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Thorlabs lens tubes

SM

We use [thorlabs lens tubes](#) to build telescopes, fibre collimators etc. Lens tubes allow fairly accurate positioning of components along the optical axis (although adjustment is a pain), but are superb at preserving *centration*, which is a major source of aberrations in optical imaging systems.

An alternative to the lens tube system is the [cage system](#), which are somewhat easier to assemble and allow much easier access to elements along the optical path - especially elements such as waveplates in rotation stages which require adjustment. We will use cage systems for fibre couplers and MOT beams.

Cage or tube systems should be preferred to post mount assembly onto optical benches whenever possible. They allow the x and y degree of freedom around the optical axis to be removed, and also the θ_x and θ_y centration degrees. They provide modularity: an aligned telescope or fibre coupler can be moved as a block.

This page contains some hard to find information for building your own components to interoperate with Thorlabs lens tubes and other Thorlabs components using the same threads (mirror mounts and some cage components too). We are manufacturing custom lens tubes to hold small aspheres in SM05 compatible tubes for the [tapered amplifier](#) project.

Basic specifications

Thorlabs labels their tube system *SM*. SM05 is the half-inch nominal diameter, then SM1, SM2 and SM3 for whole inch diameters. They also offer the *SM30* metric tube size in 30mm nominal diameter. We avoid this one.

Tube	Thread	Clear ID	Clear ap	Thread OD	Tube OD
SM05	0.535"-40	12.9 mm	10.9 mm	11.4 mm?	17.8mm
SM1	1.035"-40	25.5mm	22.9mm	24.0 mm?	30.5 mm
SM2	2.035"-40	51.0 mm	48.3mm	48.3mm?	55.9 mm

Thread specifications

The threads are 40 TPI (threads per inch) pitch at rather odd imperial diameters. Newport has a series of compatible lens tubes, but it seems Thorlabs came first. The thread diameter was presumably chosen to be the smallest imperial increment larger than the clear diameter.

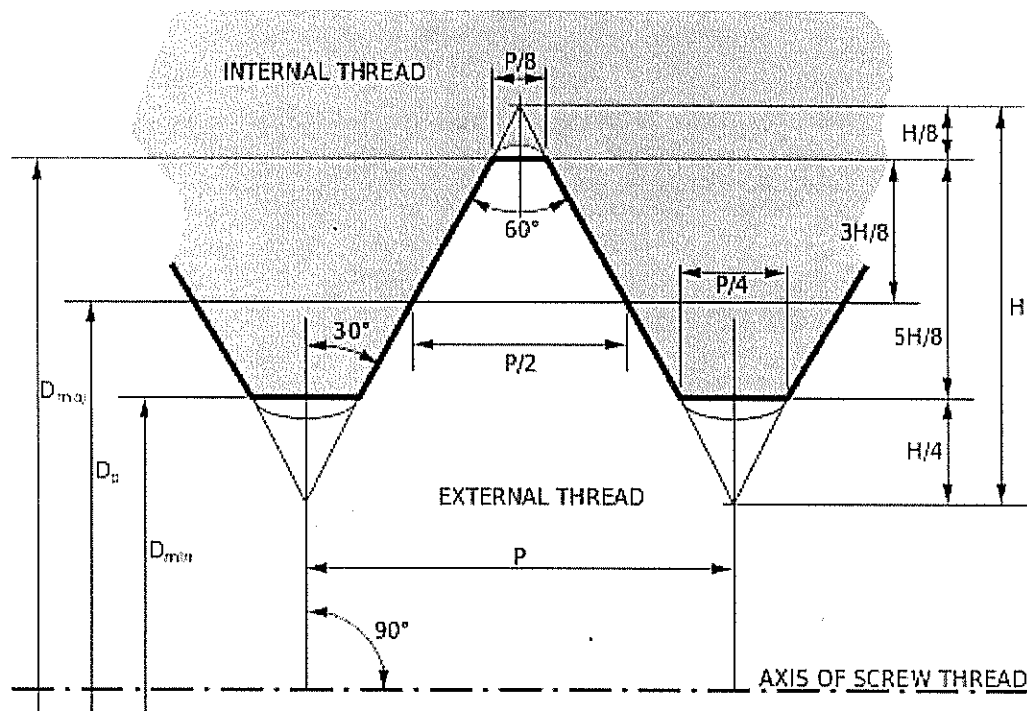
The thread form is the US [Unified Thread Standard](#). The UTS is actually the same basic thread design as the ISO 68-1 standard for metric screw threads (these are the *M* threads such as M3, M4, M9-0.5 etc) - they both have symmetric 60 degree profiles with more-or-less harmonised rounding of the roots and crests (see http://www.sizes.com/tools/thread_american.htm). The difference of course is that the UTS threads have imperial diameters and threads per *inch*. This doesn't help the interoperate but does allow the same cutting procedure I guess.

In the US everything is UTS and the term is little used. The familiar UNC (coarse), UNF (fine) etc terms are used. The UN (unified national) refers to the UTS standard. The Thorlabs thread is classed

as UNS (unified national special) indicating that it is not UNC, UNF nor UNEF. More precisely the threads are specified by Thorlabs as UNS-2A and UNS-2B. The A refers to external threads and the B to internal. The "2" is a tolerance class indicating common fit (neither loose fit for easy assembly nor fine tolerance). As this is a 40 TPI thread the tolerance has to be pretty fine anyway!

Detailed thread specs for machine shop

Thread specifications are with respect to:



Summary suitable for machine shop use:

Series	Type	Thread	Nom diam	Minor diam	Pitch diam	Major diam
SM05 internal	UNS-2B	0.535"-40.0	13.59 mm	12.98 % \pm % 0.07 mm	13.24 % \pm % 0.05 mm	> 13.59 mm
SM05 external	UNS-2A	0.535"-40.0	13.59 mm	< 12.78 mm	13.10 % \pm % 0.05 mm	13.50 % \pm % 0.05 mm
SM1 internal	UNS-2B	1.035"-40.0	26.29 mm	25.68 % \pm % 0.07 mm	25.95 % \pm % 0.07 mm	> 26.29 mm
SM1 external	UNS-2A	1.035"-40.0	26.29 mm	< 25.48 mm	25.79 % \pm % 0.05 mm	26.19 % \pm % 0.06 mm
SM2 internal	UNS-2B	2.035"-40.0	51.69 mm	51.08 % \pm % 0.075 mm	51.35 % \pm % 0.075 mm	> 51.69 mm
SM2 external	UNS-2A	2.035"-40.0	51.69 mm	< 50.87 mm	51.18 % \pm % 0.05 mm	51.59 % \pm % 0.05 mm

Min and max diams taken from spreadsheet sent by Thorlabs tech support. Full original imperial specs from Thorlabs:

Series	Type	Thread	Nom diam	Minor diam	Pitch diam	Major diam
SM05 internal	UNS-2B	0.535"-40.0	0.535"	0.5079 - 0.5139"	0.5188 - 0.5239"	> 0.5350"
				0.5109 % \pm %	0.5214 % \pm %	

		0.003"	0.0025"	
		13.589 mm	12.977 %\$\pm\$% 0.07 mm	13.242 %\$\pm\$% 0.05 mm > 13.589 mm
SM05 external	UNS- 0.535"-40.00.535" 2A	< 0.5032"	0.5137 - 0.5176"	0.5287 - 0.5338"
			0.5157 %\$\pm\$% 0.002"	0.5313 %\$\pm\$% 0.0025"
		13.589 mm	< 12.781 mm	13.098 %\$\pm\$% 0.05 mm
				13.494 %\$\pm\$% 0.05 mm
SM1 internal	UNS- 1.035"-40.01.035" 2B	1.0079 - 1.0139"	1.0188 - 1.0243"	> 1.035"
		1.0109 %\$\pm\$% 0.003"	1.0216 %\$\pm\$% 0.003"	
		26.289 mm	25.677 %\$\pm\$% 0.07 mm	25.947 %\$\pm\$% 0.07 mm > 26.289 mm
SM1 external	UNS- 1.035"-40.01.035" 2A	< 1.0031"	1.0133 - 1.0175"	1.0286 - 1.0337"
			1.0154 %\$\pm\$% 0.002"	1.0312 %\$\pm\$% 0.003"
		26.289 mm	< 25.479 mm	25.791 %\$\pm\$% 0.05 mm
				26.191 %\$\pm\$% 0.06 mm
SM2 internal	UNS- 2.035"-40.02.035" 2B	2.0079 - 2.0139"	2.0188 - 2.0248"	> 2.035"
		2.0109 %\$\pm\$% 0.003"	2.0218 %\$\pm\$% 0.003"	
		51.689 mm	51.077 %\$\pm\$% 0.075 mm	51.354 %\$\pm\$% 0.075 mm > 51.689 mm
SM2 external	UNS- 2.035"-40.02.035" 2A	< 2.003"	2.0128 - 2.0174"	2.0285 - 2.0336"
			2.0151 %\$\pm\$% 0.0025"	2.0311 %\$\pm\$% 0.0025"
		51.689 mm	< 50.876 mm	51.184 %\$\pm\$% 0.05 mm
				51.589 %\$\pm\$% 0.05 mm

Tools

Spanner wrenches are highly recommended for inserting retaining rings. We have them in SM05, SM1 and SM2.

Taps and dies

Thorlabs sell taps for SM series threads as well as for mildly exotic threads such as the metric threads on mounted aspheres. Below is an inventory of the taps we have.

Series	Thread	Type	Thorlabs part number	Tap drill size	metric	Location
SM05 lens tubes	0.535"-40	Tap - flute	<u>83373</u>	0.508"	12.9 mm	???
SM1 lens tubes	1.035"-40	Tap - flute	<u>97355</u>	1.008"	25.6 mm	G46
Aspheres: C110. 220. 260. 280. 330.	M9-0.5	Tap -	98109	0.3307"	8.4 mm	G46

340, 560, 570, 610, 671, 660	first			
M25 Threaded Microscope Objectives	M25-0.75 Tap - <u>99925</u>	0.945"	24.0mm G46	
	flute			
RMS Threaded Microscopes	0.8"-36 Tap - <u>46720</u>	0.772"	19.6mm G46	
	flute			

We have not yet located a supplier of dies, but external threads can be cut readily on machine shop lathe.

-- Main.LincolnTurner - 02 May 2010

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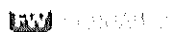
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SM05 Threading: Ø1/2" Lens Tubes, 16 mm Cage Systems			
External Thread, 0.535"-40.0, UNS-2A		Internal Thread, 0.535"-40.0, UNS-2B	
Max Major Diameter	0.5340"	Min Major Diameter	0.5350"
Min Major Diameter	0.5289"	Min Pitch Diameter	0.5188"
Max Pitch Diameter	0.5178"	Max Pitch Diameter	0.5230"
Min Pitch Diameter	0.5146"	Min Minor Diameter (and 83.3% of thread)	0.508"
Max Minor Diameter	0.5069"	Max Minor Diameter (and 64.9% of thread)	0.514"

RMS Threading: Objective, Scan, and Tube Lenses			
External Thread, 0.800"-36.0, UNS-2A		Internal Thread, 0.800"-36.0, UNS-2B	
Max Major Diameter	0.7989"	Min Major Diameter	0.8000"
Min Major Diameter	0.7934"	Min Pitch Diameter	0.7820"
Max Pitch Diameter	0.7809"	Max Pitch Diameter	0.7866"
Min Pitch Diameter	0.7774"	Min Minor Diameter (and 83.3% of thread)	0.770"
Max Minor Diameter	0.7688"	Max Minor Diameter (and 64.9% of thread)	0.777"

C-Mount Threading: Machine Vision Lenses, CCD/CMOS Cameras			
External Thread, 1.000"-32.0, UN-2A		Internal Thread, 1.000"-32.0, UN-2B	
Max Major Diameter	0.9989"	Min Major Diameter	1.0000"
Min Major Diameter	0.9929"	Min Pitch Diameter	0.9797"
Max Pitch Diameter	0.9786"	Max Pitch Diameter	0.9846"
Min Pitch Diameter	0.9748"	Min Minor Diameter (and 83.3% of thread)	0.966"
Max Minor Diameter	0.9651"	Max Minor Diameter (and 64.9% of thread)	0.974"

SM1 Threading: Ø1" Lens Tubes, 30 mm Cage Systems			
External Thread, 1.035"-40.0, UNS-2A		Internal Thread, 1.035"-40.0, UNS-2B	
Max Major Diameter	1.0339"	Min Major Diameter	1.0350"
Min Major Diameter	1.0288"	Min Pitch Diameter	1.0188"
Max Pitch Diameter	1.0177"	Max Pitch Diameter	1.0234"
Min Pitch Diameter	1.0142"	Min Minor Diameter (and 83.3% of thread)	1.008"
Max Minor Diameter	1.0068"	Max Minor Diameter (and 64.9% of thread)	1.014"

SM30 Threading: Ø30 mm Lens Tubes			
External Thread, M30.5x0.5		Internal Thread, M30.5x0.5	
Max Major Diameter	30.480 mm	Min Major Diameter	30.500 mm
Min Major Diameter	30.371 mm	Min Pitch Diameter	30.175 mm
Max Pitch Diameter	30.155 mm	Max Pitch Diameter	30.302 mm
Min Pitch Diameter	30.059 mm	Min Minor Diameter (and 83.3% of thread)	29.959 mm
Max Minor Diameter	29.938 mm	Max Minor Diameter (and 64.9% of thread)	30.094 mm

SM2 Threading: Ø2" Lens Tubes, 60 mm Cage Systems			
External Thread, 2.035"-40.0, UNS-2A		Internal Thread, 2.035"-40.0, UNS-2B	
Max Major Diameter	2.0338"	Min Major Diameter	2.0350"
Min Major Diameter	2.0287"	Min Pitch Diameter	2.0188"
Max Pitch Diameter	2.0176"	Max Pitch Diameter	2.0239"
Min Pitch Diameter	2.0137"	Min Minor Diameter (and 83.3% of thread)	2.008"
Max Minor Diameter	2.0067"	Max Minor Diameter (and 64.9% of thread)	2.014"

SM3 Threading: Ø3" Lens Tubes			
External Thread, 3.035"-40.0, UNS-2A		Internal Thread, 3.035"-40.0, UNS-2B	
Max Major Diameter	3.0337"	Min Major Diameter	3.0350"
Min Major Diameter	3.0286"	Min Pitch Diameter	3.0188"
Max Pitch Diameter	3.0175"	Max Pitch Diameter	3.0242"
Min Pitch Diameter	3.0133"	Min Minor Diameter (and 83.3% of thread)	3.008"

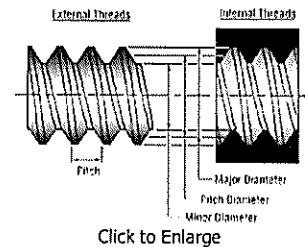
SM3 Threading: Ø3" Lens Tubes			
Max Minor Diameter	3.0066"	Max Minor Diameter (and 64.9% of thread)	3.014"

Visit the *Optical Component Threading Adapters with SM1 (1.035"-40) Threads* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=1524

THREADING SPECS

Thorlabs' Threading Specifications

Thorlabs' lens tubes utilize a series of non-standard threadings. Threading specifications are given below for our SM threadings utilized in our lens tube and cage system components so that you can machine mating components to suit your application. We also offer products with C-Mount and RMS threadings, and the specifications for these threadings are also given below. Please note that other manufacturers may have different tolerances for these threads. For other thread specifications that are not listed here, please contact Tech Support.



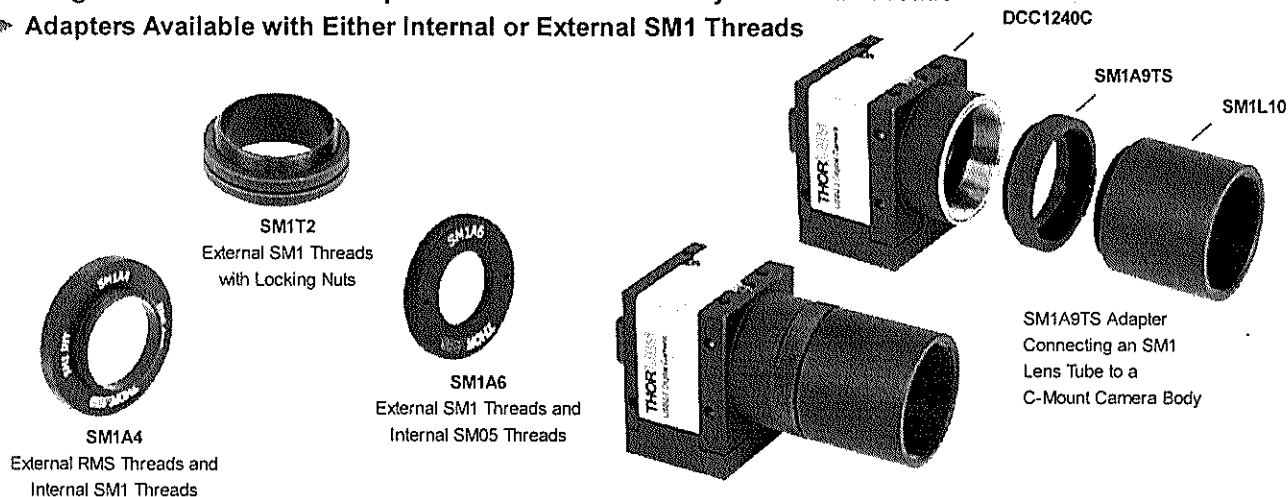


56 Sparta Avenue • Newton, New Jersey 07860
(973) 300-3000 Sales • (973) 300-3600 Fax
www.thorlabs.com

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- ▶ **Integrate SM1-Threaded Components with Other Industry-Standard Threads**
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3M Threadfin® 30" Lanes Tubes, 30 mm O-ring Systems

External Thread, 1.035"-40.0, UNS-2A		Internal Thread, 1.035"-40.0, UNS-2B	
Max Major Diameter	1.0330"	Min Major Diameter	1.0350"
Min Major Diameter	1.0280"	Min Pitch Diameter	1.0180"
Max Pitch Diameter	1.0177"	Max Pitch Diameter	1.0234"
Min Pitch Diameter	1.0142"	Min Minor Diameter (and 88.3% of thread)	1.008"
Max Minor Diameter	1.0050"	Max Minor Diameter (and 84.9% of thread)	1.014"