Measuring & Marking out& Hand Tools

Measurement *a method to determine quantity, capacity, or dimension, in other word, it is values made meaningful by quantifying into specific units*. Measurements act as labels which make those values more useful in terms of details. Several systems of measurement exist, each one comprising units whose amounts have been arbitrarily set and agreed upon by specific groups, but International System is accepted all over the world as the standard system for use in science. Measuring is taken from a *baseline* or *datum surface*. A lot of tasks require two datum surfaces at right angles to each other. Smoothing off will turn a rough, newly-sawn edge into a datum surface.

- To create a datum surface on wood, a plane is used.
- To create a datum surface on metal and plastics, a flat file or hand file is used.

A steel rule or straight edge is used to check that a surface is flat, and a try square is used to check a surface is at right angles to another surface

Marking out *or layout is the process of transferring a design or pattern to a work piece, as the first step in the manufacturing process. Or transfer of shapes and lines onto the material, as guides for cutting, bending or shaping them*. Accurate marking out is essential if the different parts of the product are to fit together properly. It is performed in many industries or hobbies although in the repetition industries the machine's initial setup is designed to remove the need to mark out every individual piece.

Measuring Tools

Calipers are the very simple tools used together with a steel rule for the measurement or comparison of linear dimensions. An experienced worker can achieve +/-0.05mm in the measurement. Calipers are classified

Figure 2. Outside Calipers

into two types: -

Outside Calipers

Outside calipers (figure 2) are used for measuring external dimensions such as the length, diameter, or even the thickness of a solid.

Figure 3. Inside Calipers

Inside Calipers

Inside calipers (figure 3) are used for measuring internal dimensions such as the diameter of a hole, or the width of a slot etc

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Vernier Calipers

Vernier Calipers (figure 4) are more precise tools capable for measuring external dimensions, internal dimensions, and depths. Besides the two pairs of measuring jaws and the depth gauge, its main features also include a main scale and a vernier scale.

Figure 4. Vernier Calipers

The resolution of a vernier scale is determined by the difference on the distance of one division on the main scale and one division on the vernier. For example: A vernier scale of length 49mm is divided into 50 equal divisions. That means one division on the vernier represents 49/50=0.98 mm while one division on the main scale represents 1mm. Then, the resolution of the vernier is 1mm - 0.98mm = 0.02mm

Vernier Height Gauge

A vernier height gauge (figure 5) is used for measuring height of an object or for marking lines onto an object of given distance from a datum base.

Figure 5. Vernier Height Gauge

Micrometer

A micrometer is a more precise measuring instrument than the vernier calipers. The accuracy is come from the fine thread on the screw spindle. The ratchet prevents excess force from being applied. Generally, the screw spindle has a pitch of 0.5mm. The thimble is divided into 50 equal divisions.

Common types of micrometers used in the workshops are: -

Outside Micrometer

An outside micrometer (figure 6) is used for measuring external dimensions. The work to be measured is placed between the anvil and the tip of the spindle.

Figure 6. Outside Micrometer

Inside Micrometer

This is similar in structure to an outside micrometer and is used for measuring internal dimensions as shown in figure 7.

Figure 7. Inside Micrometer

Depth Micrometer

A depth micrometer (figure 8) is used for measuring the depth of a hole, slot and keyway etc. A complete set of depth micrometer is equipped with spindles of different lengths, which can be interchanged to suit different measuring ranges.

Figure 8. Depth Micrometer

Engineer's Protractor

Engineer's protractor (figure 9) is a general purpose tool used for the measuring / checking of angles e.g. the angle of drill head, angle of cutting tool, and even for the marking out of angles on a component part.

Figure 9. Engineer's Protractor

Combination Set

Combination set (figure 10) is a set of equipment combining the functions of protractor, engineer square, steel rule, Centre finder, level rule, and scriber.

Figure 10. Combination Set

Dial Indicator

The principle of dial indicator (dial gauge) is that the linear mechanical movement of the stylus is magnified and transferred to the rotation of pointer as shown in figure 11. The accuracy of dial indicator can be up to 0.001mm. It is usually used for calibration of machine.

Figure 11. Dial Indicator

Marking Out Tools

Marking out is the preliminary work of providing guidance lines and centres before cutting and machining. The lines are in 3-D and full-scale. The workpiece can then be cut or machined to the required shapes and sizes. The common tools used for marking out are as follow:

Scriber

A scriber (figure 12) is used for scratching lines onto the workpiece. It is made of hardened tool steel.

Figure 12. Scriber

Engineer's Square

Engineer's square (figure 13) is made of hardened tool steel. It is used for checking the straightness and the squareness of a workpiece. It can also be used for marking perpendicular lines onto a workpiece.

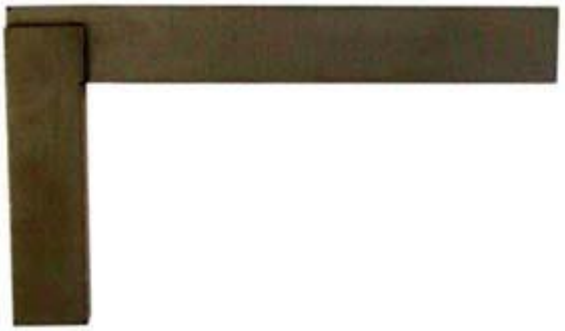

Figure13. Engineer's Square

Spring Dividers

Spring dividers (figure 14) are made of hardened tool steel. The legs are used for scribing arcs or circles onto a workpiece.

Figure14. Spring Dividers

Punch

There are two types of punch namely the Centre Punch and the Dot Punch. A dot punch it is used for making of small dots on the reference line. The centre punch shown in figure 1٤ it is used for making a large indent on a workpiece for drilling. Both punches are made of hardened tool steel.

Figure 15. Punch

Surface Plate

Surface plate (figure 16) is made of malleable cast iron. It has been machined and scraped to a high degree of flatness. The flat surface is being used as a datum surface for marking out and for measuring purposes. If it can stand on the floor, it is called surface table.

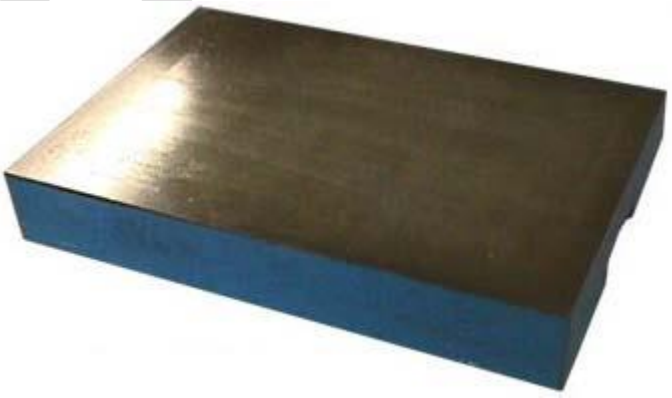

Figure 16. Surface Plate

Angle Plate

An angle plate (figure17) are used for supporting or setting up work vertically, and are provided with holes and slots through which securing bolts can be located. It is made of cast iron and ground to a high degree of accuracy.

Figure 17. Angle Plate

Vee Block

Vee blocks (figure 18) usually in a couple are made of cast iron or steel in case-hardening. They are generally used for holding circular workpiece for marking out or machining.

Figure 18. Vee Block

Hand Tools

Bench Vice

A bench vice (figure 19) is the device for holding the workpiece where most hand processes to be carried out. The body of the vice is made of cast iron while the two clamping jaws are made of hardened tool steel. Some bench vice has a swivel base, which can set the workpiece at an angle to the table. The vice height should be correct ergonomically. Vice clamps, made of copper are fitted over the vice jaws when holding finished work to avoid damage to the finish surfaces.

Figure19. Bench Vice

Care of Vices

a. Do not direct impact the vice body by the hammer.
b. Light hammering can be done on and only on the anvil of the vice.
c. To avoid over clamping, the handle of the vice should be tightened by hand only

Files

Files are the most important hand tools used for the removal of materials. They are made of hardened high carbon steel with a soft 'tang'. to which a handle can be fixed. Files are categorised as follows:-

Length - measured from the shoulder to the tip. Shape - the cross-sectional profile. Grade - the spacing and pitch of the teeth. Cut - the patterns of cutting edge.

Figure 20. File

Save Edge; there is edge without teeth on one side of the hand file. The purpose of the save edge is to avoid damage of work.

Shapes of Files

1. Hand File - The common file used for roughing and finishing. It is a rectangular in section and parallel in width. It has double cut teeth on two faces, single cut teeth on one edge, and one save edge.

Figure 20a. Hand File

2. Flat File - It is similar to a hand file rectangular in section, tapered slightly in width and thickness towards the tip. It has Double Cut teeth on two faces and Single Cut teeth on two sides.

Figure 20b. Flat File

3. Half-round File - The section is a chord of a circle with its taper towards the tip. It is used for forming radii, grooves, etc. and the flat side is used for finishing flat surfaces.

Figure 20c. Half-round File

4. Round File - This is of round section tapering toward the end. It is used for enlarging holes, producing internal round corners. Usually double cut in the larger sizes, and single cut for the smaller sizes.

Figure 20d. Round File

5. Square File - This is square in section, with tapered towards the tip, and usually double cut on all four faces. It is used for filing rectangular slots or grooves.

Figure 20e. Square File

6. Three Square File - It is also known as triangular file. This is a triangular in section, with tapered towards.

Figure 20f. Three Square File