

## Q1.

# Thread Specifications and Shapes

**Threads come in triangular and trapezoidal shapes. Why is that?**

**A:** Figure 1 shows the typical shapes of threads. The threads used for fastening basically come in triangular shapes. On the other hand, the ones used for motion transfer mechanisms such as feed screws or jacks are trapezoidal threads and square threads. Comparing the inclination angle of the thread surface to the normal section, the angle of triangular screw thread is 30 degrees, and that of a trapezoidal thread surface is 15 degrees. Furthermore, the inclination angle of square threads is

basically zero degrees, but they actually have a few degrees of inclination. Therefore, trapezoidal threads have similar mechanical properties to those of square threads. If the coefficient of friction on the thread surface is the same, the friction angle of triangular threads is larger than that of trapezoidal threads. Then, from the mechanical reason, triangular threads are less likely to loosen. Additionally, the ratio of the work done by threads to the total work given by a torque wrench is called "thread efficiency". If the coefficient of friction is the same, the thread efficiency becomes higher in trapezoidal threads. Accordingly, the thread shape of a jack used for lifting heavy objects is basically trapezoid.



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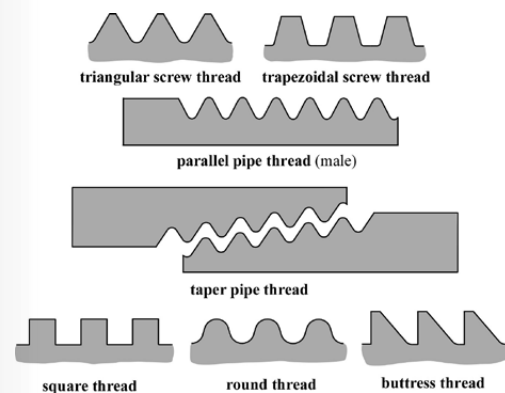



Fig. 1. Typical thread shapes

## Q2. What are the features of double-thread screws and multiple-thread screws?

**A:** The Screw thread with a single triangle being wound along a helix on the outer surface of a cylinder or the inner surface of a hollow cylinder is termed single-thread screw. The one with multiple triangles adjoining in the axial direction being wound along a helix is a multiple-thread screw (Fig. 2). In widely-used single thread screws, the thread pitch is equal to lead, which is the distance traveled in a single rotation. On the other hand, the lead of a multiple thread screw is the product of the thread pitch times the number of threads, and then the distance traveled in a single rotation becomes larger. Utilizing the feature, multiple-thread screws are sometimes used for the feed screws of emergency shutdown valves in pipelines and caps used in

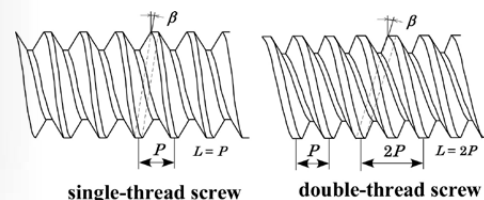


Fig. 2. Single and double threads



daily necessities. Some motion mechanisms are devised utilizing the increase of the difference between fastening torque and loosening torque. Additionally, if the nominal diameter is the same, the lead angle (the spiral angle of threads) is almost proportional to the number of threads, which is effective for multiple-thread screws with several triangles.

### Q3. I heard fine threads are less likely to loosen than coarse threads, but why are coarse threads used extensively?

**A:** The reason that fine threads are less likely to loosen is because they have smaller lead angles than those of coarse threads. There is no doubt about the fact that screw threads with smaller lead angle are less likely to loosen. However, there are various other factors that affect the occurrence of loosening. Additionally, although the shapes of fine threads and coarse threads are all similar, the fundamental triangle height of fine threads is smaller as shown in Figure 3. Considering the fact that a fair amount of the axial bolt force acts on the threads near the bearing surface of the nut, the thread strength of fine threads for shear loads may be weaker. Therefore, fine and coarse threads are respectively used in accordance with the clamping situation, considering the points mentioned above.

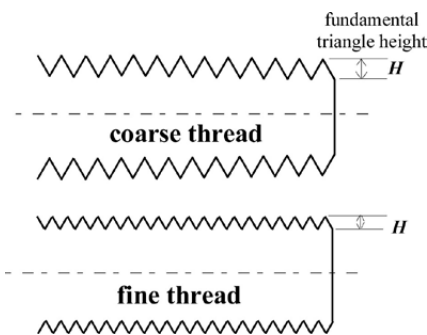


Fig. 3. Fundamental Triangle Height

### Q4. How much is a triangular thread weaker compared to a round bar with the same nominal diameter?

**A:** Though it depends on the type of loads acting on the threads, the concept of stress area, for example, proposed in JIS B1082 would be helpful. Using nominal diameter  $d$  and pitch  $P$ , the stress area can be calculated through the expression in Figure 4. Diameter  $d_s$  of the stress area is the intermediate value of pitch diameter  $d_2$  and minor diameter  $d_1$ .

### Q5. How do I calculate the bearing surface area of a nut or bolt head?

**A:** It is somewhat cumbersome to strictly calculate the area of bearing surface because the bearing surface of the nut and the bolt head are hexagonal. The area calculated by assuming the nut to be a ring-shaped cylinder is sufficiently acceptable from the mechanical point of view, in which the mean value of the width across flat  $s$  and the width across corners  $e$  of the hexagon is regarded as the outer diameter and the bolt hole is the inner diameter. However, the hole size of the bolt can be divided into several categories such as grade 1, grade 2 and grade 3. Be careful that grade 1 and grade 3 have fairly different dimensions.

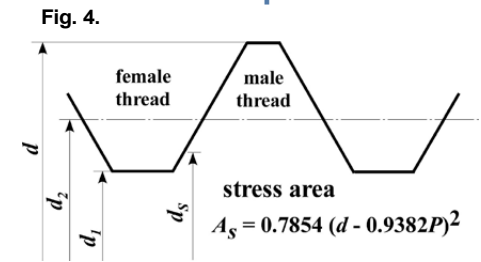




Fig. 4.


$$A_s = 0.7854 (d - 0.9382P)^2$$





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