

# DIESEL MECHANIC



MINING QUALIFICATIONS AUTHORITY

## CODE: MPD

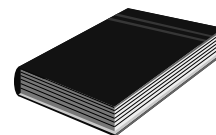
# PLAN A DRILLING WORKPIECE

## INDEX

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## SOURCE REFERENCES



Training video : Use Hand Tools Part 2

## OBJECTIVE

You will be learning towards the outcome “Plan a drilling workpiece”. Whilst learning towards the outcome you will be required to achieve the following:

- Mark off a workpiece for drilling.

On completion of this module, the learner must be able to:

- Use marking off tools to mark off a piece of flat bar for drilling.
- Mark off a circular flange according to drawing specifications, and prepare it for drilling.

During this process you must adhere to certain specified requirements as listed in the Module.

## ASSESSMENT AND EVALUATION CRITERIA

You will be assessed, when you are confident that you may achieve the outcomes as listed, to determine your competence as measured against the required criteria. This assessment will be in line with accepted best practices regarding assessment.

- A practical assessment will be set at the end of the module and must be completed without using reference.
- The learner will be given one or more circular flanges and will be required to mark off a four – hole and / or six – hole drilling pattern according to given specifications.
- The following standards must be achieved:
  - The marked off centre must be within  $\pm 0.3\text{mm}$  of the true centre of the flange.
  - The marked off PCD must be within  $\pm 0.5\text{mm}$  of the drawing size.
  - There must not be more than  $\pm 0.5\text{mm}$  difference between the marked off hole centres.
- All answers must be correct and in accordance with the module content.

**HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM****MPD****PLAN A DRILLING WORKPIECE**

<b>STEPS IN OPERATION / PROCESS</b>	<b>POTENTIAL ACCIDENT / INCIDENT</b>	<b>CONTROLS (BY RESPONSIBLE PERSON)</b>
1. Use hand tools.	<ul style="list-style-type: none"> <li>Using damaged tools or wrong tools for the job can cause injury and damage to equipment.</li> </ul>	<ul style="list-style-type: none"> <li>Always use the correct tools for the job.</li> <li>Ensure tools are in good condition.</li> <li>Use tools correctly.</li> <li>Wear appropriate PPE where necessary.</li> <li>Always take good care of tools. Maintain, clean and store it properly.</li> </ul>

**NOTE:** Before doing the practical work contained in this module, the learner must study the content of the above HIAC form again and then sign the statement below.

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of learner:

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Signature of Training Officer:

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Date:

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## 1. MARKING OFF (LAYOUT) TOOLS

**ITEM / TASK:** The steel rule.

**DESCRIPTION:**

- A. The steel rule was dealt with in Module MMI, and it is assumed that you know how to measure with it.
- B. In addition to measuring with a steel rule, it can also be used as a straight edge to guide a scribe when scribing a straight line on a workpiece.
- C. It can be used to set dividers or jenny callipers to a given size.

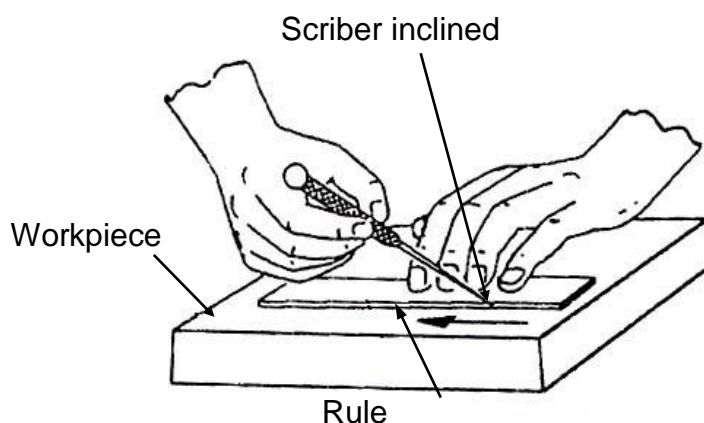
**ITEM / TASK:** Scribes.

**DESCRIPTION:**

- A. Scribes come in various sizes and are either straight, or have a hooked end in which case they are known as hook scribes. (Fig 1)



**FIG 1.**



**FIG 2.**

- B. The scribe is usually made from good quality high carbon steel. After the point has been ground, it is hardened and tempered, then it is honed to a needle point so that it will scribe a fine sharp line.
- C. The method of scribing a line is shown in Fig 2. Note how the scribe is inclined to allow its point to get right into the corner formed by the rule and the workpiece.

## **ITEM / TASK:** Punches.

### **DESCRIPTION:**

Two types of punches are used for marking off a workpiece, namely, the **prick punch** and the **centre punch**.

A. The prick punch is made of hardened tool steel and ground to a slender point with an included angle of between 30° and 60°. (Fig 3)

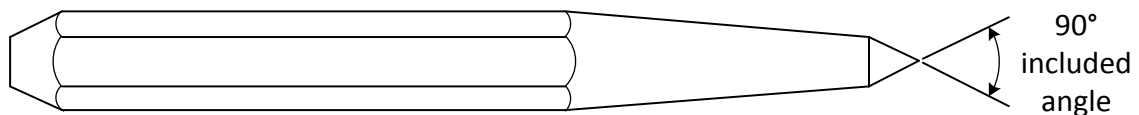
- The prick punch is struck lightly with a small hammer to make light marks or indentations at the intersections of layout lines.
- It is also used to locate hole centres and to provide a small centre mark for divider points when laying out circles or spacing dimensions.



**FIG 3.**

B. The centre punch is made of the same material as the prick punch and is similar in appearance, except that it is heavier and the point is ground to an included angle of 90°. (Fig 4)

- The centre punch is used to enlarge a prick punch mark so that a drill can be started in the exact location.

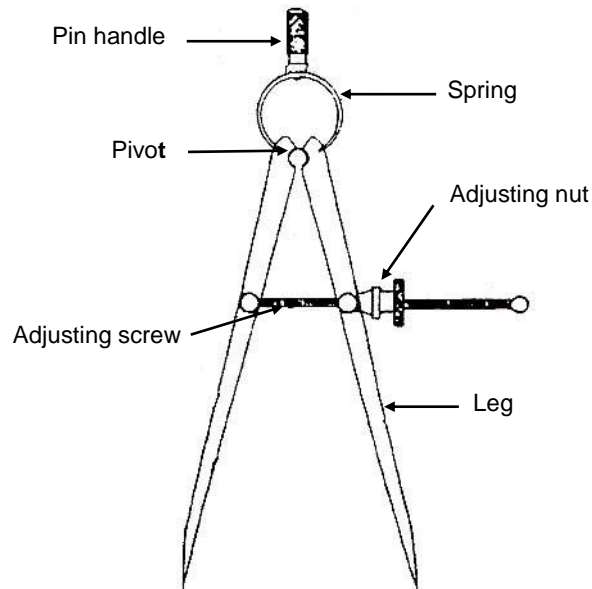


**FIG 4.**

**ITEM / TASK:** The divider.

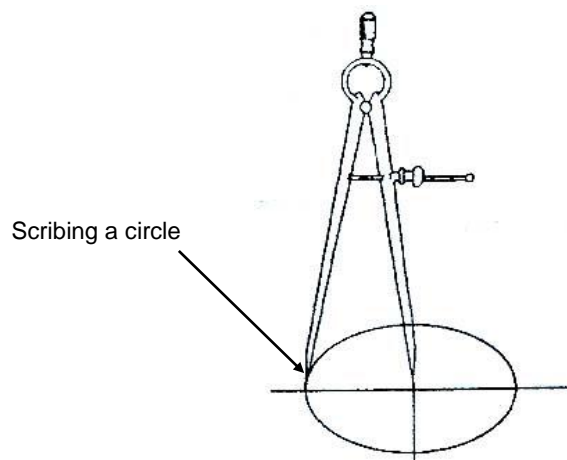
**DESCRIPTION:**

A. Dividers are made from the same type of material as scribes, and the points are also hardened and tempered, and honed to needle sharpness. It consists of the parts shown in Fig 5.



**FIG 5.**

B. Dividers are used for measuring the distance between two points, for transferring the size from a rule, and for scribing circles and arcs on metal.  
C. The method of scribing a circle with a divider is shown in Fig 6.



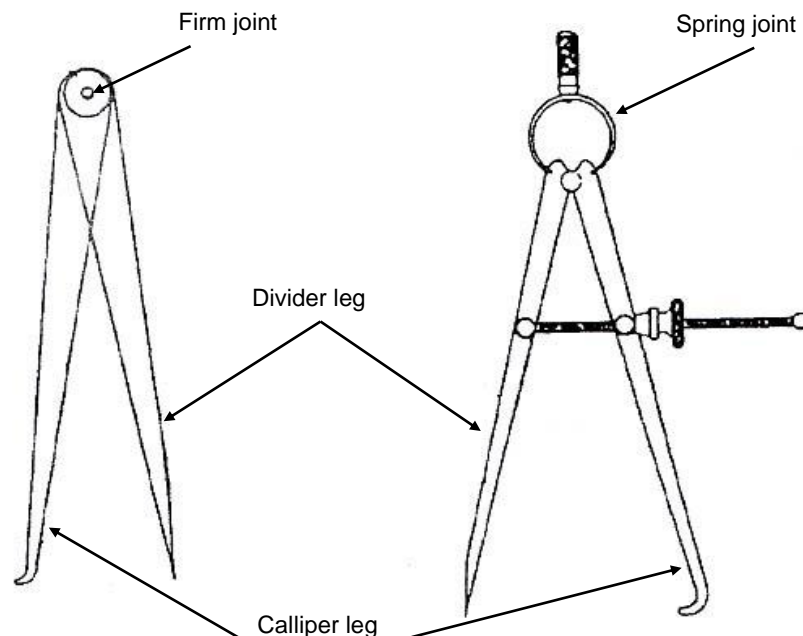
**FIG 6.**



**ITEM / TASK:** The odd leg (Jenny) calliper.

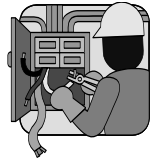
**DESCRIPTION:**

- A. Jenny or odd leg callipers come in various designs, but the basic operation remains the same. Fig 7 shows that the one leg of the jenny resembles the leg of a divider while the other leg resembles the leg of an inside calliper, hence the name odd leg calliper.
- B. The odd leg (Jenny) calliper is made of the same material as callipers and dividers. The point of the scribing leg is suitably hardened and tempered to withstand wear.
- C. Jenny callipers may be used to scribe arcs, or as a marking gauge in layout work. Fig 7 shows a spring joint and a firm joint jenny calliper.



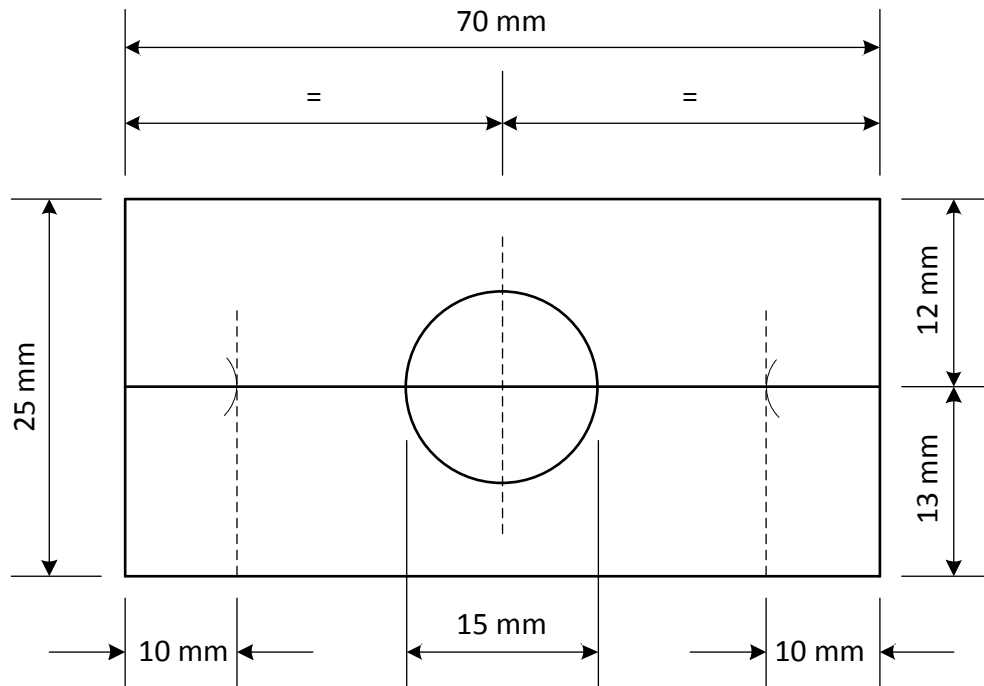
- D. The method of setting a jenny calliper is to locate the calliper leg of the jenny against the end of a rule and adjusting the scribing leg to line up with the desired scale line on the face of the rule.
- E. The firm joint jenny calliper is more versatile, because the calliper leg can be inverted to locate either on the inside or outside of a margin.

**DO THE PRACTICE ON THE NEXT PAGE BEFORE  
CONTINUING WITH THE REST OF THE MODULE.**



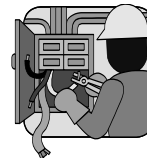
## PRACTICE

Practice marking off a mild steel plate to the dimensions given in the drawing below. Use all the tools described in this section.



Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
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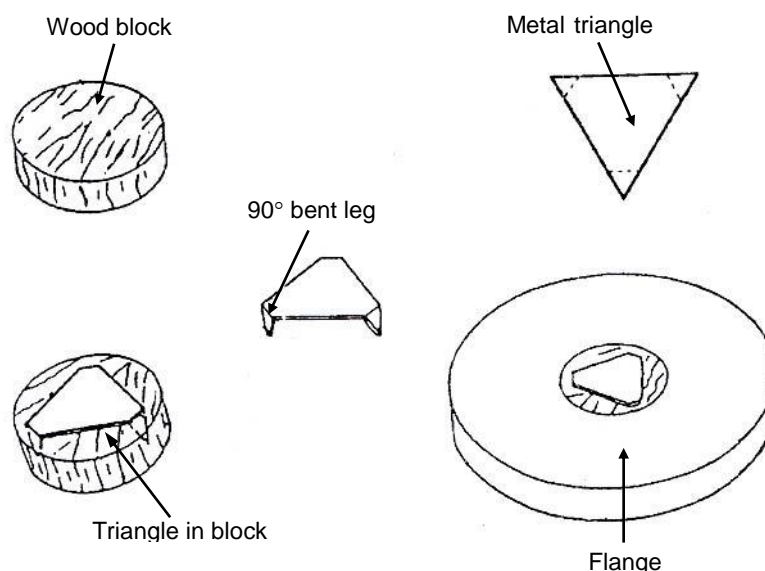


## 2. MARK OFF A FLANGE FOR DRILLING

**ITEM / TASK:** Finding the centre of a flange.

### **DESCRIPTION:**

- A. In order to mark off a circular flange for drilling, it is necessary to first scribe the pitch circle on which the holes must be drilled. The pitch circle is the circle that passes through the centres of all the holes in the flange.
- B. If the flange has a centre bore, it is necessary to plug the bore of the flange and then establish a centre point for the flange on it that can be used to scribe the pitch circle.
- C. The following method can be used to establish a centre point for the flange: (Fig 8)

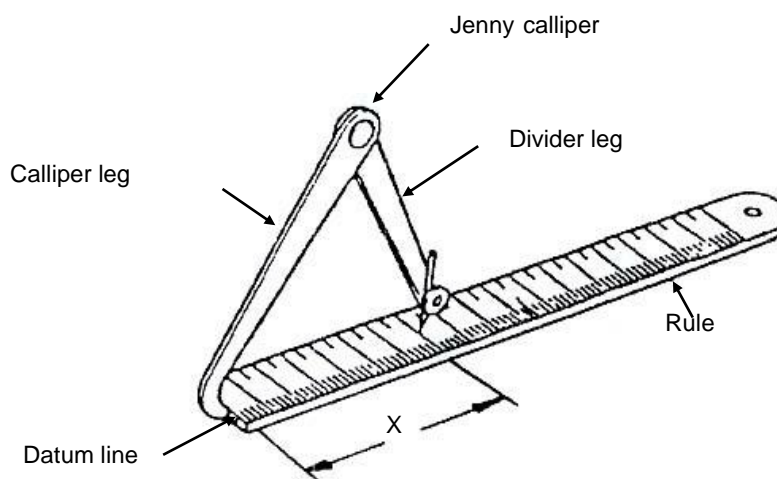


**FIG 8.**

- Cut a circular piece of wood approximately 2mm larger in diameter than the bore of the flange.
- Taper the block of wood slightly with a coarse file so that it will enter into the bore of the flange.
- Cut a piece of 0.5mm shimstock or galvanised plate into a triangle with legs approximately 25mm long with a pair of tin snips.
- Bend approximately 3mm of each corner of the triangle up at 90° with a pair of pliers.

- Tap the points of the triangle into the wood with a small hammer.
- Tap the block of wood into the bore of the flange until the faces are flush.
- Paint the centre and the face of the flange with a thin coating of marking blue. This will make all future scribed lines more easily visible on the flange.
- Set a pair of **jenny callipers** to a distance equal to the **radius** of the flange (see Fig 9). The radius is equal to half the flange diameter, i.e.

$$x = \frac{\text{Diameter}}{2}$$

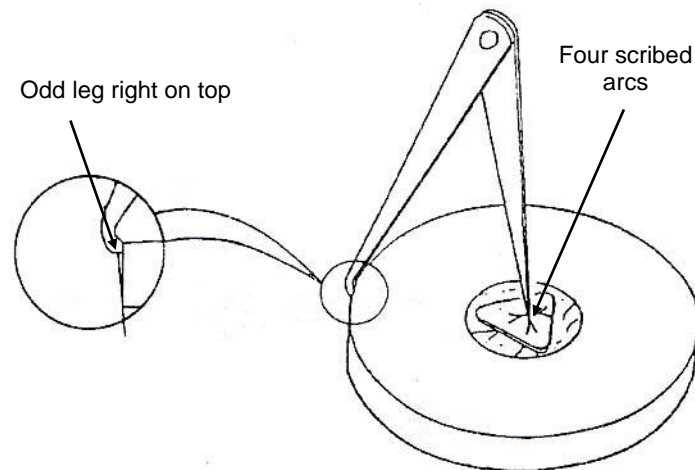


**FIG 9.**

- Scribe four arcs on the centre plate at 90° spacing. (Fig 10 on the next page)

**NB:**

- Keep the odd leg of the calliper as close to the top of the flange as possible and at the same height for all four positions.
- The odd leg of the jenny calliper must be held in position against the flange with a thumb or forefinger, while the other hand moves the calliper to scribe an arc on the centre plate.



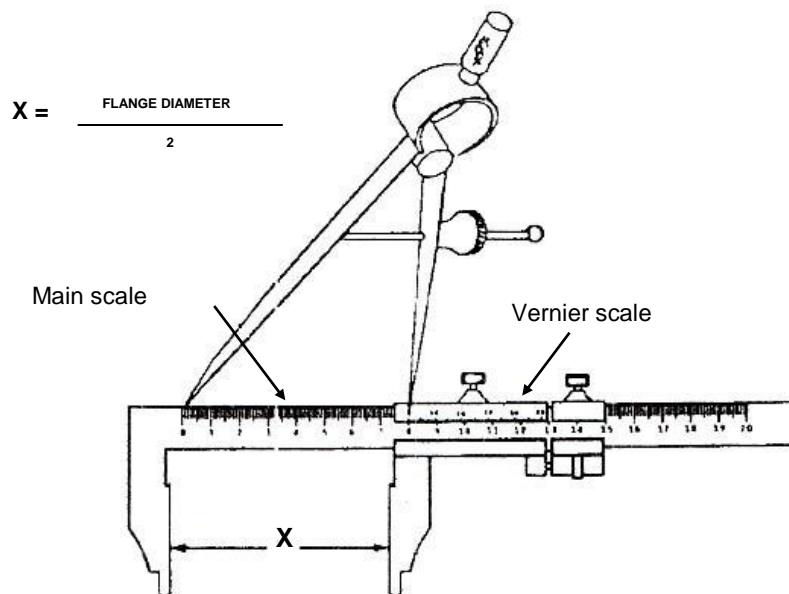
**FIG 10.**

- With a small prick punch and light hammer, make a light centre pop mark at the exact point where the four arcs intersect each other.

**NB:**

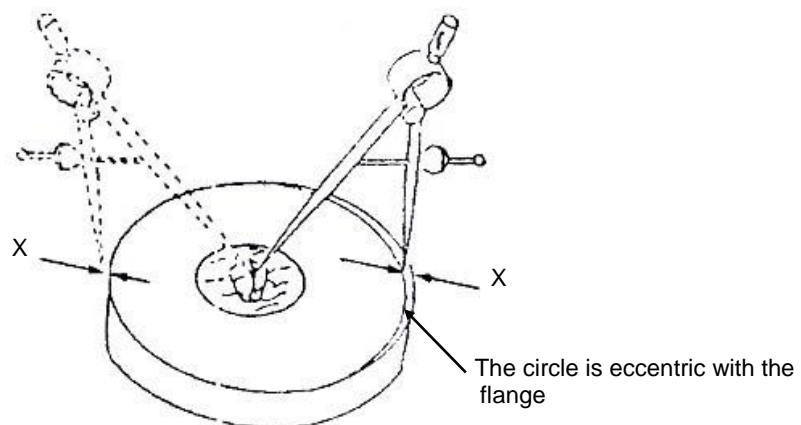
**The accuracy of marking off depends on the sharpness of the instruments, proper and careful use of them and the smoothness of the work face.**

- Set a **Vernier calliper** at a size equal to the radius of the flange.
- Open a pair of dividers to the approximate radius of the flange.
- Place the point of one leg of the dividers on the zero line of the main scale of the Vernier calliper.
- Adjust the dividers until the point of the other leg lines up with the zero line on the Vernier scale of the calliper. The dividers are now set to the outside radius of the flange (Fig 11 on next page).



**FIG 11.**

- Place the point of one leg of the divider in the centre pop mark on the centre plate.
- Rotate the divider so that the scribing leg follows the circumference of the flange.



**FIG 12.**

**NB:**

If the centre pop mark is not in the dead centre of the flange, the scribed circle will be eccentric to the flange, x = the amount that the pop mark is out of centre. (Fig 12)

- Adjust the scribing leg of the divider until it will scribe a circle right around the face of the flange.
- Place the point of one leg on the zero line of the main scale of the Vernier calliper.
- Adjust the Vernier calliper until the zero line of the Vernier scale lines up with the point of the other leg of the divider.
- Compare the reading on the Vernier with the radius size of the flange.
- Move the centre accordingly if the difference is more than 0.25mm.

**DO SELF TEST AND THE PRACTICE ON THE NEXT PAGES  
BEFORE CONTINUING WITH THE REST OF THE MODULE.**

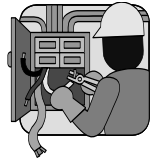


## SELF TEST

Write down the radius (r) for each of the following diameters (D).

- a.  $D = 100 \text{ mm}$ , then  $r =$  \_\_\_\_\_
- b.  $D = 125 \text{ mm}$ , then  $r =$  \_\_\_\_\_
- c.  $D = 127.5 \text{ mm}$ , then  $r =$  \_\_\_\_\_
- d.  $D = 170.5 \text{ mm}$ . then  $r =$  \_\_\_\_\_



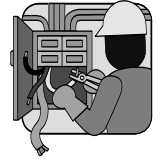


## PRACTICE

Practice preparing a flange for marking off and finding the centre of the flange.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

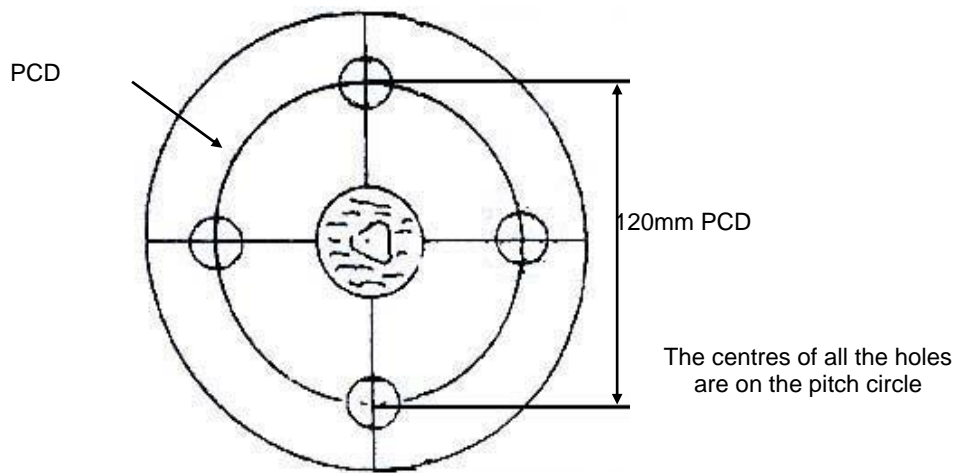
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**ITEM / TASK:** Mark off a four – hole flange.

**DESCRIPTION:**

- A. Use one of the flanges for which you determined the centre in the previous section and obtain its pitch circle diameter (PCD) from the drawing.
- B. The pitch circle is the circle that passes through the centres of all the holes in the flange.  
See Fig 13.



**FIG 13.**

- C. Proceed as follows to mark off the flange:
  - Set the dividers to the radius of the PCD on a Vernier calliper as described in the previous section.

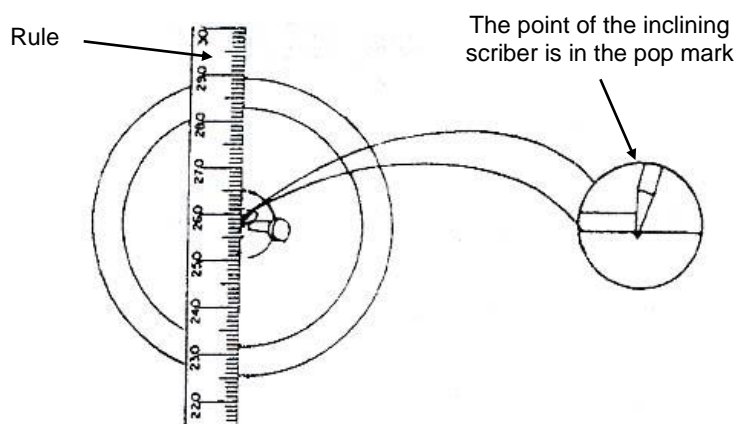
**NB:**

**If no great accuracy is required a steel rule can be used to set the diameters.**

- Place the point of one leg of the dividers in the centre pop mark at the flange centre and scribe a circle on the face of the flange.
- Place the point of your scriber in the centre pop mark at the centre of the flange.
- Place a steel rule or straight edge flat on the face of the flange against the scriber.
- Scribe a line on the face of the flange against the edge of the rule (Fig 14 on the next page).

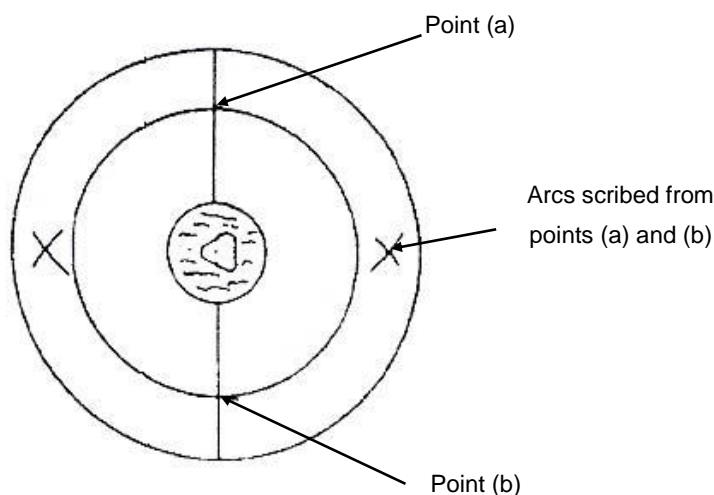
**NB:**

The scribe is held in an inclined position to allow its point to get right into the corner formed by the face of the flange and the end of the rule or straight edge.



**FIG 14.**

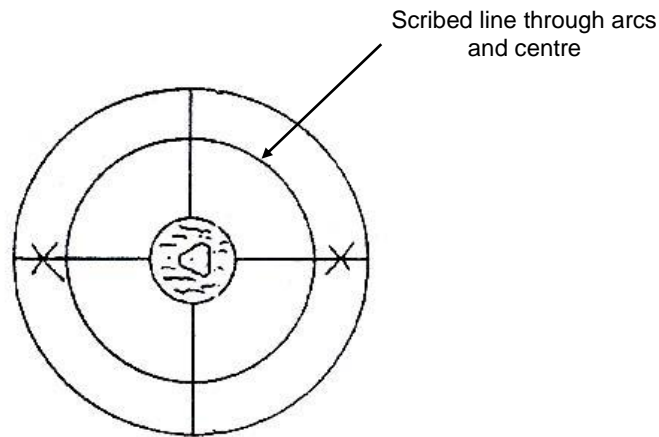
- Make light pop marks where the scribed line intersects the pitch circle.
- Open and adjust the divider leg so as to scribe two intersecting arcs on the outside of the pitch circle on either side of the straight scribed line, using the two pop marks as centres. (Fig 15)



**FIG 15.**

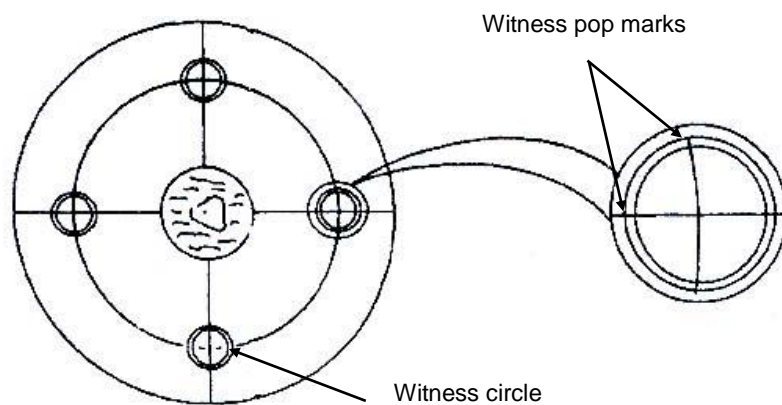
- Make a light pop mark with a prick punch where the arcs intersect each other.
- Scribe a line through the centre of the pop marks to cut the pitch circle. (Fig 16 on the next page)

- Make a light pop mark with a prick punch at the four points where the straight lines intersect the pitch circle.



**FIG 16.**

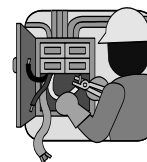
- Draw four circles of the same diameter as the hole size given on the drawing.
- Draw a witness circle 1mm smaller than the hole inside each of the circles.
- Make four witness pop marks with a prick punch on the outer circle. See the enlarged details of the marked off hole in Fig 17.



**FIG 17.**

**NB:**

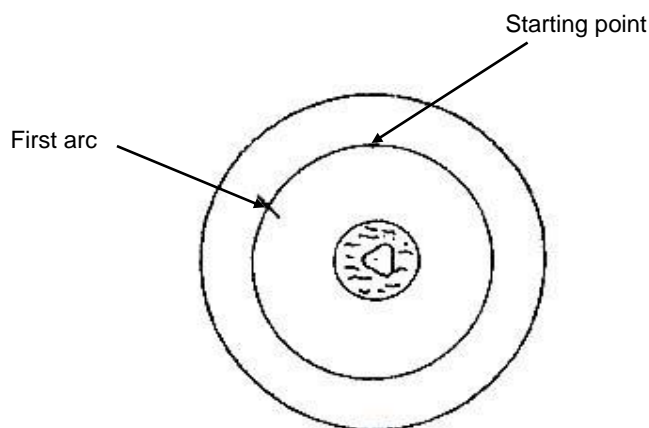
**The distance from the centre of the flange to the centre of the marked off hole must not differ more than  $\pm 0.05\text{mm}$  from the drawing size. The distance between the marked off hole centres must not differ by more than  $\pm 0.05\text{mm}$  from the drawing size.**



**ITEM / TASK:** Mark off a six – hole flange.

**DESCRIPTION:**

- Find the centre of the flange and mark off the PCD in the same manner as for a four-hole flange.
- Make a light pop mark with a prick punch at any position on the pitch circle.  
(Fig 18)



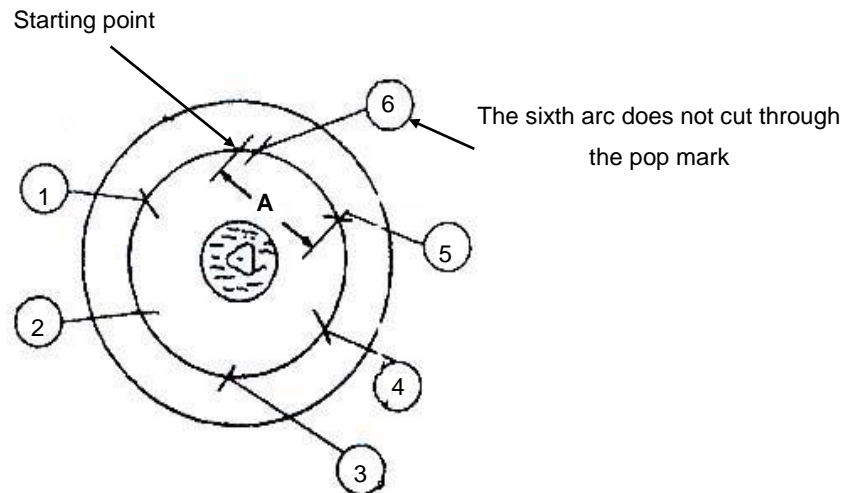
**FIG 18.**

- Scribe the first arc on the PCD as shown in Fig 18 with the divider set at the **radius of the pitch circle** and using the pop mark as the centre.
- Make an indentation with the point of a scribe at the point where the arc intersects the pitch circle.
- Use this indentation as the next centre and scribe a second arc on the pitch circle.
- Continue doing this until there are six points on the pitch circle.

**NB:**

**You will find that if you were to scribe an arc from the indentation where the fifth arc intersects the pitch circle it will not cut through the centre of the starting point pop mark. (Fig 19 on the next page)**

- Place the point of one leg of the divider in the pop mark at the starting point.
- Adjust the divider until the point of the other leg will intersect the centre of the fifth arc and pitch circle and scribe an arc. (Fig 19 on the next page)



**FIG 19.**

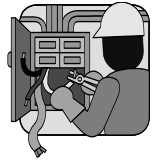
- Measure this distance (A) (Fig 19) on a Vernier calliper as already described previously.
- Adjust the Vernier calliper **one sixth smaller** than the difference between the measured size and the radius of the pitch circle.
- Paint out the pitch circle and all other scribed marks.
- Re-draw the pitch circle from the centre of the flange.
- Adjust the divider to the new size set on the Vernier calliper.
- Proceed as before and mark off the points on the pitch circle.

**NB:**

**It might be necessary to make further adjustments to the divider until the arc drawn from the fifth point cuts through the centre of the pop mark at the starting point.**

- Mark off the six holes in the same way as for a four-hole flange.

**DO THE PRACTICE ON THE NEXT PAGE.**



## PRACTICE

1. Practice marking off the pitch circles and holes for a **four hole** and a **six hole** flanges.

- The distance from the centre to the outside of the flange must not vary by more than 0.3mm at any position.
- The distance from the centre of the flange to the centre of the marked off holes must be within  $\pm 0.5\text{mm}$  of the drawing size, and the distance from the hole centres must not vary by more than  $\pm 0.5\text{mm}$  from the drawing size.

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



### **REMEMBER ALWAYS WORK SAFE**

**Once you have passed the entire practices and self test, you are now at liberty to request a Formative Assessment from your Assessor.**