

Pre-Coated External Threads

by:

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What size should they be to avoid assembly interference?

When coating or plating is added to a threaded part, the thread's major diameter and pitch diameter become larger. This is rather a simple concept, but one about which questions often arise.

The American Society of Mechanical Engineers (ASME) addresses this matter thoroughly in standard *B1.1* for inch threads and standard *B1.13M* for metric threads. The guidelines in these standards explain the dimensional affect coating or plating has on the various thread characteristics. Companies coating or plating threads should be aware of these guidelines to avoid coating or plating threads to a thickness that will cause assembly interference between the mating external and internal threads.

"Basic" Thread Size Must Not Be Exceeded With Coating or Plating

An external thread's "basic size" is its maximum allowable size on all of its characteristics. On inch threads, the basic size is equal to the maximum pitch diameter limit of *Class 3A* and on metric threads the basic size is equal to the maximum pitch diameter limit of *Class 6h*. A plain finished thread of *Class 3A* or *Class 6h* should not be plated because assembly thread interference is likely. The addition of coating or plating on a *3A* or *6h* thread generally causes the thread's size after coating or plating to exceed the thread's "basic size."

The ASME standards recognized the potential assembly problems associated with coating or plating threads long ago. In response, the ASME created thread classes having sizes smaller than basic size to allow for common coating thicknesses to be applied without exceeding basic size. These smaller classes are *Class 2A* for inch threads and *Class 6g* for metric threads.

Table 1 and **Table 2** show the maximum coating or plating thickness that can be applied to *Class 2A* and *Class 6h* threads without exceeding the thread's basic size.

How Does Coating or Plating Application Effect External Thread's Major & Pitch Diameters?

A thread's size is changed per the following when coating or plating is added:

- **Major diameter:** Major diameter grows by two times the thickness of the plating. This is easy to understand, because when measuring an outside diameter the plating builds up on both opposing sides of the part's surface. If a plating thickness of 0.0002" (5 µm) is applied to the surface of an

Thread Size	Thread Class	Standard Coating Allowance on Pitch Diameter (inches)	Maximum Coating Thickness	
			inches	µm
2-56	2A	0.0006	0.00015	3.7
3-48	2A	0.0007	0.00018	4.5
4-40	2A	0.0008	0.00020	5.0
4-48	2A	0.0008	0.00020	5.0
5-40	2A	0.0008	0.00020	5.0
6-32	2A	0.0008	0.00020	5.0
8-32	2A	0.0009	0.00023	5.7
10-24	2A	0.0010	0.00025	6.2
10-32	2A	0.0009	0.00023	5.7
12-24	2A	0.0010	0.00025	6.2
12-28	2A	0.0010	0.00025	6.2
1/4-20	2A	0.0011	0.00028	7.2
1/4-28	2A	0.0010	0.00025	6.2
5/16-18	2A	0.0012	0.00030	7.5
5/16-24	2A	0.0011	0.00028	7.2
3/8-16	2A	0.0013	0.00033	8.2
3/8-24	2A	0.0011	0.00028	7.2
7/16-14	2A	0.0014	0.00035	8.7
7/16-20	2A	0.0013	0.00033	8.2
1/2-13	2A	0.0015	0.00038	9.5
1/2-20	2A	0.0013	0.00033	8.2
9/16-12	3A	0.0016	0.00040	10.0
9/16-18	3A	0.0014	0.00035	8.7
5/8-11	2A	0.0016	0.00040	10.0
5/8-18	2A	0.0014	0.00035	8.7
3/4-10	2A	0.0018	0.00045	11.2
3/4-16	2A	0.0015	0.00038	9.5
7/8-9	2A	0.0019	0.00048	12.0
7/8-14	2A	0.0016	0.00040	10.0
1-8	2A	0.0020	0.00050	12.5
1-12	2A	0.0018	0.00045	11.2

Note 1: 2A threads after coating or plating are inspected with 3A Go and 2A No Go gages.
Note 2: .0001 inch = 2.5 µm

Thread Size	Thread Class	Standard Coating Allowance on Pitch Diameter (µm)	Maximum Coating Thickness	
			µm	inches
M3X0.5	6g	20	5.0	0.00020
M3.5X0.6	6g	21	5.3	0.00021
M4X0.7	6g	22	5.5	0.00022
M5X0.8	6g	24	6.0	0.00024
M6X1.0	6g	26	6.5	0.00026
M8X1.25	6g	28	7.0	0.00028
M10X1.5	6g	32	8.0	0.00032
M12X1.75	6g	34	8.5	0.00034
M14X2.0	6g	38	9.5	0.00038
M16X2.0	6g	38	9.5	0.00038
M20X2.5	6g	42	10.5	0.00042
M24X3.0	6g	48	12.0	0.00048

Note 1: 6g threads after coating or plating are inspected with 6h Go and 6g No Go gages.
Note 2: 1µm = 0.00004 inches

externally threaded part, the major diameter of the thread grows by 0.0004" (10 μ m).

- **Pitch diameter:** The pitch diameter grows by four times the thickness of the plating. This is a little less obvious than what happens to the major diameter. For pitch, the plating builds up on four surfaces affecting the thread's size instead of two as in the case of the major diameter. The coating or plating builds up on four thread flanks affecting the pitch diameter size. When 0.0002" (5 μ m) of plating is applied to a thread, its pitch diameter grows by some 0.0008" (20 μ m).

How Should Pre-Coating or Pre-Plating Thread Size Be Altered if Required Coating or Plating Thickness Exceeds "Allowance" in the Standards?

The ASME B1 committees have established the following guidelines in *Section 7 of ASME B1.1* (comparable wording is also found in *B1.13*):

7.5.2 Only Nominal or Minimum Coating Thickness Specified. If no coating thickness tolerance is given, it is recommended that a tolerance of plus 50% of the nominal or minimum thickness be assumed. Then, in order to determine before coating gaging limits for a uniformly coated thread, decrease:

- a) The maximum pitch diameter by six times the coating thickness.
- b) The minimum pitch diameter by four times the coating thickness.
- c) The maximum major diameter by three times the coating thickness.
- d) The minimum major diameter by two times the coating thickness.

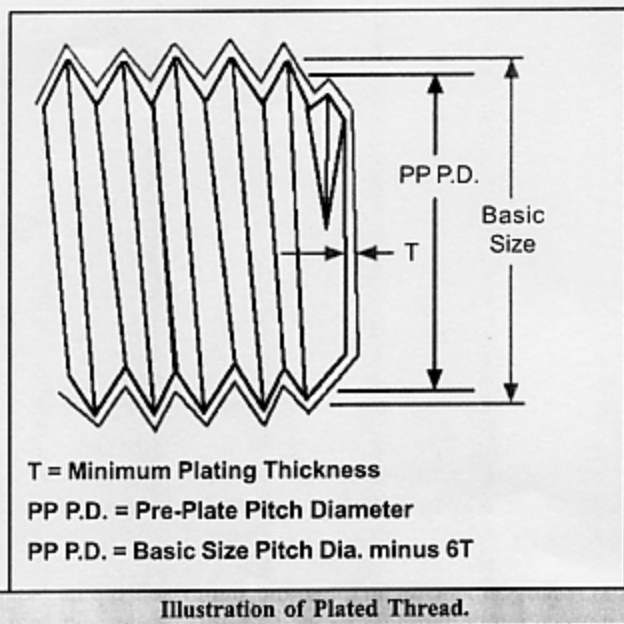
EXAMPLE:

1/2-13 UNC-3A (22)

Coating thickness 0.0004"

Since the allowance for *Class 2A* thread is 0.0015", the nominal or minimum coating thickness that may be applied is equal to 0.0015" divided by six, or 0.00025" (the maximum thickness of coating that may be applied is equal to 0.0015" divided by four or 0.00038"). This is not sufficient for the requirement, so additional adjustments to the thickness before coating pitch and major diameters must be made.

To determine the before coating maximum material sizes, decrease the maximum 3A pitch diameter of 0.4500" by 0.0024" (6 x 0.0004") to 0.4476", and the maximum 3A major diameter of 0.5000" by 0.0012" (3 x 0.0004") to 0.4988". For the before coating minimum sizes, decrease



the minimum 3A pitch diameter of 0.4463" by 0.0016" (4 x 0.0004") to 0.4447", and the minimum 3A major diameter of 0.4891" by 0.0008" (2 x 0.0004") to 0.4883". The before coating sizes should be included in the thread designation.

How Do These Calculated Sizes Relate to the Part's "Rolling or Blank" Diameter?

Manufacturers of fasteners should reduce their normal rolling diameters for *Class 3A* or *Class 6h* threads by six times the minimum required coating or plating thickness in order to allow for coating or plating build-up without generating thread interference problems on the finished threaded parts.

If the manufacturer's normal rolling diameter for a 1/2-13 3A thread is 0.4500" and the minimum coating or plating thickness required is 0.0005", then the special rolling diameter that accommodates this coating or plating should be 0.4470" (6 x 0.0005" = 0.0030").

Awareness of these ASME thread plating guidelines and adherence to them when supplying coated or plated externally threaded products can help in avoiding assembly problems which could lead to end-user complaints as well as to product returns. To receive additional information, contact the author or **Circle 230**.

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Joe Greenslade is a regular contributor of articles to this magazine. He has been active in the fastener industry since 1970 and has held positions with major fastener producers.