 3.6 is used on surface plates for scribing lines on work pieces and checking parallel surfaces and heights as shown in Fig 3.6b.



(a)

The surface gauge is used also in finding the center of a cylinder and determining whether a plane's surface is truly horizontal. The link below shows the function of the service gauge and how it could be used to mark round workpieces.

<http://www.technologystudent.com/equip1/surgau1.htm>



(b)

Fig.3.6:
(a) Service gauge
(b) Checking parallel surfaces and heights

7. Angle plate

The angle plate shown in Fig 3.7 is used to assist in holding the work piece perpendicular to the table. The angle plate is provided with holes and slots to enable the secure attachment, clamping and adjusting of work pieces.

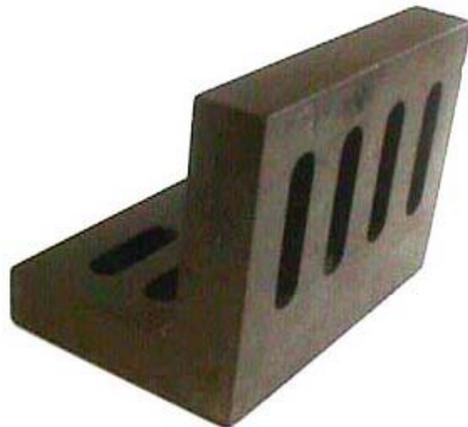


Fig 3.7: Angle plate

8. Vee block

The Vee blocks shown in Fig 3.8 are generally used for holding circular work pieces for marking out or machining.

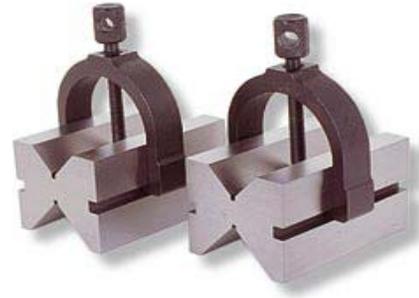


Fig 3.8: Vee blocks set

9. Spring dividers

The spring divider shown in Fig 3.9a is used for scribing arcs or circles. Figure 3.9 b shows a circle that was marked by a spring divider onto a work piece.

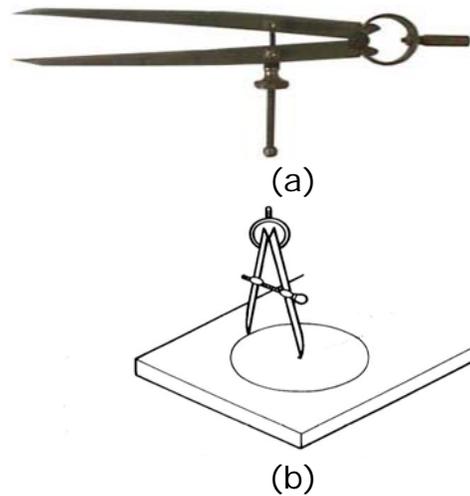


Fig. 3.9:
(a) Spring dividers
(b) Spring Dividers in use.

10. Ball peen hammer

The ball-peen hammer is shown in Fig.3.10. The crowned, or rounded, edge (hemispherical head) works metal smoothly without marking it. The other end of the hammer can be used to strike punches and chisels



Fig 3.10: Ball peen hammer

3.3. Practical Task

3.3.1. Objective

The objective of this task is to mark out a certain work piece in order to produce a drill gauge according to the given dimensions (see the drill gauge project document).

3.3.2. Required tools

SR	Tool	SR	Tool
1	Steel ruler	6	Center punch
2	Surface plate	7	Spring dividers
3	Scriber	8	Ball peen hammer
4	Surface gauge	9	Vernier caliper
5	Prick punch	10	Angle plate

3.3.3. Procedure

1. Marking out the hack sawing and filing lines. See Fig. 3.11.

- a) Locate the reference plane.
- b) Use the surface plate, surface gauge and steel ruler to set the required height as shown in Fig.3.6b.
- c) Use the angle plate, surface gauge to scribe the first line and repeat the same procedure to scribe the other three lines.
- d) Punch the scribed lines by using the prick punch.

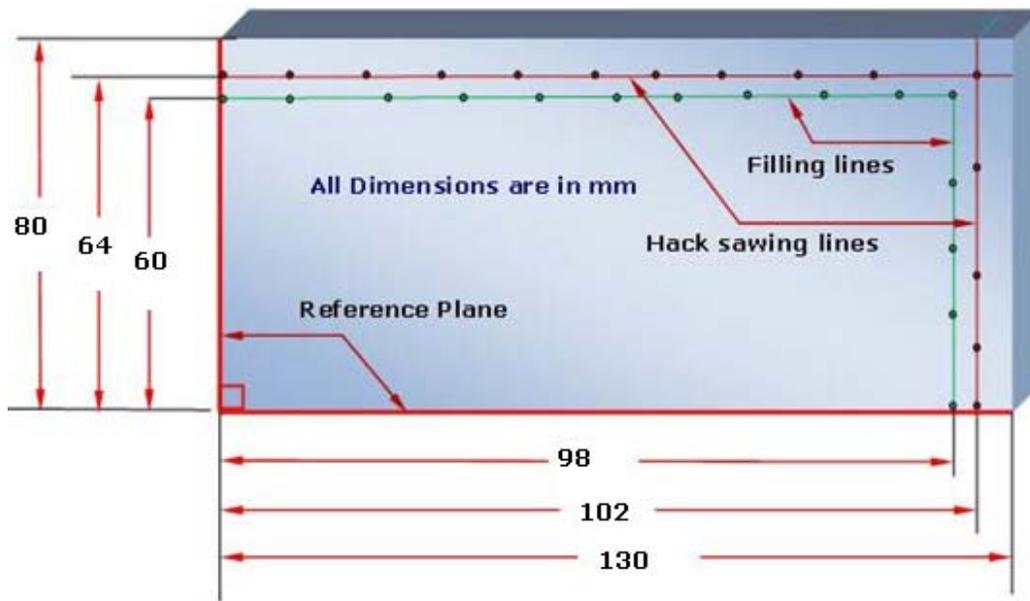


Fig 3.11: The filling and hack sawing lines

2. Marking out the Fillets

This practical task will be achieved after cutting and filing to the part size as shown in Fig. 3.11

- Locate and scribe centers for fillets.
- Punch the centers by using a prick punch.
- Scribe the fillets by using spring dividers.

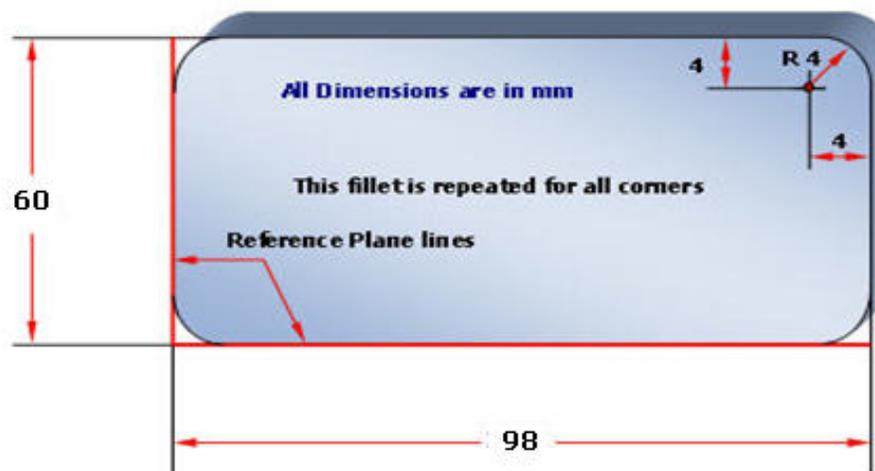


Fig 3.12: Shows the fillets arcs

3. Marking out for drilling

Fig. 3.13 shows all the holes centers and other required dimensions.

Note: This task could be done after finishing cutting the shape shown in Fig 3.12.

- a) Locate and scribe lines for holes' centers using the same procedure used for scribing the hack sawing and filing lines.
- b) Punch the intersection of the lines by using a center punch.

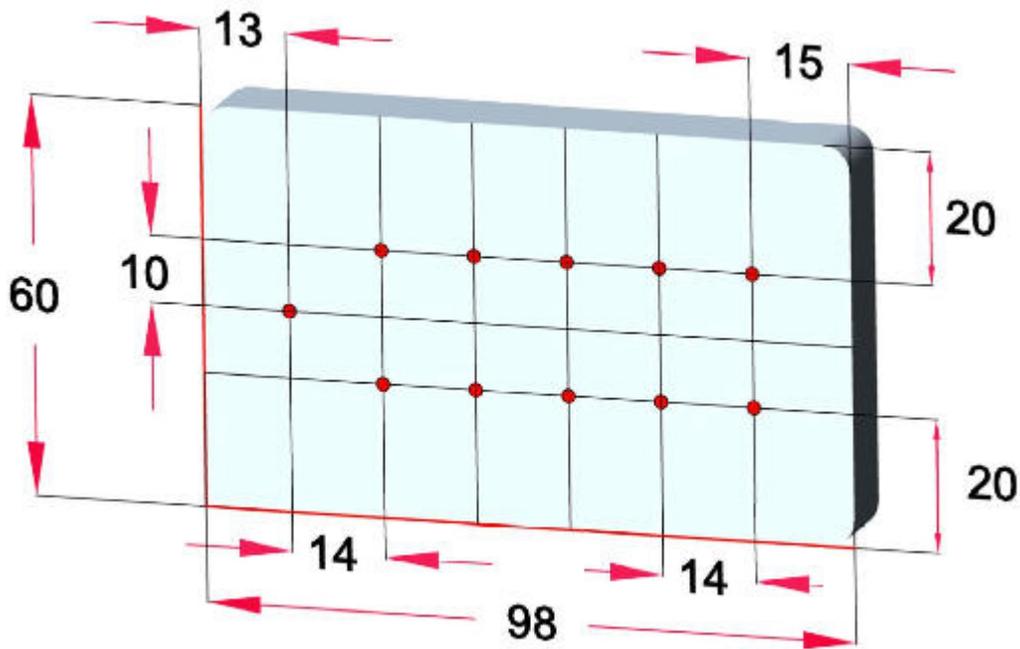


Fig 3.13: The lines for holes' centers.

3.4 Introduction to hand tools

The mechanical engineer very often have to use a number of various hand tools in the course of his duties as a fitter or machinist, many of these tools are common to both.

3.4.1 Spanners/Wrenches

The two words “**spanner**” (in British English) and “**wrench**” (in American English) refer to the same tool. Spanners/Wrenches are different in shape to provide ease of operation under certain conditions. They are manufactured from high tensile or alloy steel. The sizes of metric spanners are identified by the distance across flats of a nut or bolt head as shown in Fig 3.14.

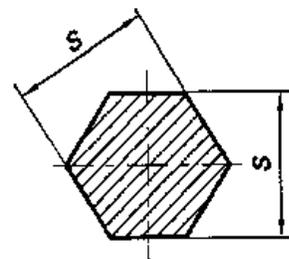


Fig. 3.14: Distance across flats (s)

3.4.1.1 Spanner Types

1- Open-ended spanners

The ends of this type of spanners are generally oriented at an angle of 15° to the longitudinal axis of the handle to allow greater range of movement in enclosed spaces. Fig. 3.15 shows open ended spanners of different sizes.



Fig. 3.15: Open-ended spanners

2- Ring spanners

Ring spanners or box-end wrenches are recommended to be used when a better grip is needed and when the spanner swing is restricted. Fig. 3.16 shows ring spanners of different sizes.



Fig. 3.17: Combination spanner

3- Combination spanners

This type comes with an open end from one side and a ring end from the other side and usually both ends are having the same size as shown in Fig. 3.17.

4- Adjustable spanners

Adjustable spanners are spanners that have a moving jaw to fit different bolt/nut sizes as shown in Fig. 3.18.



Fig. 3.18: Adjustable spanner

3.4.1.2 Accidents Prevention

When working with spanners, accidents are usually caused by the slipping of a spanner from a nut or bolt head. In order to avoid these accidents, the following recommendations should be considered

- Use the correct size spanner for the job.
- Pull towards the body whenever possible.
- Do not obtain extra leverage by using pieces of pipe.
- Use a steady pull not a jerking action.
- Do not hit a spanner with a hammer.
- Make sure your hands will not strike any obstructions.

3.4.2 Allen keys

They are referred to as Allen keys and sometimes Allen wrenches (Fig. 3.19a). Allen keys are used on grub screws (Fig. 3.19b) and socket head cap screws (Fig. 3.19c). The size of Allen keys is almost like spanners measured across flats.

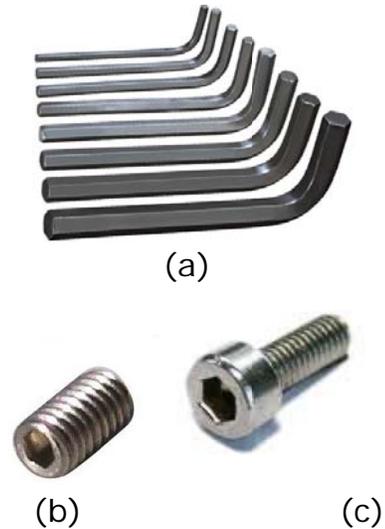


Fig. 3.19:
(a) Allen keys
(b) Grub screw
(c) Socket head cap screw

3.4.3 Screwdrivers

Screwdrivers (Fig. 3.20a) are made in different lengths and designs, the two most common are:

1. Flathead/slotted
2. Crosshead/Phillips

The flathead (Fig. 3.20b) is identified by its length and in some cases by the blade width. The crosshead (Fig. 3.20c) screwdriver is identified by its point size. Always use the correct size screwdriver for the screw head; the blade should fit the width of the screw head.

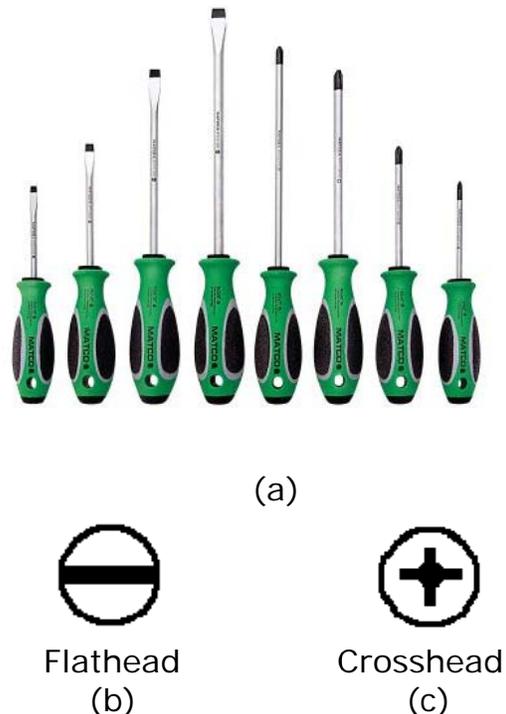


Fig. 3.20:
(a) Set of screwdrivers.
(b) Flathead (slotted)
(c) Crosshead (Phillips)

3.4.4 Pliers

Pliers are a hand tool used to hold objects firmly, or for cutting and bending tough materials such as wires. There are different types such as flat nose pliers, long nose pliers, combination pliers and circlip pliers. These types are designed to deal with different types of jobs.

1- Long nose pliers

Long nose pliers (Fig. 3.22) are both cutting and gripping pliers used by electricians and other tradesmen to bend, re-position and cut wire.



Fig. 3.22: Long nose pliers

2- Combination pliers

These pliers (Fig. 3.23) incorporate side cutters, joint cutters and pipe grip.



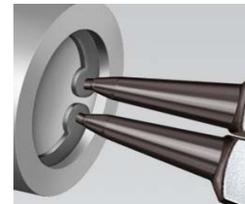
Fig. 3.23: Combination pliers

3- Circlip pliers

Circlips are retaining devices (Fig. 3.24). They are fitted inside a groove on bores and shafts. The internal circlip (Fig. 3.24 a) has to be squeezed to be removed and the external circlip (Fig. 3.24 b) which is fitted onto a shaft has to be opened out to be removed. The nose is either straight or bent depending on the type of job



(a)



(b)



(c)



(d)

Fig.3.24:

(a) External circlip

(b) internal circlip

(c) Bent nose external circlip

(d) Straight external circlip

3.4.5 Pipe wrench

A pipe wrench is designed to tighten its grip on the part being rotated. It has serrated jaws that leave marks on the part and so it might damage the surface of the part. Accordingly, pipe wrenches must not be used to loosen a nut, unless the nut is to be replaced. Fig. 3.26 shows a pipe wrench.



Fig. 3.26: Pipe wrench

Worksheet

Solve the following questions.

1. Choose the correct answer.

1. Which tool of the following is used to scratch lines on metal?

A



B



C



D



2. How can scratches on metal be made to appear more clearly?

A By using pen

B By using chalk

C By covering a metal with marking blue

D By using pencil

3. How is the pivoting leg of a pair of dividers stopped from sliding over the surface of metal?

A By using scriber

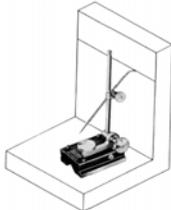
B By using prick punch

C By using height gauge

D By using caliper

2. Match the following.

a. Match the marking out tools in column B with their correct functions in column A, Write your answer in the box below?

Column A		Column B	
1	Is used for checking the straightness of a work piece.	A	
2	Is used to scratch lines	B	
3	Is used for making indents that position the drill points and stop them slipping	C	
4	Is used for supporting or setting up work vertically	D	
5	Is used for scratching lines parallel to a surface	E	

Column A	1	2	3	4	5
Column B					

b. Match the hand tools in column B with their correct names in column A, Write your answer in the box below?

Column A		Column B	
1	Combination pliers	A	
2	Adjustable spanner	B	
3	Allen key	C	
4	Crosshead screwdriver	D	
5	Open-ended spanner	E	
6	Ring spanner	F	
7	Pipe wrench	G	
8	Flathead screwdriver	H	

Column A	1	2	3	4	5	6	7	8
Column B								