Metrology Laboratory
Department of Mechanical Engineering

Experiment No. 1A

TOOL MAKER'S MICROSCOPE

Aim: To make use of tool maker microscope for measurement of dimensional parameters of the given workpiece.

Instruments used: Tool maker's microscope, measuring workpiece (Thread gauge).

Theory:

The Tool Maker's Microscope (TMM) essentially consists of the cast base, the main lighting unit, the upright with carrying arm and the sighting microscope. The rigid cast base is resting on

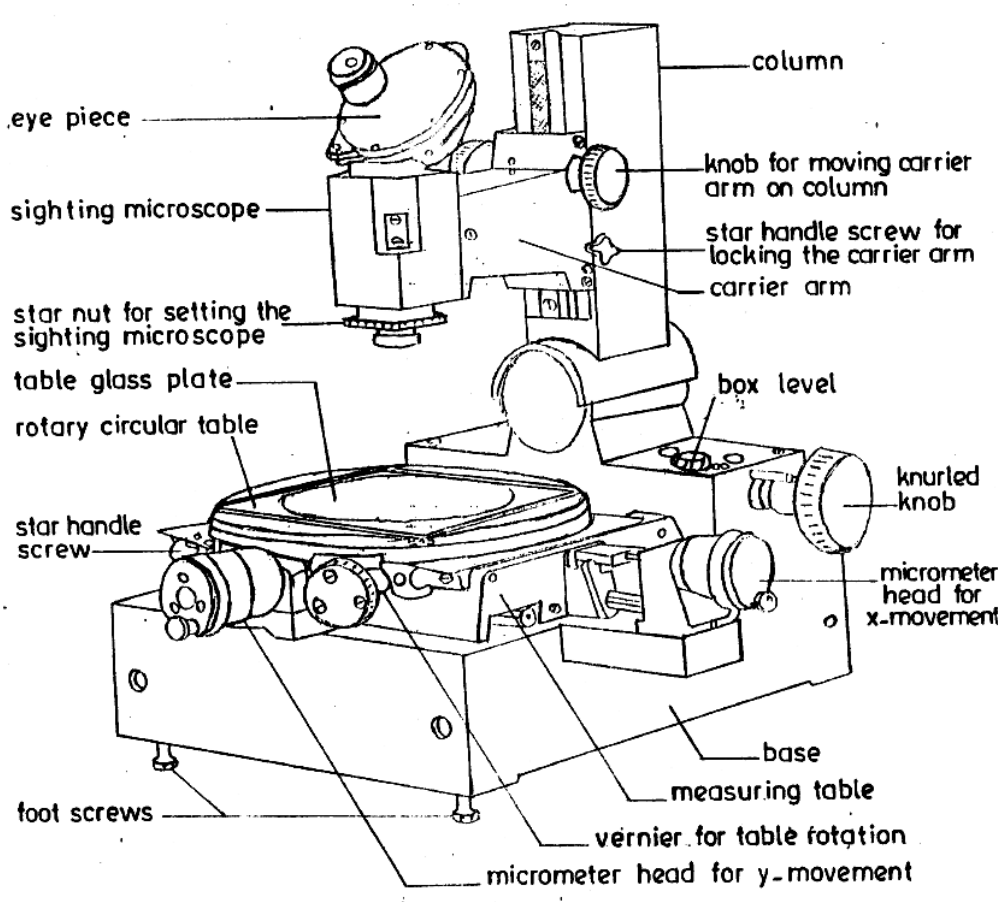

Fig.1 Tool Maker's Microscope

three foot screws by means of which the equipment can be leveled with reference to the built-in spirit level. The base carries the co-ordinate measuring table, consists of two measuring slides: one each for directions X and Y, and a rotary circular table provided with the glass plate. The slides run on precision balls in hardened guide ways warranting reliable travel. Two micrometer screws each of them having measuring range of 0 to 25 mm permit the measuring table to be displaced in the directions X and Y. The range of movements of the carriage can be widened up to 75 mm in the X direction and up to 50mm in the Y direction with the use of gauge blocks. The rotary table has been provided with 360 degrees graduation and with a 60 minute vernier. The rotary motion is initiated by activation of knurled knob. Slots in the rotary table serve for fastening different accessories and completing elements. The sighting microscope has been fastened to column with a carrier arm. The carrier arm can be adjusted in height by means of a rack. The main lighting unit has been arranged in the rear of the cast base and equipped with projection lamp where rays are directed via stationary mounted mirror through table glass plate into the sighting microscope.

Measuring principle:

Tool Maker's Microscope is a precision Optical Microscope that consists of single or multiple objective lenses, which magnifies the object under observation and by the help of eyepiece lens the object is focused and viewed. A high precision micrometric X-Y stage and the Z axis travel are used to measure the three dimensions [Length (X), Width (Y), Depth (Z)]. The angle is measured with the help of a rotating stage and eyepiece graduation.

Applications:

The tool maker's microscope is an essential part of engineering inspection, measurement and calibration in metrology labs. Hence is used to the following,

- Examination of form tools, plate and template gauges, punches and dies, annular grooved and threaded hobs etc.
- Measurement of glass graticules and other surface marked parts.
- Elements of external thread forms of screw plug gauges, taps, worms and similar components.
- Shallow bores and recesses.

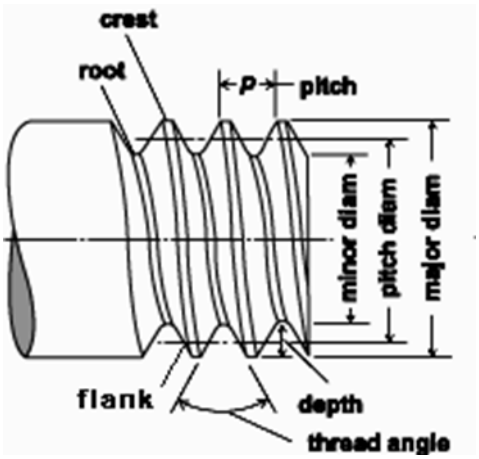

Fig.2 Screw thread nomenclature

Fig.3 Thread gauge

Procedure:

Switch on the projection lamp. Get familiar with the least count, linear and angular readings of the tool maker's microscope and nomenclature of the thread shown in Fig.2. Place the given specimen (thread gauge shown in Fig.3) on the glass table plate. Viewing through the eyepiece, rotate the knob for moving carrier arm on column to get the sharp image of the specimen kept on the glass plate. Position the specimen such that the table movement in the X direction is parallel to the direction of the pitch measurement. This is checked by ensuring the crosswire touching the tips (crests) of all the teeth during table movement in the X direction.

- *To measure the pitch:* Rotate micrometer head for X direction to touch the intersection point of the crosswire to the crest of the thread as seen from the eye piece. Note down the reading of the micrometer. Again rotate the micrometer head to move the specimen so that the next successive crest will come in contact with the crosswire intersection point. Note down the reading. The difference in reading will give the pitch.
- *To measure the depth of the thread:* Similarly rotate micrometer head for Y direction to touch the intersection point of the crosswire (along with the horizontal dotted line) to the root of the thread, as seen from the eye piece. Note down the reading of the micrometer. Again rotate the micrometer head to move the specimen so that the horizontal dotted line touches all the crests. Note down the reading. The difference in reading will give the depth of the thread.

- *To measure the thread angle:* Rotate the crosswire by the silver colour knob located behind the eye piece to match the flank of the thread with the cross wire. Make use of both the micrometer heads for X and Y direction to move the flank, and note down the angle by viewing through the lens below the eye piece. Now rotate only the crosswire to match the opposite flank and note down the angle. The difference will give the thread angle.
- Represent all the measured readings of the given specimen (thread gauge) with a neat diagram.

Observations:

Sl No.	Pitch *(p)*, mm	Height *(h)*, mm	Angle *(θ)*, deg
1			
2			
3			

Average *p*	Average *h*	Average *θ*

Questions:

1. What is the working principle of a tool maker's microscope?
2. What are the applications of the tool maker's microscope?