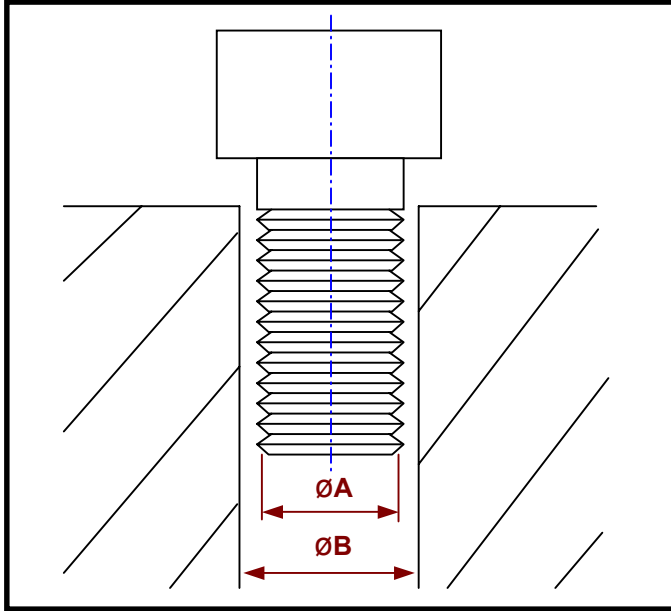# Guide for Specification of Imperial Bolts, Threads and Hole Fits in Advanced LIGO Parts

Metric Equivalents to Imperial Bolts and Through Hole Specification

This document serves as a reference guide when adding clearance holes on parts drawn up in Solidworks or other associated CAD packages.

During the development of the Mode Cleaner Controls Prototype the close-fit hole specification and drill sizes, shown in the table below, were used. Where tight positional tolerances were required, a hole-to-hole tolerance of +/-0.001inch was commonly specified. A good example of this can be seen in the upper blade drawings (D020205).
For further information on coaxial and concentric tolerancing of holes, refer to ASME Y14.5M-1994 or equivalent.

Where possible, to avoid unneeded additional cost of tight tolerance machining, the Free or Normal-fit specification (again, shown in the table below) should be used. In this situation a hole-to hole tolerance of +/-0.005 will be adequate.

Whilst working in metric units, typing 'in' after a dimension will trigger SolidWorks to automatically calculate the metric equivalent of an inch dimension. e.g. for a close-fit hole specification for a #4-40 bolt, typing '0.1285in' will give you a metric dimension of '3.2639mm'

NOTE ** - In compiling this document, the term 'close-fit' has been found to be used very loosely with some references implying close-fits greater than those shown.

Imperial Size	Approx. Metric Equivalent	Actual Diameter [inches] ØA	Actual Diameter [mm]	Close-fit hole ** spec. [in] ØB	Drill Size	Alternative Hole Specification (i.e. available Drill sizes between Close and Free Fit) [inches / Drill Size]								Free-fit hole spec. [in]	Drill Size	Normal-fit hole spec. [in]	Drill Size
#2-56	M2	0.086	2.1844	0.0890	43	0.0935	42	0.0938	3/32	-	-	-	-	0.0960	41	0.1065	36
#4-40	M3	0.112	2.8448	0.1160	32	0.1200	31	0.1250	1/8	-	-	-	-	0.1285	30	0.136	29
#6-32	M3.5	0.125	3.175	0.1285	30	0.1360	29	0.1406	9/64	0.1440	27	0.1470	26	0.1495	25	0.1695	18
#8-32	M4	0.164	4.1656	0.1695	18	0.1719	11/64	0.1730	17	-	-	-	-	0.1770	16	0.1935	10
#10-24	M5	0.19	4.826	0.1935	10	0.1960	9	0.1990	8	-	-	-	-	0.2010	7	0.221	2
#1/4-20	M6	0.25	6.35	0.2570	F	0.2610	G	0.2656	17/64	-	-	-	-	0.2660	H	0.2812	9/32
#5/16-18	M8	0.3125	7.9375	0.3230	P	0.3281	21/64	-	-	-	-	-	-	0.3320	Q	0.3438	11/32
#3/8-16	M10	0.375	9.525	0.3860	W	0.3906	25/64	-	-	-	-	-	-	0.3970	X	0.4062	13/32
#1/2-13	M12	0.5	12.7	0.5156	33/64	-	-	-	-	-	-	-	-	0.5312	17/32	0.5312	17/32

Additional Information for Countersink Holes, etc.

Imperial Size	Max. Bolt Head Dia. (in.) ØC	Max. Bolt Head Height (in.) D	Typical C'Bore Dia. (in.) ØE
#2-56	0.140	0.086	0.188
#4-40	0.183	0.112	0.219
#6-32	0.226	0.138	0.281
#8-32	0.270	0.164	0.313
#10-24	0.313	0.190	0.375
#1/4-20	0.375	0.250	0.438
#5/16-18	0.409	0.313	0.531
#3/8-16	0.562	0.375	0.625
#1/2-13	0.750	0.500	0.813
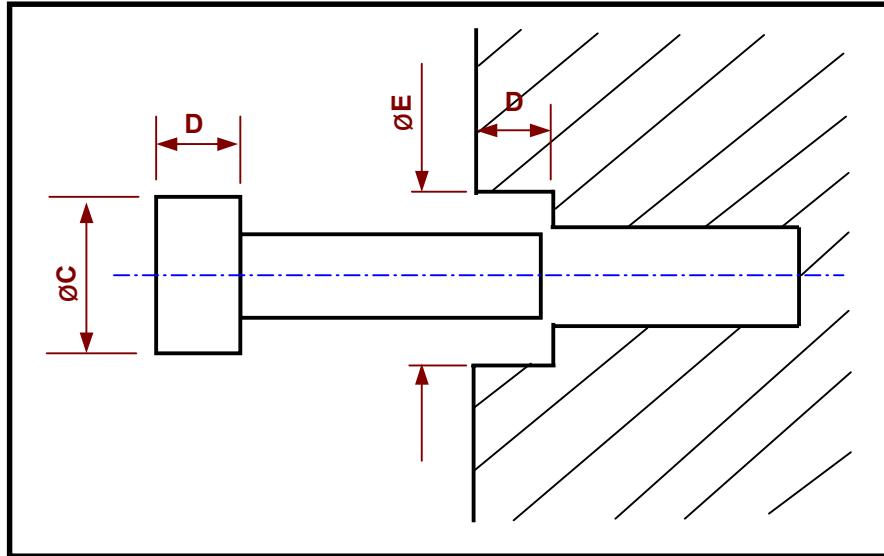
INCH/METRIC TAP DRILL SIZES & DECIMAL EQUIVALENTS

REFERENCES:

1 Starrett Precision Tools; www.starrett.com; *Inch/Metric Tap Drill Sizes & Decimal Equivalents*; Free reference Card (as shown in picture, left); Catalogue item number 1317 . Note that all above decimal hole diameters have corresponding fractions or drill sizes.

2 Tapping and Clearance Hole Information, www.stanford.edu/~jwodin/holes.html

3 Unbrako Engineering Guide (Inch & Metric), *Through Hole Preperation* ; www.spstech.com/unbrako/htm/unbrakodl.html

4 ASME Y14.5M-1994 Dimensioning and Tolerancing,