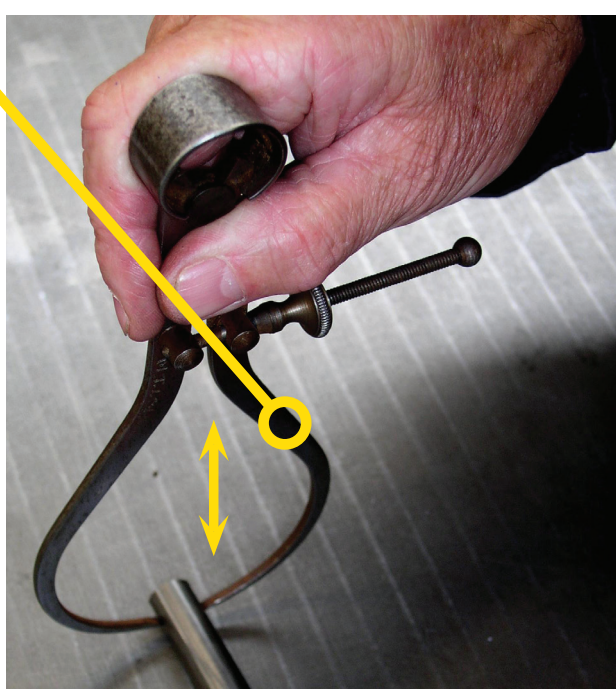




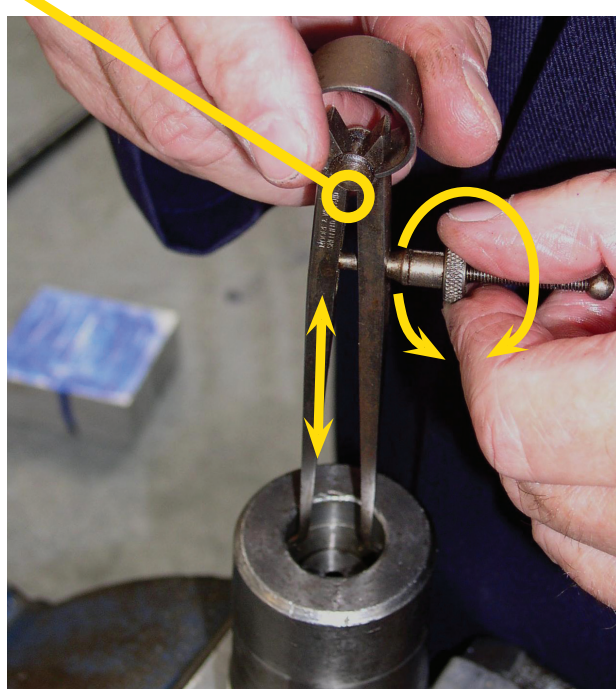
Know your measuring tools

Me mōhio ki ō taputapu ine

External calipers are used to measure the outside of work pieces. They are used when you can't get normal measuring instruments onto the part that requires measuring.



Internal calipers are designed to measure internal dimensions that other measuring tools can not reach.

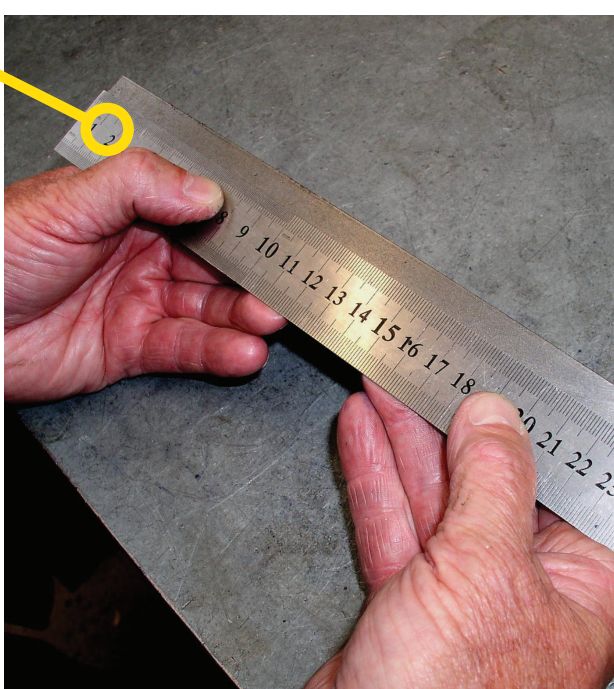


With both of these tools light pressure is applied onto the work piece, not enough so as to mark the surface, but enough that you can feel it touching.

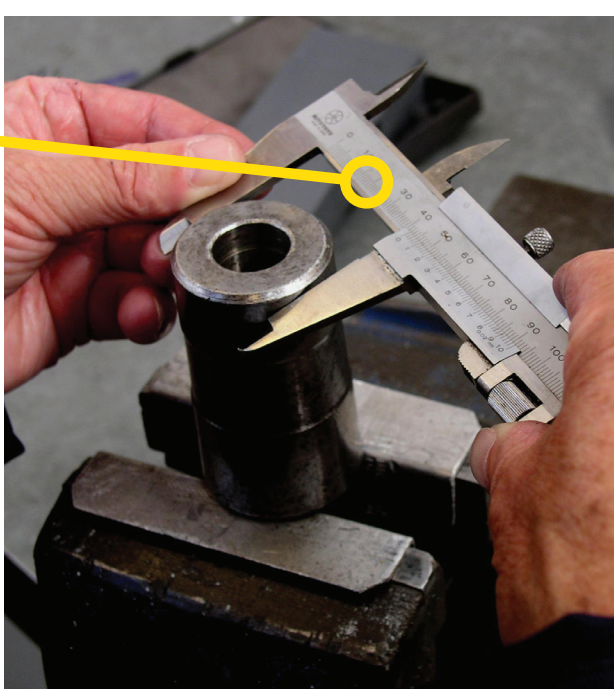
The tips of the caliper are compared against a rule to transfer the measurement.

A **steel engineer's rule** is one the most useful tools in the workshop

It is used to perform marking-out on low accuracy work and to give the engineer a rough idea on size before starting precision work.



The **vernier caliper** is a multipurpose measuring tool being over 20 x more accurate than a rule. They can measure both internal and external sizes.

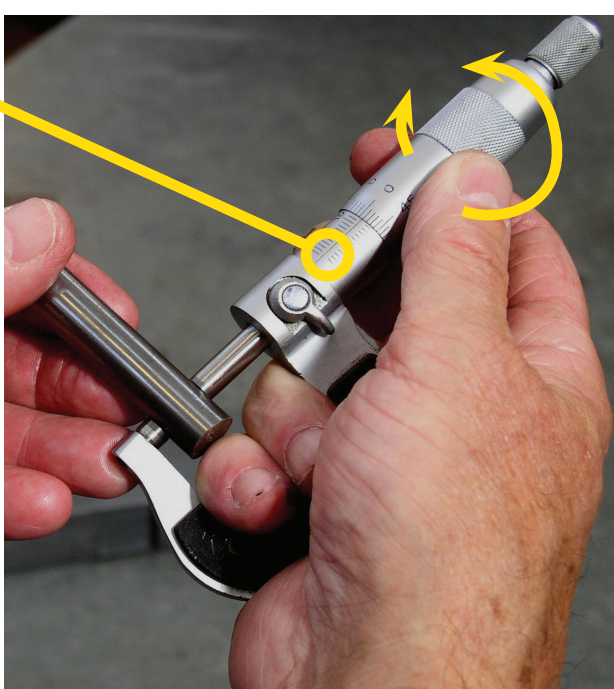


Smart tip
Check both faces of the tool and do a zero check before starting work.

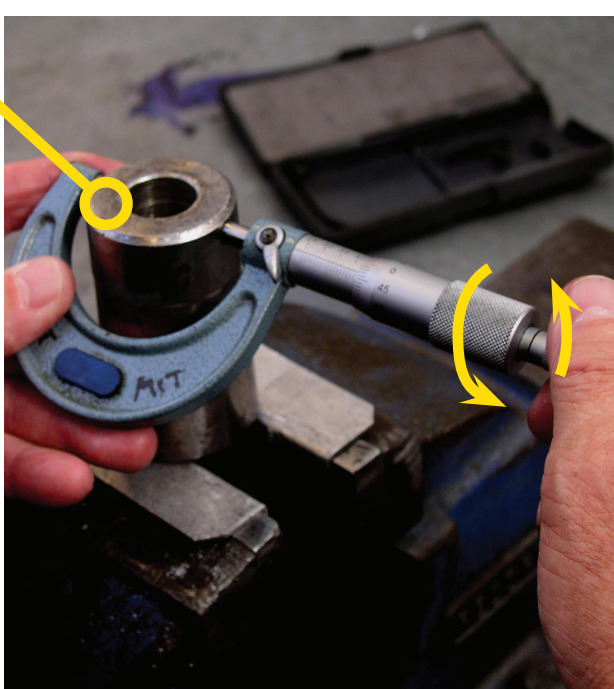
Check list

- Check for damage and deterioration of the tool. Do not drop or hit the tool as this will cause measurements to become inaccurate.
- While using the tool, ensure it is not over tightened, as this leads to incorrect readings and excessive wear on the tool.
- Remember your clothing must always be suitable, with sleeves rolled up.

The **micrometer** is the most accurate measuring device commonly used in the workshop. The most common variant is the external mic (pronounced "mike").



Each revolution of the ratchet closes the mic by 0.5 mm. The component being measured is placed in-between the two anvil surfaces.



The ratchet is turned clockwise until it makes a 'clicking' noise and the component is 'trapped' between the anvil surfaces.

This means that the correct closing pressure has been applied and the measurement can be read accurately.

Marking-out

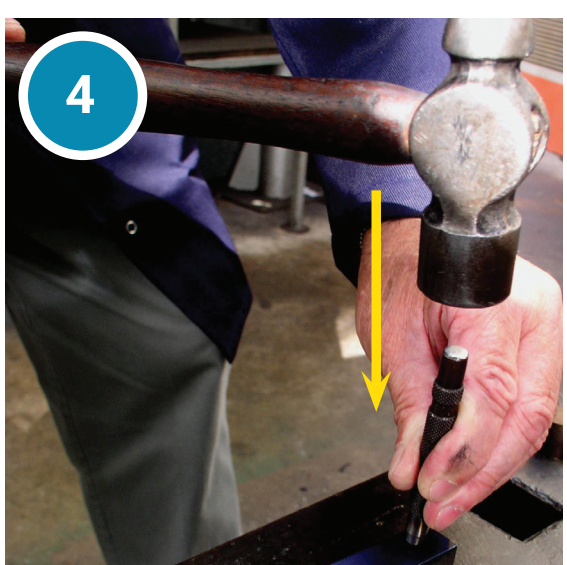
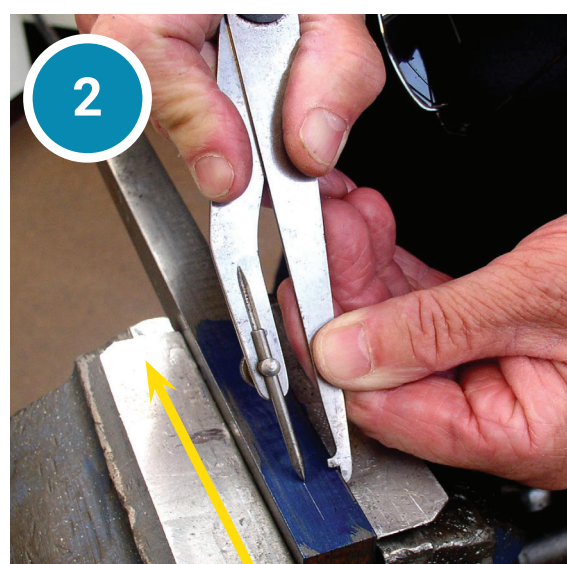
Te tautuhi

WARNING KIA TŪPATO

Always wear safety glasses and keep your fingers clear.
Me whakamau mōhiti haumarū i ngā wā katoa, kia wātea tonu ō matimati.

Marking out a hole position

- 1 Brush a thin layer of marking blue onto the surface of the metal to highlight the lines.
- 2 Using 'odd-leg' calipers, find the centre of the bar. This is done by marking from each side of the bar towards the centre until only one line is produced, whatever side you mark from.
- 3 A scribe, engineers-square and metal ruler are used to mark positions on the bar.
- 4 When drilling, always start by centre punching, to ensure surface irregularities don't cause the drill to 'wander'.



Smart tip
Always use a try-square when work at right angles. The finished accuracy will be much higher.
Only put a thin layer to engineers blue on the work piece, it'll dry quicker and mark easier.

Marking out a pitch circle diameter

- 1 Brush a thin layer of marking blue onto the surface of the metal to highlight the marking out lines.
- 2 Use an engineers-square to mark the centre of the circle and lightly punch with a centre punch.
- 3 Mark the piece using dividers, set to the radius of the required circle.
- 4 Centre punch the intersections to get the Pitch Circle Diameter (PCD).

