**University Of Jordan**
**School of Engineering**
**Industrial Engineering Department**

# Measurement Lab.

Experiment 5

# Screw Thread Inspection

# *Screw thread Inspection*

**Objectives**

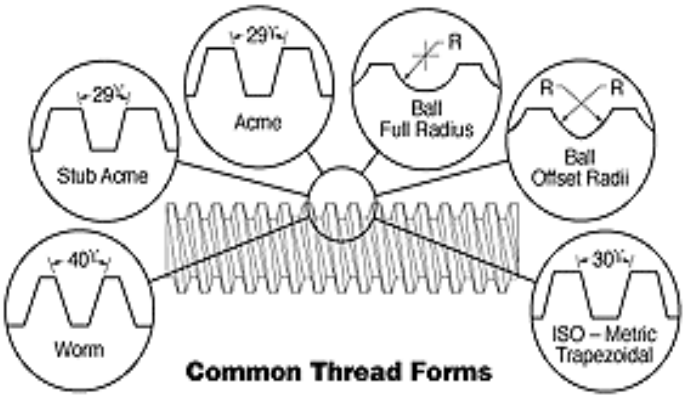
- Measure the major, minor and effective diameters of a screw thread as well as the flank angle and pitch.

**APPARATUS:** 1. Floating carriage diameter measuring machine
2. Thread cylinders
3. Plain cylindrical standards.
4. Vee prisms
5. Metric parallel screw thread plug gauge specimen

Theory

Thread Form

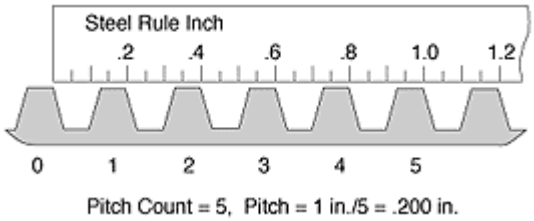
There are many different thread forms in use today. The forms most widely used for power transmission screw threads are illustrated in Figure 1. An optical comparator is the easiest method of determining thread form. Profile gages, if available, and visual methods can also be used. Great care must be taken as many forms are almost identical. The Acme form (29 degree included angle) is only 1 degree different from the ISO Metric Trapezoidal form (30 degree included angle). Many thread forms such as Unified, Metric ISO and Acme are subject to published standards while others, including Ball screw and Worm threads, are not defined in detail by any standards organizations.




Thread Pitch

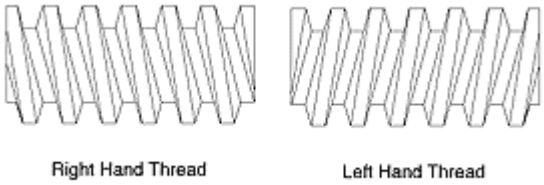
The thread pitch is the axial distance from one thread groove to the next grove along the same line. It can be measured with a steel rule, as illustrated in figure below or a caliper or comparator can be used. By laying a steel rule down the axis of a screw and counting the number of thread crests in a given length, the pitch can be determined by dividing the count into the length.

Example: in the figure shown below, there are 5 pitches in 1 in. so the thread pitch is .200 in. Note that the number of threads per inch is the reciprocal of the thread pitch. A common mistake is to count the number of threads starting with "one". This will lead to a one pitch error. Make sure you start with "zero" for the first thread. To double check your pitch determination, check your pitch determined by count against your actual pitch measurement.




Hand of the Thread

The hand of the thread can be easily determined by visual inspection. Simply compare your screw threads with the right hand and left hand threads illustrated in figure below Most threads are right hand and right hand is assumed if no left hand designation is specified. Left hand threads are common on manual drives where clockwise handle rotation raises, tightens, extends, or creates motion away from the operator. On fine threads, it may be necessary to lay a small wire in the thread grooves to determine hand. Matching the angle of lie of the wire with the illustrations will indicate the hand of thread.




The pitch diameter (often called the effective diameter)

The pitch diameter is the diameter at which the thread tooth and the thread space are equal.

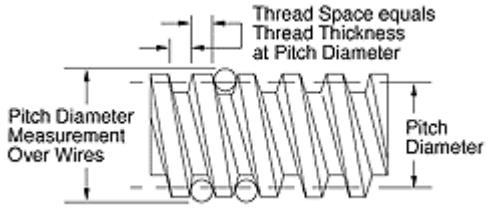



Figure : Pitch diameter

The major diameter : can be measured with a micrometer, caliper or steel rule

Care must be taken to measure the major diameter on a section of the screw thread that is not worn. A worn portion will measure smaller (or larger if burrs have been rolled up) than the original major diameter

Therefore, it is good practice to measure the major diameter over the least used section of the screw.

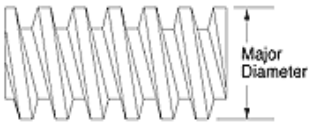



Figure (3): Major Diameter

The minor diameter is the diameter of the cylinder that just touches the root of an internal thread. **The minor diameter can be determined by measuring the depth of the thread with a depth micrometer and subtracting twice the measured depth of thread from the major diameter. When using a comparator to measure the minor diameter,**

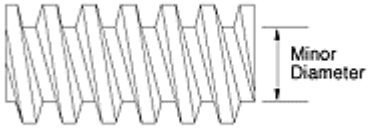
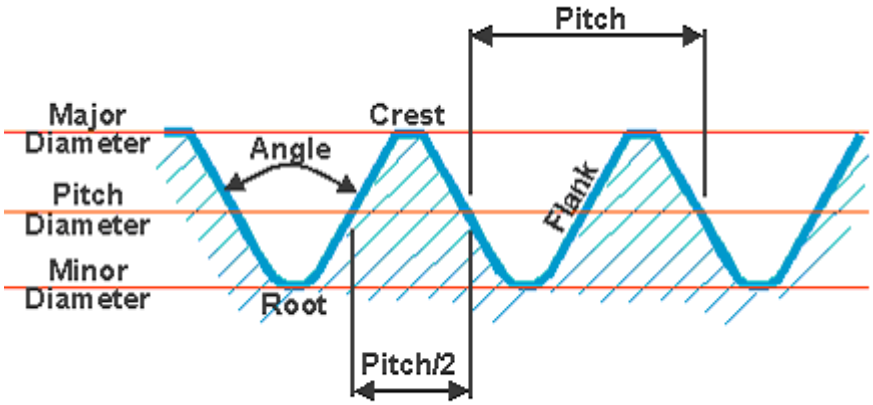



Figure (4): Minor diameter

The crest of a thread : is the prominent part of a thread, whether internal or external.
The root : is the bottom of the groove between the two flanking surfaces of the thread whether internal or external.
The flanks of a thread: are the straight sides that connect the crest and the root.
The angle of a thread : is the angle between the flanks, measured in an axial plane section.




**Measuremenrt of major diameter:**
Select the appropriate cylindrical standard and mount it between the two male centers. Take the reading R of the micrometer when the fiducial pointer in the null position. The standard is then replaced by the workpiece; the specimen provided and a second reading $R_g$ is taken.
If: the micrometer reading over cylindrical standard= R mm ➔ the micrometer reading over specimen= $R_g$ mm, the diameter of the cylindrical styandard= D mm

Then major diameter= D+ ($R_g$ –R)

**Measurement of mean effective diameter**:
1. We selected per correct thread measuring cylinders (wires) from the tables. Again we mounted the plan cylindrical standard between the two centers. We hanged the thread measuring cylindrical vertically, freely from the hook and we took the micrometer reading say $R_s$.
2. The standard is then replaced by the specimen with the thread measuring cylinders located in the thread form. A second reading $R_g$ of the micrometer is taken.

The value p is the difference between the effective diameter (E) and the diameter under the cylinder (T) as below. (i.e. P=E-T).
the value of P is usually calculated from the following expression:

$$P=(p/2)\cot\theta-(\csc\theta-1)d$$

If θ=30 then P=0.86602*Pitch-diameter of thread measuring cylinders (wires).
Now the reading for an effective diameter equal the standard diameter=$R_s$-P value

If E is the actual effective diameter of the specimen, then E=D±[($R_s$-P value)-$R_g$] mm

**Measurement of the minor diameter:**

To determine the minor diameter of a thread, measurement are taken over prisms. We selected the appropriate size prisms from the table.

The first reading is taken over a cylindrical standard and selected Vee prisms, and we measured $R_s$.

Having taken the reading, the standard is replaced by the specimen with prisms located in the thread root. A second reading "$R_g$" of the micrometer is taken.

If: Reading over standard and prisms = $R_s$, Reading over work piece and prisms = $R_g$

Diameter of the standard= D

Then the minor diameter C=D±($R_s$-$R_g$)

**CALCULATIONS**

By using a **micrometer** or caliper; determine the major diameter (actualoutside diameter) of the male screw thread.

By using **a rule or caliper**, determine the number of threads per inch.(see diagram ii).

Measure very carefully the pitch (p) using a thread pitch gage, orany other type of measuring tool which will give an accurate reading forpitch.

Multiply the factor value: (f)=1.0825 by the pitch (p) which yieldsresult (r). f x p = r. example: 1.0825 (f) x 1.75 (p) = 1.8944 (r)

Measure very carefully the (i.d.) inside diameter **(minor diameter)** of thefemale metric thread using an internal micrometer, internal caliper, orgage pin.

Add the measured value for the inside diameter (i.d.) to the result (r)which will yield the nominal major diameter (o.d.) of the female thread.i.d. + r = o.d.

Example: assume measured value 10.1036 (i.d.) + 1.8944 (r)= 12 (o.d. or approximate nominal major diameter).

Fill the following table:

| Parameters | BS3643 Size | Measured size | Comments, Satisfactory/unsatisfactory |
|---|---|---|---|
| Major Diameter | 30.00+0.002 to +0.030 | | |
| Minor Diameter | 26.12 | | |
| Simple effective Diameter | 27.727+0.009 to 0.023 | | |
| Pitch | 3.5 mm+0.006 | | |
| Flank angle | 30° 0' +9' | | |

**Discussion and conclusion :**

- Why we are taken comparative measurement
- The designed accuracy of the floating carriage micrometer is mm.
- What are the advantages of fiducial & non rotating micrometer spindle?