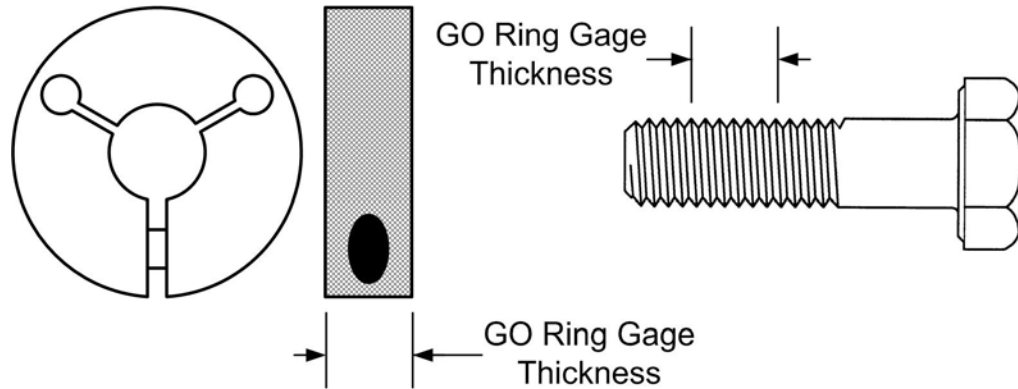


How To Determine A Thread's Lead Variation



Sometimes when threads do not assemble smoothly it is appropriate to measure the thread's lead to determine if it is within the allowable variation. The thread's lead is the distance a thread advances in exactly one 360° of rotation. The thread's pitch is the distance between the same location on two adjacent threads measured parallel to the thread's axis. Most of the time when dealing with threads the terms lead and pitch are used interchangeably.

If the distance between threads is greater than or less than the allowable lead variation the mating threads are likely to bind together before the head of the bolt or screw seats on the assembly surface. Table 4 of the American Society of Mechanical Engineers (ASME) B1.1 standard contains the allowable lead variation for threads. Paragraph 9.1.6 states how this allowable variation is to be applied to determine the acceptability of a thread's lead variation.

ASME B1.1, Paragraph 9.1.6

For the requirements of paragraphs 9.1.4 and 9.1.5, lead variation values tabulated or calculated are the maximum variations from specified lead between any two points not farther apart than the length of the standard GO thread gage.

The easiest way to measure thread's lead (pitch) is to measure the thread on an optical comparator using at least a 40 power magnification and a readout with a 0.0000" resolution. The procedure is as follows:

1. Position the thread on the comparator table parallel to the optical comparator's lens so that all of the thread's flanks appear clear and sharp.
2. Place the intersection of the vertical and horizontal cross hairs on the comparator's screen on one of the thread flanks and Zero the horizontal readout.
3. Move the table horizontally until the readout indicates the distance equal to the thickness of the appropriate GO ring gage. (Example: $\frac{1}{2}$ -13 2A GO Gage Thickness = 0.4375)

4. Next move the table horizontally until the intersection of the horizontal and vertical cross hairs is located on the flank of the thread closest to that distance equal to the GO ring gage thickness.
5. Compare the readout value to the requirements to determine if that value is within the allowable lead (pitch) variation limits. (Example: ½-13 2A allowable lead variation is +/- 0.00144 yielding an allowable range of 0.4389 - 0.4361)

The ring gage thicknesses, lead variations for all 2A and 3A threads from #0 through 1 inch, and the related acceptable value ranges are tabulated in the tables below.

The lead variation of an external thread is acceptable if the value obtained as described above using an optical comparator is within the tabulated maximum and minimum values in the tables. If the measurement is below the minimum value the thread is said to have a short lead. If the measurement is above the maximum value the thread is said to have a long lead.

If an external thread can be rotated freely for its full length into the appropriate GO ring gage and its mating internal thread can freely accept a GO plug gage the lead variation is within acceptable limits for both threads and they should mate together freely. If thread binding during assembly is reported this procedure should be employed to verify the thread's lead (pitch) is within the allowable limits and is not the root cause of the thread binding,

Allowable Lead Variation for UNC Threads within the GO Gage Length										
Nominal Size	UNC T.P.I.	Thread Lead (Pitch)	Ring Gage Thickness	Number Full Threads in Gage	Lead Allowance					
					2A			3A		
					+/-	Maximum Value	Minimum Value	+/-	Maximum Value	Minimum Value
#1	64	0.01563	0.0938	6	0.00058	0.0943	0.0932	0.00043	0.0942	0.0933
#2	56	0.01786	0.0938	5	0.00061	0.0944	0.0931	0.00046	0.0942	0.0933
#3	48	0.02083	0.1563	8	0.00066	0.1569	0.1556	0.00049	0.1567	0.1558
#4	40	0.02500	0.1563	6	0.00072	0.1570	0.1555	0.00055	0.1568	0.1557
#5	40	0.02500	0.1563	6	0.00075	0.1570	0.1555	0.00055	0.1568	0.1557
#6	32	0.03125	0.1563	5	0.00081	0.1571	0.1554	0.00061	0.1569	0.1556
#8	32	0.03125	0.1875	6	0.00084	0.1883	0.1867	0.00064	0.1881	0.1869
#10	24	0.04167	0.1875	5	0.00095	0.1885	0.1866	0.00072	0.1882	0.1868
#12	24	0.04167	0.1875	5	0.00098	0.1885	0.1865	0.00075	0.1883	0.1868
1/4	20	0.05000	0.3438	7	0.00107	0.3448	0.3427	0.00081	0.3446	0.3429
5/16	18	0.05556	0.3438	6	0.00115	0.3449	0.3426	0.00087	0.3446	0.3429
3/8	16	0.06250	0.4375	7	0.00127	0.4388	0.4362	0.00095	0.4385	0.4366
7/16	14	0.07143	0.4375	6	0.00136	0.4389	0.4361	0.00101	0.4385	0.4365
1/2	13	0.07692	0.4375	6	0.00144	0.4389	0.4361	0.00111	0.4376	0.4374
9/16	12	0.08333	0.5625	7	0.00150	0.5640	0.5610	0.00113	0.5636	0.5614
5/8	11	0.09091	0.7500	8	0.00159	0.7516	0.7484	0.00118	0.7512	0.7488
3/4	10	0.10000	0.7500	8	0.00170	0.7517	0.7483	0.00127	0.7513	0.7487
7/8	9	0.11111	0.9375	8	0.00182	0.9393	0.9357	0.00136	0.9389	0.9361
1"	8	0.12500	0.9375	8	0.00196	0.9395	0.9355	0.00147	0.9390	0.9360
Notes:			1		2			2		
1. Dimensions from ASME B47.1.										
2. Tolerances from ASME B1.1, Table 4.										

Allowable Lead Variation for UNF Threads within the GO Gage Length										
Nominal Size	UNC T.P.I.	Thread Lead (Pitch)	Ring Gage Thickness	Number Full Threads in Gage	Lead Allowance					
					2A			3A		
					+/-	Maximum Value	Minimum Value	+/-	Maximum Value	Minimum Value
#0	80	0.01250	0.0938	8	0.00052	0.0943	0.0932	0.00038	0.0941	0.0934
#1	72	0.01389	0.0938	7	0.00055	0.0943	0.0932	0.00040	6.7504	0.0934
#2	64	0.01563	0.0938	6	0.00058	0.0943	0.0932	0.00043	6.0004	0.0933
#3	56	0.01786	0.1563	9	0.00064	0.1569	0.1556	0.00046	8.7505	0.1558
#4	48	0.02083	0.1563	8	0.00069	0.1569	0.1556	0.00052	7.5005	0.1557
#5	44	0.02273	0.1563	7	0.00072	0.1570	0.1555	0.00055	6.8756	0.1557
#6	40	0.02500	0.1563	6	0.00075	0.1570	0.1555	0.00058	6.2506	0.1557
#8	36	0.02778	0.1875	7	0.00081	0.1883	0.1867	0.00061	6.7506	0.1869
#10	32	0.03125	0.1875	6	0.00087	0.1884	0.1866	0.00066	6.0007	0.1868
#12	28	0.03571	0.1875	5	0.00092	0.1884	0.1866	0.00069	5.2569	0.1806
1/4	28	0.03571	0.3438	10	0.00095	0.3447	0.3428	0.00072	9.6257	0.3430
5/16	24	0.04167	0.3438	8	0.00107	0.3448	0.3427	0.00078	8.2508	0.3430
3/8	24	0.04167	0.4375	11	0.00110	0.4386	0.4364	0.00084	10.5008	0.4367
7/16	20	0.05000	0.4375	9	0.00121	0.4387	0.4363	0.00089	8.7509	0.4366
1/2	20	0.05000	0.4375	9	0.00124	0.4387	0.4363	0.00092	8.7509	0.4366
9/16	18	0.05556	0.5625	10	0.00130	0.5638	0.5612	0.00098	10.1260	0.5615
5/8	18	0.05556	0.5625	10	0.00136	0.5639	0.5611	0.00101	10.1260	0.5615
3/4	16	0.06250	0.5625	9	0.00144	0.5639	0.5611	0.00110	9.0011	0.5614
7/8	14	0.07143	0.6875	10	0.00156	0.6891	0.6859	0.00118	9.6262	0.6863
1"	12	0.08333	0.6875	8	0.00170	0.6892	0.6858	0.00127	8.2513	0.6862
Notes:			1	2	2					
1. Dimensions from ASME B47.1.										
2. Tolerances from ASME B1.1, Table 4.										