PRODUCTIVITY QUALITY INC

The Measurement of Threads By The Three Wire Method by Van Keuren

Introduction

The three wire method is recommended for universal use in the direct measurement of threaded gages and components. It has been found to be the most satisfactory procedure for measuring the pitch diameter of straight threads. Pitch diameter is the single most significant measurement which can be made on a thread because it reflects the widest spectrum of potential defects in a threaded part or gage.

The pitch diameter is the diameter of an imaginary cylinder which passes through the thread profile at such points as to make the widths of thread groove and thread ridge equal. The correct pitch diameter assures that the threaded product or thread gage is within required limits in producing interchange ability and strength. Periodic remeasurement of the pitch diameter is recommended to determine whether a thread gage is worn below tolerance.
In Order to accomplish this measurement, three wires of extremely fine tolerance and absolute identity are required. They are placed in contact with the thread form and the measurement over wires is taken. Each set of wires has a matched constant which, when subtracted from this reading, will yield the pitch diameter. Van Keuren Thread Measuring Wires meet or exceed Federal Specification GGG-W-366B for Grade A master Thread Wires in that Van Keuren Wires are made within .000005" of the exact size of the wires. A matched constant is supplied with each set.

Technical Definitions and Explanations

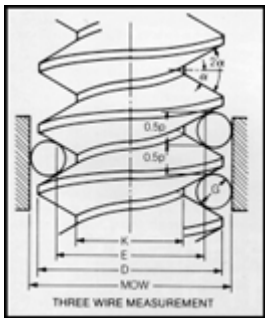
Concerning the three wire method of measuring the pitch diameter of screw threads we quote the following from Bureau of Standards Handbook H28:

"The accurate measurement of pitch diameter of a thread, which may be perfect as to form and lead, presents certain difficulties which result in some uncertainty as to its true value. The adoption of a standard uniform practice in making such measurements is, therefore, desirable in order to reduce such uncertainty of measurement to a minimum.

The so-called 'three-wire method' of measuring pitch diameter, as here outlined, has been found to be the most generally satisfactory method when properly carried out, and is recommended for universal use in the direct measurement of thread plug and thread setting plug gages."

Screw Thread Elements

The following definitions and formulas will be found useful:



1. Angle of Thread. This is the angle included between the sides of the thread measured in an axial plane. It is represented by the letter A. The half angle is represented by the small letter . The angle of thread is known from the name of the thread. All National form and Unified threads have a 60 degree angle. Acme and Worm threads have a 29 degree angle, and Whitworth threads have a 55 degree angle.

2. Pitch. This is the distance from a point on the screw thread to a corresponding point on the next thread measured parallel to the axis of the thread. It is represented by the letter p.

3. Depth of Thread. This is the distance from the crest ot the root of the thread measured perpendicular to the axis of the screw or nut. It is represented by the letter h.

4. Major Diameter. This is the largest diameter of the screw or nut. It is represented by the letter D. No formula is needed for the Major diameter as it is used to identify the size of the screw. For instance a ¼" -20 screw is one having a major diameter of 1/4 inch, and 20 threads per inch.

5. Pitch Diameter. The pitch diameter is the diameter where the thread thickness is equal to the space between the threads. If the flats at the top and bottom of the thread are the same, the pitch diameter will coincide with the middle of the sloping side of the thread. The pitch diameter is represented by the letter E.

Formula. E=D−Depth of thread=D−h
or E=D−Twice the addendum
(Gears, Worms and Acme).

6. Minor Diameter. This is the smallest diameter of the screw or nut. On the nut it corresponds to the tap drill size. It is represented by the letter K.

Formula. K = D − 2 · Depth of Thread
K = D − 2h

7. Lead Angle. This is the angle made by the pitch helix, with a plane perpendicular to the axis. It is represented by the letter s or .

$$\text{Formula. } \tan\lambda = \frac{\text{Lead}}{\pi E} = \frac{0.31831 \cdot \text{Lead}}{E}$$

Note: The term LEAD ANGLE is taken from the ASME, Tentative American Standard for Letter Symbols for Gear Engineering B6.5, 1954, as being preferable to the former term helix angle. In Worm threads the lead angle is as defined above, and in gears the helix angle is the angle made by the pitch helix with the AXIS. The two angles are complementary or:

$$\psi = \text{Helix angle} = 90^\circ - \text{lead angle}$$
$$\text{also, } \tan\psi = \frac{\pi E}{\text{Lead}}$$

8. Best Size Wires.* Wires which touch the thread at the pitch diameter are known as "Best Size" Wires. Such wires are used because the measurements of pitch diameter are least affected by errors that maybe present in the angle of the thread. The diameter of the measuring wires is represented by the letter G.

The approximate formula for Best Size Wires* is: $G = 0.5p \cdot \text{secant } \alpha$

For 60° threads this reduces to
$G = 0.57735p$

For 55° threads Best Size Wires
$G = 0.56369p$

For 53°–8′ threads Best Size Wires
$G = 0.55902p$

For 47½° threads Best Size Wires
$G = 0.54626p$

For 40° threads Best Size Wires
$G = 0.53209p$

For 29° threads Best Size Wires
$G = 0.51645p$

*Exact only for threads of zero lead angle. Usually sufficiently accurate for lead angles up to 5 degrees.