

Calibrating Threaded Plug Gages

Just like gage blocks provide the basis for dimensional measurement, threaded plug gages are the fundamental tool used to verify that an internal thread is correct. As there are many different types of threads to serve different purposes, so there are many different threaded plug gages. And as with any reference standard, these threaded plug gages need to be inspected to ensure they are within their original specification.

There are many dimensional characteristics on a threaded plug gage that can be measured, but the two most common checks which need to be certified are the plug gage major diameter and the pitch diameter. As with other dimensional standards there are industry standards that define how thread standards must be calibrated. In this case ASME B1.2 is the one to reference.

The key to any measurement of gage variation is to use a calibration gage and tools that have proper geometric contacts and are both accurate and sensitive enough to do the thread calibration. For a threaded gage plug major diameter, for example, the measuring system must have anvils large enough to span the thread OD and parallel enough to reduce the potential of introducing unwanted gage errors. If you refer to the specification there are additional details about the face of the contacts that specify parallelism of 4.0μ " ($0.1\mu\text{m}$) or better. The specification also notes that the resolution of the measuring system should be 10μ " ($2.5\mu\text{m}$) or better. Of course these two callouts alone do not make for a perfect measurement. The gage needs to be checked in an appropriate environment, using proper reference standards and by trained operators.

The major diameter is checked by placing the test piece between the reference and sensitive jaw in the gage. In making the measurement the specification calls out the number of measurements to be made on the threaded plug along with the proper gaging pressure to be used. The gaging pressure is typically the same as is specified when making the second most common check on the threaded plug, the pitch diameter.

The "three wire method" is the only acceptable procedure used for checking thread pitch diameter as defined by the ASME specification. Unfortunately there is no easy and direct technique for taking pitch diameter measurements. But it just happens to be the most critical measurement on the threaded plug gage.

The three wire method provides for locating segments of wire of a known diameter at three places on the thread and using a measuring machine to measure the diameter over the three points of wire. The key to an accurate reading is in selecting the "best size" wire diameter for the measurement. These wires sizes are selected based on the threads per inch and are usually found in a Table of Thread Elements.

Also specified, based on the threads per inch, is the gaging pressure to be used. For example, if the plug has 20 or fewer threads per inch, a 2.5 lb. gaging force is required. At the other extreme, if there are 140 threads per inch or more, then only 2 oz. of gaging force is used.

To calculate the pitch diameter using the "best size" wire, refer to the Table of Thread Elements to choose both the thread wire size and the "best size constant" which corrects for the diameters of the wires and the amount they protrude from the thread when measured over the wires. Look at the following example:

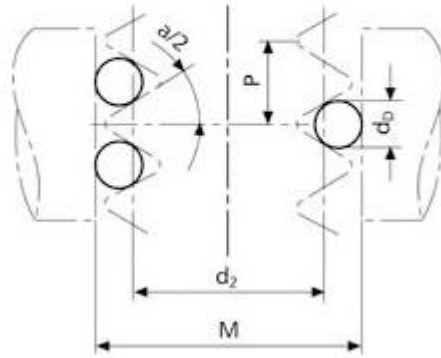
Plug Thread Size	¼-20
"Best Size" wire	0.02887"
"Best Size" constant	0.04331"
Gaging Pressure	2.5 lbs
Actual measurement "over wires"	0.263801"
Threaded plug actual size (actual measurement "over wires" minus the "best size" constant)	0.2202"

The specification also requires that a number of measurements be taken at various locations along the thread to ensure that the pitch diameter size is constant and within tolerance over its full length.

You will also note in Figure 1 that the location of the wires is pretty clear. For most threads there is not much of an issue making the measurements because the three wires make a pyramid and provide a stable fixturing of the threaded plug between the anvils. For plug gages that are small and have very fine threads, there may be a tendency to move the two wires on the one side further apart and skip a few threads to make for a more stable platform. This may be a good idea but it would not be in compliance with the specification.

Figure 1.

Figure 1.



M — Measured Diameter

d_D — Best Size Ball

d_2 — Pitch Diameter

The major diameter is checked by placing the test piece between the reference and sensitive jaws in the gage.

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