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INSTITUTE OF APPLIED TECHNOLOGY

Mechanical Workshop

Module 3: Marking out and Hand Tools

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Module 3: Marking out and Hand Tools

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 workpieces according to the dimensions given in engineering drawings.
4. Identify the different hand tools and their uses.
5. Identify and 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 plan to a workpiece, 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. Marking blue
2. Scriber
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

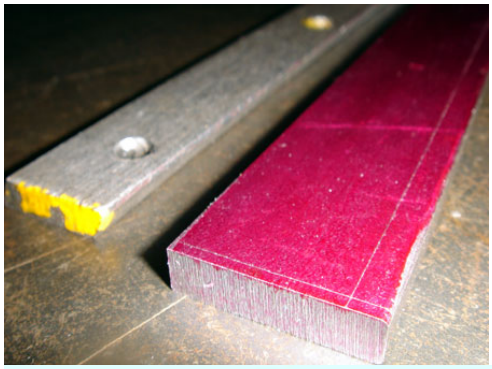
1. Marking blue.

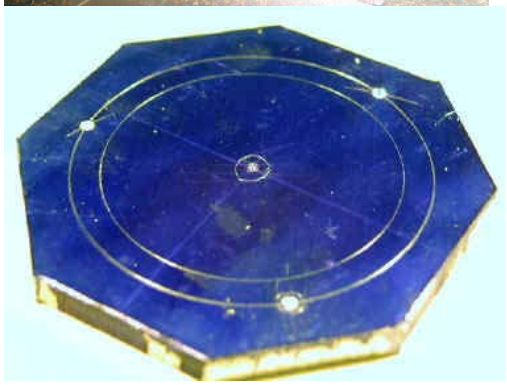
Marking blue is a dye used in metalworking to aid in marking out. See Fig. 3.1a. It is used to paint a metal object with a very thin layer of dye that can be scratched off using a scriber to show the bright metal underneath as shown in Fig. 3.1b.

The advantages of using the marking blue are:

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

(a)





(b)

Fig. 3.1: (a) Marking blue layout dye. (b) Using of marking blue for marking out.

2. Scriber

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

There are two types of scribers:

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

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

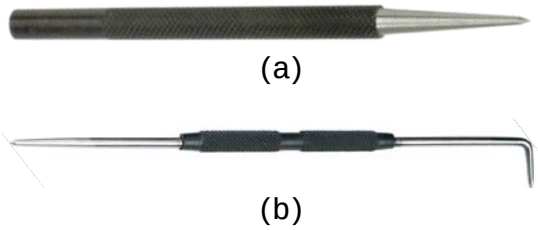


Fig 3.2: (a) One-end scriber (b) Double-end scriber.

3. Punch

A punch is a hard metal rod with a shaped tip at one end and a rounded butt at the other end that is usually struck by a hammer.

There are many types of punches, and the most commonly used ones for marking out are:

A) Center punch: It is used as an aid to drilling operations. A center punch forms an indent in which the tip of the drill will fit. A center punch has a point angle of 90° as shown in Fig. 3.3a.

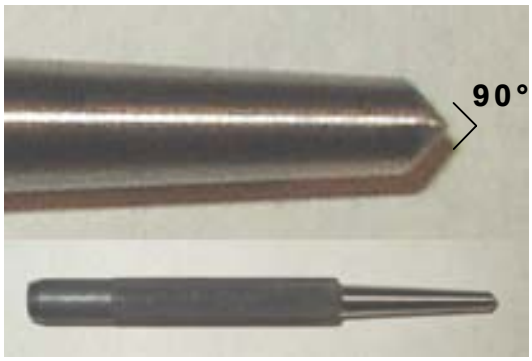


Fig 3.3a: Center punch

B) Prick punch: It is used for layout. A prick punch produces a smaller indentation than a center punch, which acts as a useful datum point in layout operations. A prick punch has a point angle of 60° as shown in Fig.3.3b.

C) Letter stamps or number stamps: These are used to print a letter or number into a workpiece. See Fig.3.3c.

(b)

(c)

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

4.Engineer's square

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

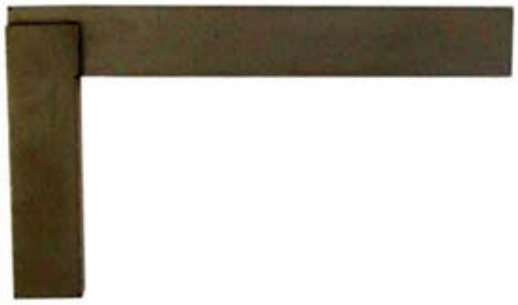


Fig 3.4: Engineer's square.

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.

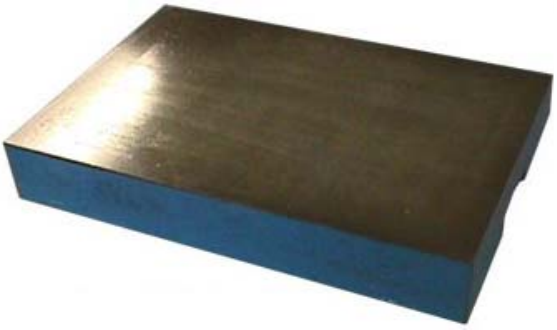


Fig 3.5: Surface plate

5.1 Care to the surface plate

YOU MUST

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.

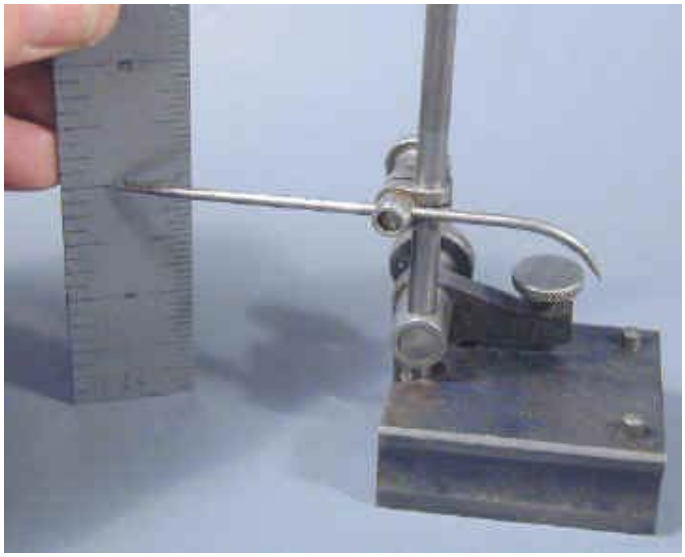
YOU DO NOT

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)



(b)

Fig 3.6: (a)Surface gauge (b) setting the height of the surface gauge.

7. Angle plate

The angle plate shown in Fig 3.7 is used to assist in holding the workpiece perpendicular to the table. The angle plate is provided with holes and slots to enable the secure attachment or clamping of workpieces.

Fig 3.7: Angle plate

8. Vee block

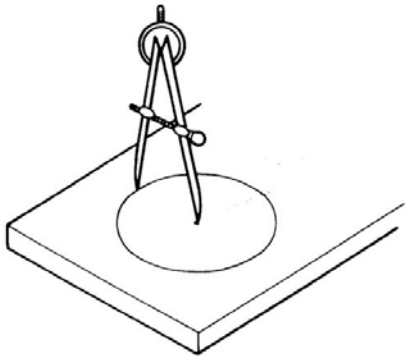
The Vee blocks shown in Fig 3.8 are generally used for holding circular workpieces for marking out or machining.

Fig 3.8: Vee blocks set

9. Spring dividers

The spring dividers shown in Fig 3.9a are used for scribing arcs and circles as shown in Fig. 3.9b or marking off lengths onto a workpiece.

(a)



(b)

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:

To mark out the workpiece to produce a drill gauge according to the dimensions given (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 filling 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.

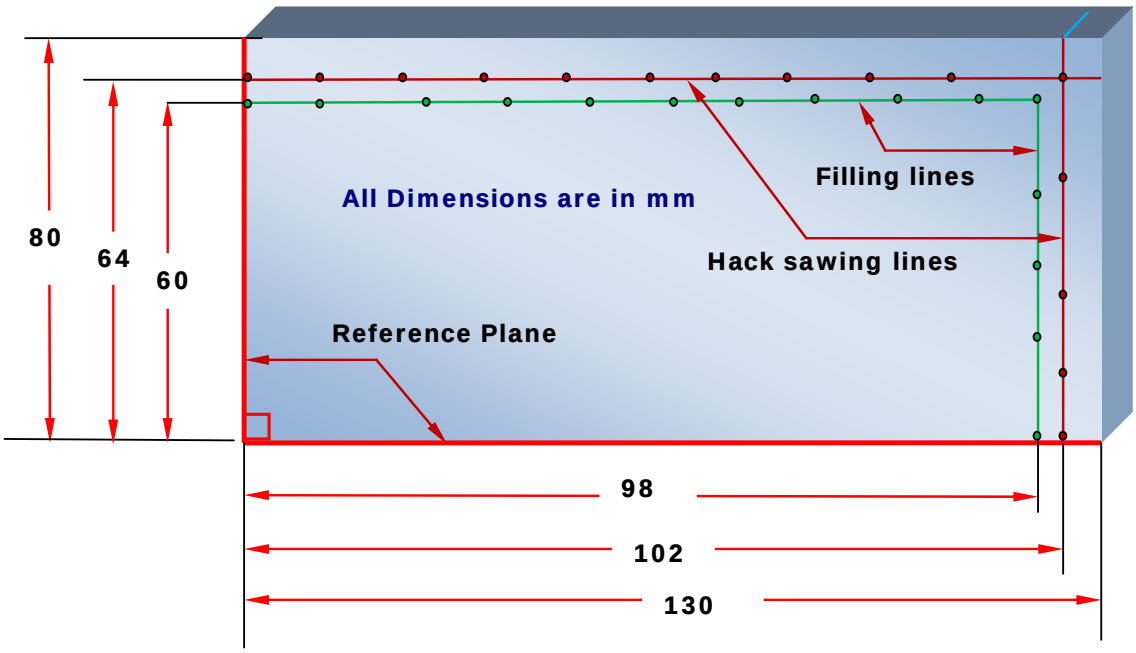


Fig 3.11: The filling and hack sawing lines.

2. Marking out the Fillets. See Fig.3.12.

A) Locate and scribe centers for fillets.

B) Punch the centers by using a prick punch.

C) Scribe the fillets by using spring dividers.

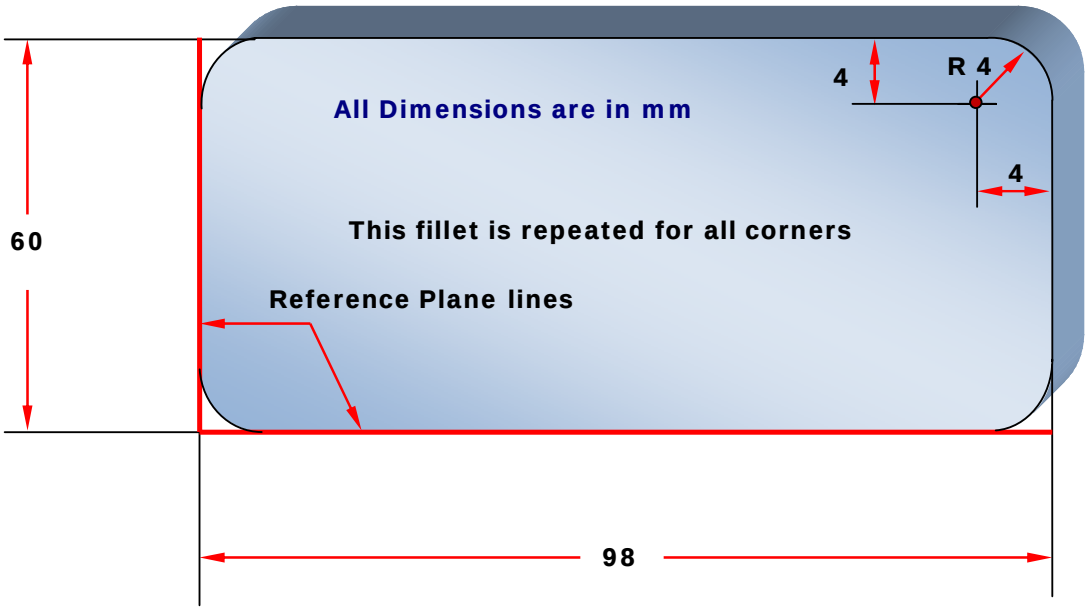


Fig 3.12: Shows the fillets arcs

3. Marking out for drilling. See Fig.3.13.

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.

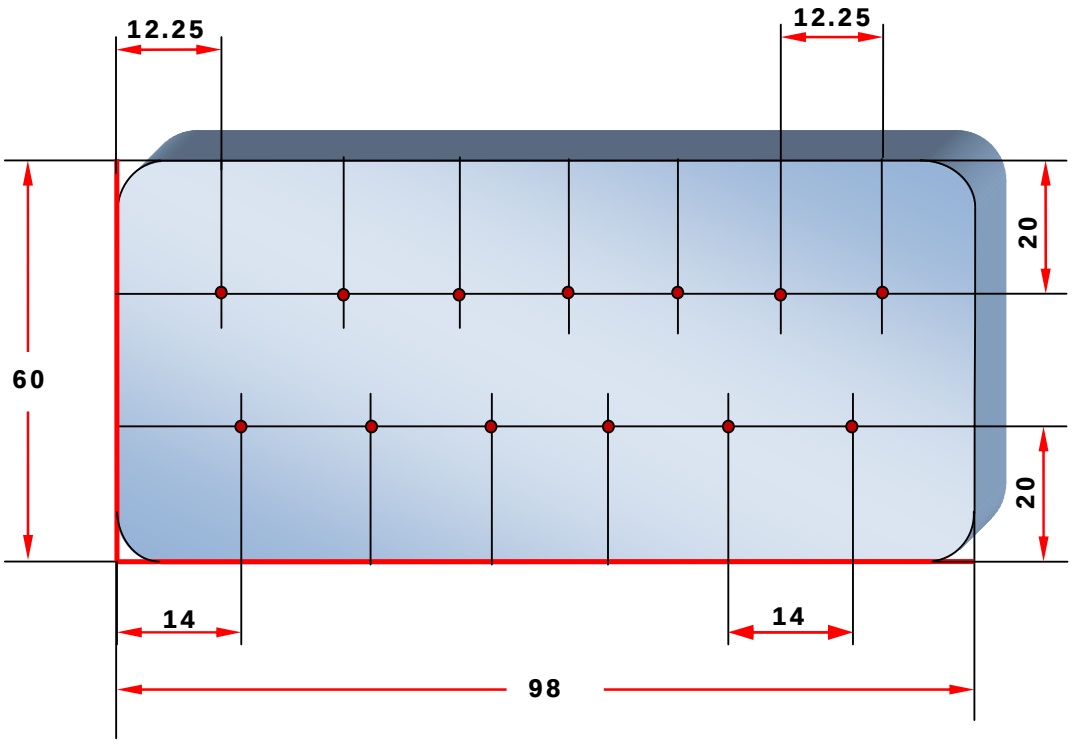


Fig 3.13: The lines for holes' centers.

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

In British English “spanner” and in American English “wrench” describe 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.

S= 24 mm

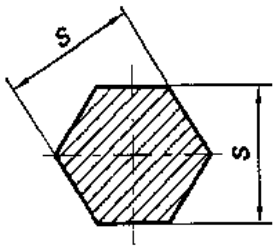


Fig. 3.14: Distance across flats (s)

3.4.1.1 Spanner Types

1- Open-ended spanners

The ends of this type of spanners are generally oriented at an angle of 15º 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. 3.16: Ring spanners

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. Fig. 3.17 shows a combination spanner.

Fig. 3.17: Combination spanner

4- Adjustable spanners

Adjustable spanners are spanners that have a moving jaw to fit different bolt/nut sizes. Fig. 3.18 shows an adjustable spanner.

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 and in order to avoid that the following should be taken into consideration:

- 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 socket head cap screws (Fig. 3.19c) and grub screws (Fig. 3.19b). The size of Allen keys is measured across flats.

(a)

(b) (c)

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. 3.20b) 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.

(a)

Flathead Crosshead

(b)

Fig. 3.20: (a) Different types of screwdrivers. (b) Flathead and Crosshead.

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- Flat nose pliers

These are used to hold pins and small objects when working in confined spaces. Fig. 3.21 shows a flat nose pliers.

Fig. 3.21: Flat nose pliers.

2- 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.

3- Combination pliers

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

Fig. 3.23: Combination pliers

4- 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. Fig. 3.25 shows internal and external circlip pliers. The nose is either straight or bent depending on the type of job.

(a) (b)

Fig.3.24: (a) Internal circlip
(b) External circlip

(a) (b) (c) (d)

Fig. 3.25: (a) Straight internal circlip pliers. (b) Bent nose external circlip pliers. (c) Bent nose internal circlip pliers. (d) Straight external circlip pliers.

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

Student's notes

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

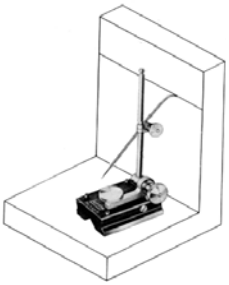
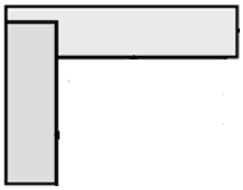
   C By using height gauge

   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	1	2	3	4	5
Column B					

Column A	**Column B**
1) Is used for checking the straightness of a workpiece.	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) 

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

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

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)