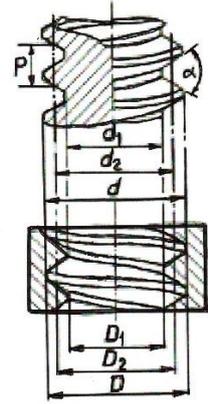


## THREAD INSPECTION

	<p><b>EXTERNAL THREAD</b></p> <p>D1 major diameter D2 pitch diameter D1 minor diameter</p> <p><b>INTERNAL THREAD</b></p> <p>D major diameter D2 pitch diameter D1 minor (bore) diameter</p> <p>P Pitch A Flank angle</p>	<p>The two easiest diameters to inspect (measure) on a thread are:</p> <p>Major diameter (d) on an external thread and minor diameter (D1) on an internal thread and, as they are easy to measure, should always be measured.</p> <p>Given the size of the tolerances on those two diameters a caliper will often be enough.</p> <p>Pitch can easily be checked with a pitch gauge.</p>
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Thread inspection in this document means both thread inspection and thread measurement. It is intended for those making and checking threads (practical) and not for theoretical purposes.

Too many make thread inspection seem much more complicated than it is although it does tend to get overlooked that solid gauges do not reveal if d is below tolerance or if D1 is above tolerance.

By "thread inspection" is meant using solid gauges and preferably both Go and NoGo. The use of solid gauges is very common especially with relatively small diameter standard threads.

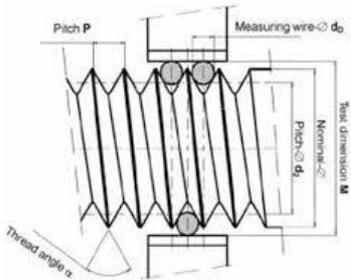
An external thread where the major diameter (d) is below tolerance and an internal thread where the minor diameter (D1 = bore diameter) is above tolerance means that the thread will be weakened with the possibility of stripping the thread when tightened. Also be aware that when a finished thread is to be plated then this will change the pitch diameter of a 60° thread by 4 times the plating thickness and 8 times the plating thickness with a 30° thread.

Below are the advantages and disadvantages of various thread inspection and measurement methods. There are of course others but the ones given are the best known and used.

Suggestions as to other methods are welcome and if any information given is regarded as incorrect please inform as to your opinion.

<b>SOLID THREAD GAUGES</b>		
	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
	<p>Easy to use.</p>	<p>Only suitable for the specific thread type, diameter and tolerance.</p> <p>Gauges for special threads, pitches and tolerances are usually expensive and have lengthy delivery times.</p> <p>Thread plug gauges do not inspect for below tolerance major diameter and thread ring gauges do not inspect for above tolerance minor diameter.</p>

Machine shops that make their own gauges (usually only the Go gauge for internal threads) tend to overlook the cost of manufacturing these gauges. It also gets forgotten at times that a "home made" thread plug gauge is in fact for an internal thread and the relevant internal pitch diameter tolerance isn't the same. That's why a thread plug gauge can never be screwed into the same thread ring gauge. An ideal "home made" thread plug gauge should be made to nominal pitch diameter.

<b>THREAD WIRES</b>		
 	<p style="text-align: center;"><b>ADVANTAGES</b></p> <p>Accurate when used with thought.</p> <p>Loose wires are inexpensive.</p>	<p style="text-align: center;"><b>DISADVANTAGES</b></p> <p>Only suitable for external threads.</p> <p>Can give a false impression of the measurement accuracy result. The "constant" (the number to be subtracted) often has many digits and also assumes that the flank angle is exactly the theoretical one. Gauge flank angles have a much smaller tolerance than actual threaded items.</p> <p>The final measurement result requires a calculation.</p> <p>Measuring with loose wires requires experience and patience.</p>

There are two types of thread wires. "Loose wires" and those that attach to a micrometer anvil and spindle. Re those that attach to a micrometer spindle be aware that micrometers are made with 3 different spindle diameters. 1/4" (6.25mm), 6.5mm and 5/16" (8mm) so purchase those that fit your micrometer. When measuring with wires at the machine having something below the threaded item to catch a wire if dropped is always a good idea as it can take forever to find a wire among cuttings and chips.

<b>THREAD MICROMETER</b>		
 	<p style="text-align: center;"><b>ADVANTAGES</b></p> <p>Easier to use than loose thread wires.</p>	<p style="text-align: center;"><b>DISADVANTAGES</b></p> <p>Only suitable for external threads.</p> <p>Often each pitch requires its own inserts.</p> <p>Each insert can only be used for a specific flank angle.</p> <p>For micrometers over 25mm / 1" a reference is required.</p> <p>As the micrometers are special these micrometers for large diameter threads are not normal.</p>

The "cone" on these inserts (almost always 60°) means that, if the flank angle isn't exactly 60°, then the measurement result will be slightly inaccurate.

<b>OPTICAL THREAD MEASUREMENT – PROFILE PROJECTOR</b>		
	<p style="text-align: center;"><b>ADVANTAGES</b></p> <p>Can measure almost everything on an external thread.</p>	<p style="text-align: center;"><b>DISADVANTAGES</b></p> <p>Only suitable for external threads unless a threaded item is cut exactly in half.</p> <p>Expensive and not usually accessible near the machine manufacturing threaded items.</p>

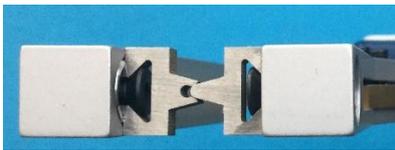
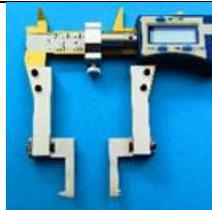
As a projector can be used for much more than measuring threads having one is always an advantage.

<b>FMS THREAD MEASUREMENT SYSTEM</b>		<b>WWW.F-M-S.DK</b>
<b>ADVANTAGES</b>		<b>DISADVANTAGES</b>
 d2	<p>Measures both external and internal threads and 4 FMS standard thread inserts cover the same pitch range as 16 thread wires with most threads.</p> <p>Can be used at the machine by the machinist. Excellent for machine set up and process control.</p> <p>No calculation necessary when measuring external pitch diameter. After zeroing the digital caliper the measurement result you read is the pitch diameter.</p> <p>The only limit on measurable thread diameter is the caliper length.</p> <p>Thread inserts (external and internal) are available (or can be made) for all thread types and pitches.</p> <p>The same thread inserts can be used for all thread diameters with the relevant pitch scope.</p>	<p>Internal thread measurement requires a reference. FMS calibration plates are available or can be made.</p> <p>The thread pitch diameter tolerance should be compatible with caliper accuracy.</p> <p><i>N.B. The most accurate measurement results are achieved when a pressure device (FMS A40) is used to ensure constant measurement pressure. A40 can be used for both external and internal measurement pressure.</i></p>
 D2 (small threads)		
 D2 (large threads)		



Caliper accuracy can be determined by using a calibration plate as reference on d2 and use of a pressure device FMS A40. Measurement accuracy to within  $\pm 0.01\text{mm}$  /  $0.0004''$  is then possible. When thread pitch diameter is measured at machine set up, if a solid gauge is used for inspection, then wear will be significantly less if the manufactured thread tolerance is kept away from the upper and lower tolerance limit. A thread with a good fit is never too loose or too tight.

**PICTURE EXPLANATION & INFORMATION FOR FMS**

	Positioning for measuring external thread pitch diameter with pressure device A40.		Thread insert contact (0.00mm) and preferably by using a caliper pressure device.
	Inserts for smaller diameter threads but can be used for large threads.		Positioning when measuring external thread pitch diameter.
	Use d2 on a calibration plate to determine caliper accuracy.		Calibration plate necessary when measuring internal thread pitch diameter.

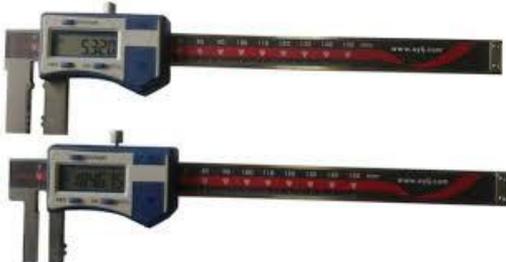
There are of course several other excellent methods (depending on purpose) for measuring internal thread pitch diameter (see page 4 - 4) but a "search" will probably show these to be very expensive alternatives. Remember too that these will also require calibration references and often expensive.

## ALTERNATIVE METHODS AND SYSTEMS FOR INTERNAL THREAD PITCH DIAMETER MEASUREMENT

As mentioned (pictures below) there are many systems for measuring internal thread pitch diameter. Those interested will find they almost all have one thing in common – the supplier of the instruments must be contacted if you want a price and they are relatively expensive. Remember too that they all need a calibration reference. Calibration references can also be expensive.

	
Limited thread diameter range	Thread micrometer. Limited thread diameter range

	
<p>Both similar to the above but they measure over several pitches so it is a question of priority as to what is important. Thread profile or pitch diameter. As they measure thread profile inserts are required for each pitch and a limited diameter. If measurement shows "not within tolerance" the question is – which dimension (or dimensions) is wrong.</p>	

	
External & internal digital thread calipers	
<p>I'm guessing but a caliper is probably necessary for each thread pitch. A calibration reference is necessary for internal pitch diameter measurement. The calibration reference for external measurement looks to be built in.</p>	<p>A pitch gauge does not "measure" but always very useful to have for pitch inspection. Also inexpensive. Can be used on both external and internal threads.</p>

What is it that makes FMS different from almost all others? See page 3 – 4. Probably the almost unlimited thread diameter range possible to measure with both external and internal threads and all thread types. The smallest thread we've had an order for to measure (and delivered) was an internal 3/16"-16 Stub Acme and the largest was for an external and internal M880x12. The M880x12 was to be measured while the items were still in the machine. The M880x12 required a 1,000mm digital caliper and special long insert holders to measure the external thread. Everything for both orders were made within 3 work weeks and delivered. With "normal" diameter thread types and pitches most items are in stock and delivery is usually the day after an order has been received. Payment, except for special tailor-made items, is usually after the order has been received by the customer. Another unique factor with FMS is that any questions customers have re threads and tolerances are usually answered free of charge (assuming we can answer) as part of our service. Our approach to thread measurement is practical rather than theoretical.