Experiment No. 3

Title :- Measurement of different characteristics of screw thread.

Specific Outcomes:- Students will able to

1) To know and identify kinds of threads.
2) To know the important thread characteristics.
3) To acquire the skill of comparing the threads and finding the pitch.
4) To acquire the skill of measuring effective diameter.

Instruments/ Equipment with Specifications:-

1) Floating Carriage micrometer :
2) Screw pitch gauge :
3) Screw thread micrometer:
4) Standard Wires:
5) Surface Plate:
6) Stands:
7) Bolt:

Theory :-

- The two types of threads are a) Vee, b) Square, c) Buttress, d) Acme and e) Knuckle.
- The effective diameter of a screw thread may be ascertained by placing two wires or rods of identical diameters between the flanks of the threads.
- Wires are made of hardened steel and lapped to sizes suitable for various pitches. For each pitch of thread is a 'Best Size Wire'.
- Best Size Wire is one having such a diameter that it makes contact with the flank of the thread on the effective diameter or pitch line.
- Common definitions involved in thread characteristics are shown in figure which shows outline of a typical 'V' type screw threaded cylinder.

Characteristics of Screw Threads:

1) Major diameter

2) Minor (core) diameter:

3) Effective diameter (pitch diameter):

4) Pitch:

5) Thread angle:

6) Radius of Crest:

7) Radius of Root:

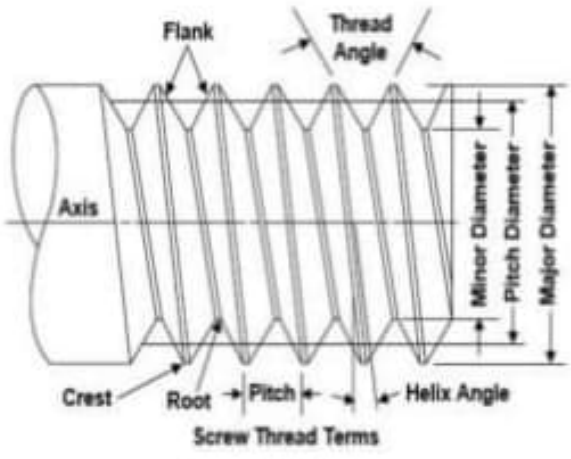

Fig. 3.1 Screw Thread Profile

Image Source: https://practicalmaintenance.net/wp-content/uploads/Fundamentals-of-Threaded-Fasteners.pdf

Fig. 3.2 Screw Thread Pitch Measurement using pitch gauge

Image Source: https://www.tubomart.com/whats-the-difference-between-4-screw-thread-types/

Charateristics of screw threds :-

1. **Major Diameter :-**

The major Diameter is a diameter that can be measured from two points. It is the diameter of an imaginary cylinder formed around the crest of an external thread.

2. **Minor (core) diameter =**

The smallest diameter of the thread of the screw or nut. The term "minor diameter" replaces the term "core diameter" as applied to the thread of a screw and also the term "inside diameter" as applied to the thread of nut.

3. **Effective Diameter :-**

The pitch diameter also known a effective diameter. is used to determine wheather two threaded parts could be sucessfully mated together properly mated parts will demonstrate equal distance between thread flanks when in contact.

4. **Pitch :-**

Pitch is a perceptual property of sounds that follows their ordering on a frequently scale, or more commonly, pitch is a quality that makes it possible to judge sounds as higher and "lower" in the sense associated with musical melodies.

5. Thread Angle :-

The included angle characteristic of cross-sectional shape is often called thread angle. For most V-threads this is standerdized as 60°C. But any angle can be cross-section to measure this angle lies on plane which includes the axis of the cylinder.

6. Radius of crest :-

The surface of the thread corresponding to the major radius of the screw and the minor radius of the nut. The Imajinary cylinder or cone bounding crest of screw thread.

7. Radius of root :-

The root of a tap is the surface at the bottom of the thread from that connects adjacent thread flanks and is expressed as width or as a diameter.

Fig. 3.3 Floating Carriage Micrometer

Image Source: https://accurategauging.com/products/educell/

$$E = T + P$$

Where T = Dimension under the wires

$= M - 2d$

M = dimension over the wires, d = diameter of each wire

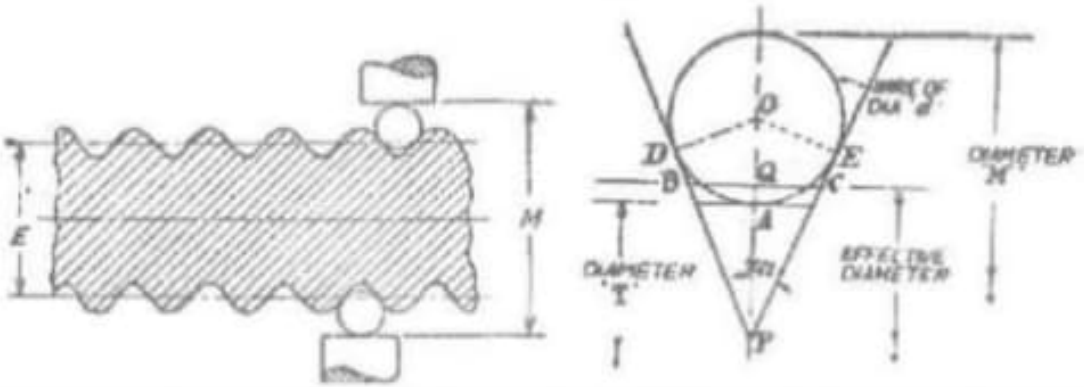

Fig.3.4 Effective Diameter of Screw Thread Measurement by 2 Wire Method

Procedure:-

1) Measure the nominal diameter and major diameter of screw thread with the help of ordinary micrometer.
2) Note the angle of thread for metric thread (θ = 60°).

3) Measure the pitch of the screw threads with the help of screw pitch gauge.
4) The setting master is held between center and taken the reading at the diameter say RS
5) The master cylinder is then replaced by a threaded work piece and R is taken.
6) Take the reading on micrometer and indicator in such a way that radius portion of prism touches master.
7) Select the appropriate diameter of the standard wires.
8) Place two wires in separate holders.
9) The cylinder or wire should be chosen so that when placed between the threads, they should contact about halfway down the flanks.
10) Place the wires between the flanks of the threads on opposite sides.
11) Measure the dimension over the wires.

Observations:-

1) Thread angle (θ) = Degrees
2) Nominal Diameter of bolt (D) = mm
3) Pitch of the screw thread (p) = mm
   Therefore size of Screw threaded bolt : M X (Metric thread)
4) Diameter of standard wires (d) = mm

Calculations :-

1) **Best size wire = dw = p/2 secθ/2.**

If best size wire is not available, select the nearest size available.

CHART - A (For selection of standard wire)

Wire size (d) mm	Pitch (p) mm	P_{value} (for reference only)
0.17	0.25	0.047
0.22	0.35	0.083
0.53	0.9	0.246
0.62	1.0	0.249
0.725	1.25	0.358
0.895	1.5	0.404
1.1	1.75	0.416
1.35	2.0	

2) **Major Diameter Measurement**

Major diameter=Ds + (Rt–Rs)

Where Ds= Diameter of standard setting master cylinder

Rs= Micro meter reading over setting master cylinder

Rt = Micro meter reading over threaded W/P or gauges and

+/ – is determined by relative size of master & work piece

3) **Minor Diameter Measurement**

The minor diameter = Ds +(Rt—Rs)

Where, Rs= Reading on setting cylinder with Vee-pieces (prism) in position

Rt= Reading on thread

Ds= diameter of setting cylinder

4) **Measurement of effective diameter by using 2 wire method:**

E = T + P

T = M— 2d Where

T= Dimension under the wires

M=dimension over the wires

d= diameter of each wire

T= D+ (Rw - Row) Where,

E = Effective or pitch diameter

T = Measured dimension using cylinder.

Rw= Reading measured over setting master with wire.

Row= Reading measured over work piece over wire.

P=It is a value which depends upon the diameter of wire and pitch of the thread.

If P= pitch of the thread, then

P= 0.9605p–1.1657d (for Whitworth thread)

P= 0.866p—d (for Metric thread)

5) **Rake correction (C)**

For Metric thread $\theta = 60°$

L = lead of screw thread &

A = constant = d / (T + d)

$$C = [\cos \theta/2 \times \cot \theta/2 \times L^2 \times A (1 + A \times \sin \theta/2 + A^2 \times \sin^2 \theta/2)] / 2\pi^2 d$$

6) **Correct effective diameter of the screw thread = E – C**

Sources of error:-

1) Improper cleaning of instruments or work piece.
2) Damaged instruments and damaged work piece surface.
3) Improper setting of instrument.
4) Initial error in measuring instruments.

Precautions:-

1) When making a test, micrometer must be located at right angles to the axis of the screw being measured.
2) Threads must be fixed on the table of the microscope, so that observation is not disturbed.

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Observation

1. Thread Angle (θ) = 60 degrees.

2. Nominal Diameter of bolt (D) = 20 mm.

3. Pitch of the screw thread (P) = 1mm

   Therefore size of screw thread.

   Bolt = M x pitch

   = 20 x 1 = 20 mm.

4. Diameter of standerd wires = 0.577 mm

5. Correct effective Diameter = 15.3636 mm.

Calculations :-

1. Best size wire $= dw = \frac{P}{2} \sec\frac{\theta}{2}$

$$= \frac{1}{2} \sec\left(\frac{60}{2}\right)$$

$$= \frac{1}{2} \times \frac{2}{\sqrt{3}}$$

$$\boxed{dw = 0.577 \text{ mm}}$$

Best size wire by theratical conversations has become as 0.577mm But this size wire is not avilable. Hence we will select the nearest size avilable Hence, we will select the nearest size wire avilable i.e 0.62 mm now. 0.577 mm is near to 0.62 mm.
ie. $0.577 \approx 0.62$ mm.

2. Major diameter $= Ds = (Rt - Rs)$

Here $Ds = 20$mm, $Rs = 20$mm

$Rt = 15.5 + 0.302 + 8 \times 0.0002 = 15.8038$ mm.

$\therefore$ Major Diameter $= Ds + (Rt - Rs)$

$20 + (20 - 15.8038)$

$= 20 - 4.1962$

$\boxed{= 15.8038 \text{ mm}}$

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3. Minor diameter :- $D_S \pm (R_t - R_s)$

Here, $R_s = 22.5 + (0.24 + 3 \times 0.002) + 5 \times 0.0.002$

$= 22.747$.

$R_t = 20 + 4209 + 4301 = 28.51 mm$

$D_s = 20 mm$

∴ Minor Diameter = $D_S \pm (R_t - R_s)$

$= 20 - (28.51 - 22.7471)$

$= 20 - 5.763$

$= 14.237$

4. Effective Diameter = $E = T + P$.

Here,

$T = D + (R_W - R_{OW})$.

$D = 20 mm$

$R_W = 20 + 2 \times 0.62 = 21.24 mm$

$R_{OW} = 16 + (0.32 + 3 \times 0.002) + 2 \times 0.002 = 16.3576 mm$

∴ $T = D \pm (R_W - R_{OW})$

$= 20 + (21.24 - 16.3576$

$= 20 \pm (4.8824$

$= 15.1176 mm$

∴ $P = 0.866 P - d$

$= 0.866 (1) - 0.62$

$= 0.246$

∴ Effective Diameter = $E = T + P$

$= 15.1176 + 0.246$

$= 15.3636 mm$

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5. Rake correction (c)

For metric thread (θ) = 60.

L = lead of screw thread = 1.

$$A\text{constant} = \frac{d}{T+d} = \frac{0.62}{15.1176+0.62}$$

$$= \frac{0.62}{15.7376}$$

$$= 0.03939\ mm^2.$$

(a)

$$C = \frac{\cos\frac{\theta}{2} \times \cos\frac{\theta}{2} \times L^2 \times P \left(1 + A \times \sin\frac{\theta}{2} + A^2 \times \sin^2\frac{\theta}{2}\right)}{2\pi^2 d}$$

$$C = \frac{\cos\frac{\theta}{2} \times \cot\frac{\theta}{2} \times L^2 \times A \left(1 + A \times \sin\frac{\theta}{2} + A^2 \times \sin^2\frac{\theta}{2}\right)}{2\pi^2 d}.$$

(b)

$$= \frac{\cos 30 \times \cot 30 \times (1)^2 \times 0.03939 \left(1 + 0.08989 \times \sin 30 + (0.08939)^2 \times \sin^2 30\right.}{2\pi^2 \times 0.62}$$

$$= \frac{\frac{\sqrt{3}}{2} \times \frac{3}{\sqrt{3}} \times 0.03939 \left(1 + 0.03951 \times \frac{1}{2} + (0.03951)^2 \times \left(\frac{1}{2}\right)^2\right.}{2\pi^2 \times 0.62}$$

$$= \frac{0.059085(1.02008)}{12.23830}$$

$$= 3.1253\ mm.$$

3) Proper lighting of the object will assist in accurate recording of measurements.
4) Screw pitch gauge with a stopper must be used especially in case of small nuts.

Conclusions :-

1) Nominal Diameter of bolt (D) = mm
2) Pitch of the screw thread (p) = mm
3) size of bolt : M X (Metric thread)
4) Thread angle (θ) = Degrees
5) Correct effective diameter of the screw thread is mm

Assignment:-

1) How threads are classified?
2) What are the applications of various screw threads?
3) What are the errors in the threads?
4) What are the sources & effects of pitch errors in screw threads?
5) Define best wire size & derive the expression for the same.

References

Title of Article	Web Link
Experiment No. 8 : Measurement of Thread Characteristics	http://egyankosh.ac.in/bitstream/123456789/27378/1/Experiments%281-20%29.pdf
Measurement of Screw Thread Parameters using Floating Carriage Micrometer(2wire method)	https://www.youtube.com/watch?v=DC5u_SvO8r4
#FloatingCarriageMicrometer | How to take reading	https://www.youtube.com/watch?v=dLY3HWCiFic
Effective Diameter by Two Wire Method | Screw Thread Measurement | Mechanical	https://www.youtube.com/watch?v=vNvJi2culC4

Conclusions =

1. Nominal Diameter of bolt (D) = 20 mm
2. Pitch of the screw thread (p) = 1 mm
3. Size of bolt : M X 20 (Metric thread.
4. Thread of angle (θ) = 60° Degrees.
5. Correct effective diameter of the screw thread is 15.3636 mm.

Assignment

1. How threads are classified?

Answer:- There are three classes of thread fit; Loose (where the joint is frequently dissembled).
Class 1. Standerd (general assembly)
Class 2. Close (high accuracy, fine, fits)
Class 3. Designations for each class and the type of thread. (inside and outside) for unified and metric.

2. What are the applications of various screw threads?

Answers:- Screw threads have several applications;
Fastening: Fastners such as wood screws, plastic screws, machine screws nuts and bolts. Connecting threaded pipes and hoses to each other and the caps and fixtures.

3. What are the error of threads.

Answer:- Pitch errors in screws Threads
Gienerally the threads are generated by a point cutting tool. In this case for a pitch to be the correct ration of the. They are major diameteter, pitch diameter, pitch of thread angle if any errors are taking place in this five elements the produced screw is rejected.

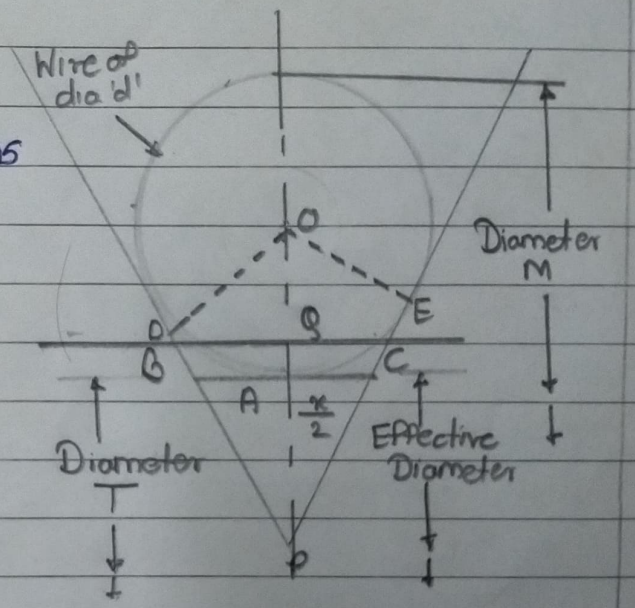
4. What are the sources and effects of the pitch errors in screw thread?

Answer:- Pitch error in screw threads. Pitch to be correct, the ratio of the linear velocity of tool and the angular velocity of the work must be correct and this ratio must be maintained constant. otherwise pitch error will occured.

5. Define best wire size and derivative expression for the same.

Answer:- **Best wire size :-**

"WIRES" which touch the thread at the pitch dia- are known as "Best Wire" size. These wires are used because measurement of pitch diameter are least affected by errors maybe present in the angle of the thread.



The p value can be derived in terms of P (pitch) d (dia of wire) and x thread angle as follows

BC lies on effective Diameter.

$\therefore BC = \frac{1}{2}$ pitch $= \frac{1}{2}P$

$$\text{Next } OP = \frac{d \operatorname{cosec}(x/2)}{2}$$

And $AQ = PQ - AP$

Where,

$PQ = QC \cot(x/2) = P/4 \cot(x/2)$

$$\boxed{PQ = \frac{P}{4}\cot(x/2)}$$

$\therefore AQ = P/4 \cot(x/2) - AP$. $(AP = OP - OA)$

Here, $\boxed{AP = \frac{d\,\operatorname{cosec} x/2 - 1}{2}}$ $\therefore AQ = \frac{P \cot(x/2)}{4} - \frac{d(\operatorname{cosec} x/2 - 1)}{2}$

And AQ is half of the value of PP.

$\therefore P$ value $= 2AQ$ $\boxed{P = \frac{P}{2}\cot\frac{x}{2} - d\left[\operatorname{cosec}\frac{x}{2} - 1\right]}$