

Thread Forming Screws for Plastics

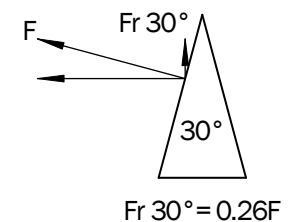
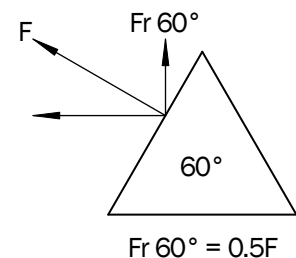
There are three primary methods of using threaded fasteners to blind-join components to plastic substrates: thread forming screws, thread cutting screws and metallic inserts with machine thread screws. The table below offers a proximal comparison of the techniques.

Fastener Type	Ease of Screw Removal and Reassembly	Use with Very Brittle Thermoset Plastics	Lowest Installed Cost	Most Resistant to Loosening	Least Plastic Installation Stress	Greatest Number of Options	Smallest Overall Footprint
Thread Forming Screw	**	--	***	***	*	**	***
Thread Cutting Screw	--	***	***	**	***	**	***
Insert w/ Machine Screw	***	***	*	*	**	***	*

This technical bulletin presents a comprehensive overview on the design, selection and installation of thread forming screws in plastics offered by PENCOM.

THREAD DESIGN

Thermoplastics are polymers composed of long, random molecular chains with ductile behavior that promotes cold-forming and filling in around tapping screw threads. Unlike standard Type B thread forming screws with 60° thread flank angles, those designed specifically for plastics have more narrow and taller thread profiles with sharp 30° to 48° thread flank angles and wider thread spacings that reduce the amount of outward radial force (Fr) and take advantage of the plastics' ductile flowing behavior. This allows for reduced boss diameters and plastic damage, installation in a wide variety of plastic strengths, lower installation drive torque and more resistance to stripping and pull out. Thermosetting plastics are less ductile and too stiff for thread forming screws. In those applications thread cutting screws, which are tapping screws with special features on the lead threads that remove material during installation, should be considered.

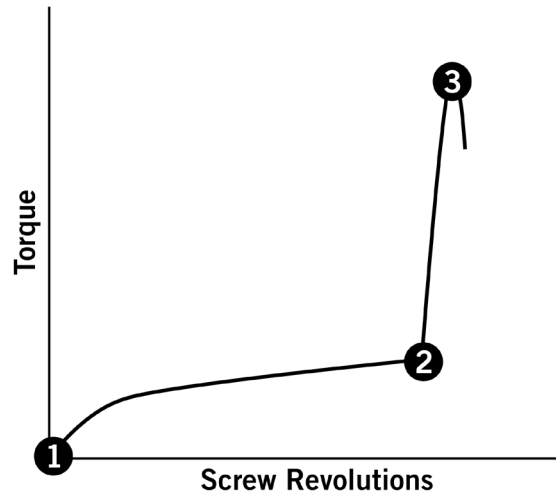


INSTALLATION TORQUE

One of the most common questions regarding thread forming screw installation is “what installation torque should be used?” Unfortunately unlike machine screws, there are no published calculations for determining thread forming screw installation torque and can be simultaneously affected by the following each having a multitude of possibilities.

- | | | |
|-------------------------|---------------------------|--------------------------|
| Hole diameter and draft | Number of engaged threads | Boss wall thickness |
| Screw finish | Installation rpm | Thread shape and spacing |
| Plastic temperature | Plastic material type | Desired clamp load |

Therefore, the only way to determine a suitable installation torque is through testing in conditions as close as possible to the actual application. The adjacent graph illustrates how thread forming screws in plastic respond to applied torque. From the points 1 to 2, torque is applied to form the threads. As the number of engaged threads increases so too does the required torque to overcome the additional friction. At point 2 the screw head is seated and any further torque results in compressive loading of plastic against the screw threads and is referred to as stripping torque. At point 3 the fastener fails due to several different possible modes such as thread stripping, fastener failure or boss collapse.



A potential installation torque spec might be somewhere in the lower 1/3 to 1/2 of the stripping range (2-3) with a tolerance of 5-10% depending on the accuracy of the installation tool at the specified rpm. As clamping load increases material relaxation (creep) and potential for stress cracking rise as well. Therefore, PENCOM strongly encourages using the minimum necessary tightening torque rather than the maximum that can be achieved before failure.

DRIVER SPEED

Friction between the screw threads and boss wall generates heat during installation. High driver rpm can cause excessive heat that may melt and damage the plastic creating a weak joint and increasing the likelihood of stripping failure during installation. Because of the wide thread spacing associated with thread forming screws, fewer rotations are needed for installation so faster rpm's don't necessarily translate to reduced assembly times. As a guideline 300-500 rpm generally results in proper installation while maintaining high productivity.

SELECTION

PENCOM offers four types of thread forming screws for plastics,

HILO

Page 5

Feature a unique twin thread profile with different thread flank angles and diameters.

PF

Page 7

Designed with a distinctive thread profile and root for use in a wide variety of thermoplastic materials.

PLAST45

Page 9

Tri-Nodular™ body cross-section resists loosening and extra wide thread spacing offers excellent performance in hard plastics.

PLAST48-2

Page 11

Similar body cross-section to the PLAST45 but with twin-lead threads for faster engagement and easier installation tool adjustments.

The table below offers thread type guidance for some common thermoplastic materials. These are approximate recommendations only as there are numerous factors affecting fastener performance.

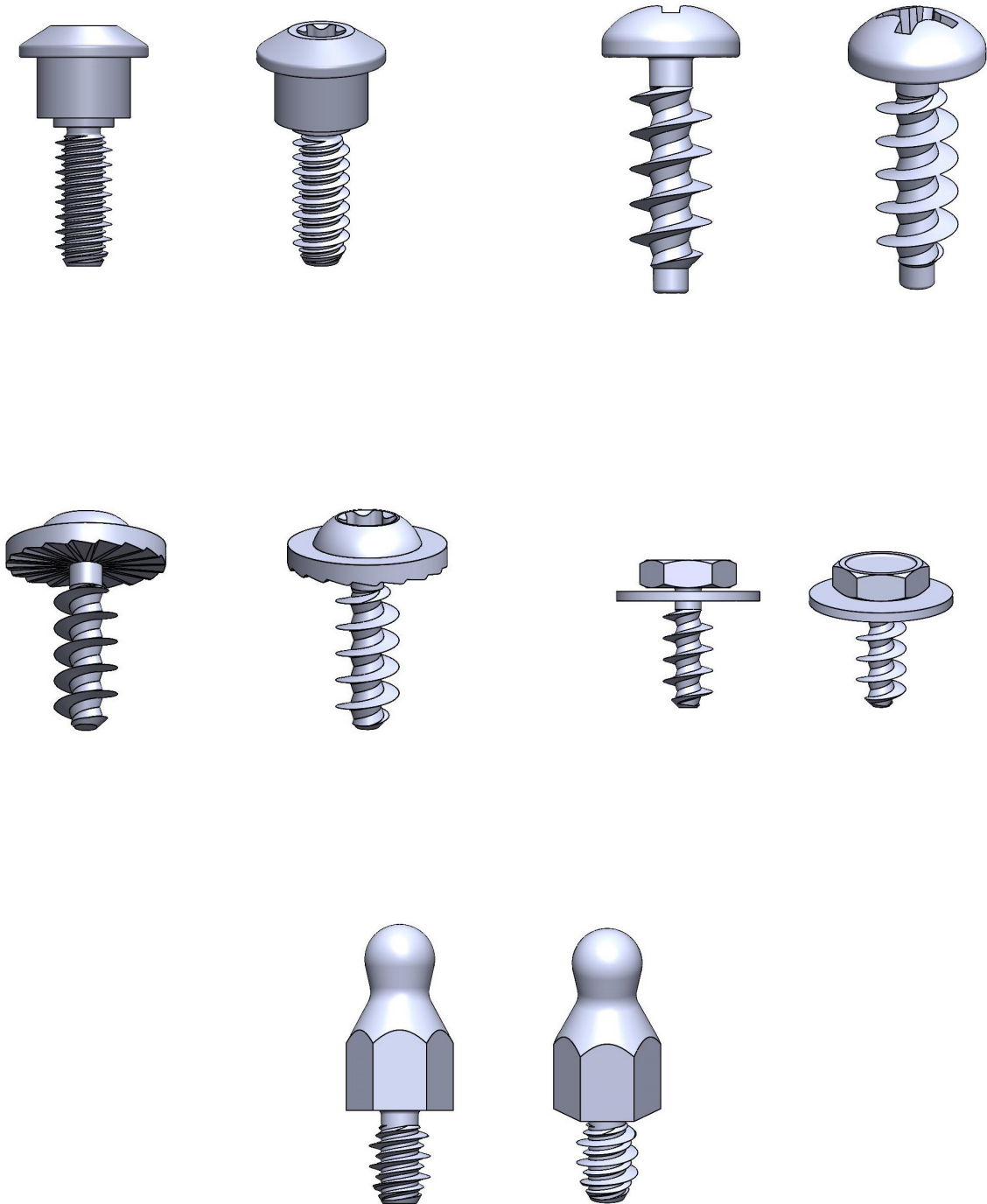
Thermoplastic		Flexural Modulus (KSI)	Thread Type
Very Soft	Polyethylene (PE) Polypropylene (PP)	150-200	HILO PF
Soft	Acrylonitrile Butadiene Styrene (ABS) 0-20% Glass Filled Polyamide 66 (PA 66) Polycarbonate (PC) Acetal (POM) Polypropylene (PP) 40% Talc-filled Polyphenylene Sulfide (PPS) Polystyrene (PS)	340-550	HILO PF PLAST48-2
Medium	Acrylonitrile Butadiene Styrene (ABS) 20% Glass Filled Polyamide 66 (PA 66) 12% Glass Filled Polycarbonate (PC) 20% Glass Filled	650-850	PF PLAST48-2
Hard	Acrylonitrile Butadiene Styrene/Polycarbonate (ABS/PC Blend) Polyamide 66 (PA 66) 30% Glass Filled Polybutylene Terephthalate (PBT) 30% Glass Filled Polycarbonate (PC) 30% Glass Filled	1,100-1,400	PF PLAST45

Ref.: Acument Global Technologies

When using thermosetting plastics and those with flexural moduli greater than 1,400 ksi, thread cutting screws should be considered instead. They remove material when being installed thus reducing stress in very brittle plastics. However, they can be difficult to remove and re-install, and may not have the same loosening resistance.

OPTIONS

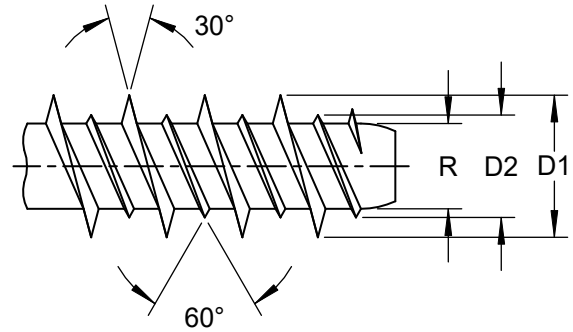
In addition to a variety of thread sizes, lengths, head types, drives, materials and finishes, PENCOR also offers custom designs. Contact a company representative for more information.



HILO

FEATURES AND BENEFITS

PENCOM's HILO screws utilize a unique twin thread profile design with different thread flank angles and diameters. The high thread has a 30° flank angle that reduces radial boss stress and improves thread engagement in softer thermoplastics.



THREAD DIMENSIONS

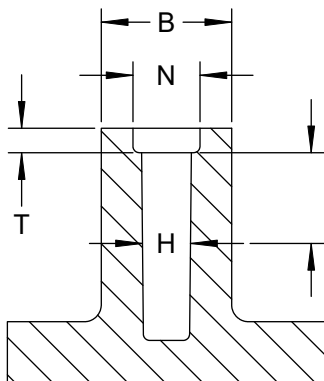
INCH	Thread Size	High Thread Diameter D1	Low Thread Diameter D2 (Ref.)	Minor Diameter R
	2-32	.084-.090	.069	.050-.058
	3-28	.095-.105	.078	.057-.065
	4-24	.105-.115	.086	.061-.070
	5-20	.119-.125	.100	.073-.082
	6-19	.135-.145	.108	.080-.090
	7-19	.148-.158	.130	.089-.100
	8-18	.160-.170	.130	.095-.105
	9-18	.175-.185	.145	.097-.108
	10-16	.185-.195	.145	.099-.110
	12-16	.210-.220	.167	.125-.137
	1/4-15	.250-.260	.200	.161-.175
	5/16-14	.307-.317	.250	.200-.212

All dimensions in inches

METRIC	Thread Size	High Thread Diameter D1	Low Thread Diameter D2 (Ref.)	Minor Diameter R
	M2.2 x 0.79	2.13-2.29	1.75	1.27-1.47
	M2.5 x 0.91	2.41-2.67	1.98	1.45-1.65
	M2.9 x 1.06	2.66-2.92	2.18	1.55-1.78
	M3.2 x 1.27	3.02-3.18	2.54	1.85-2.08
	M3.5 x 1.34	3.43-3.69	2.74	2.03-2.29
	M3.8 x 1.34	3.76-4.02	3.30	2.26-2.54
	M4.2 x 1.41	4.06-4.32	3.30	2.41-2.67
	M4.5 x 1.41	4.44-4.70	3.68	2.46-2.74
	M4.8 x 1.59	4.70-4.96	3.68	2.51-2.79
	M5.5 x 1.59	5.33-5.59	4.24	3.18-3.48
	M6.3 x 1.69	6.35-6.61	5.08	4.09-4.45
	M8 x 1.81	7.79-8.05	6.35	5.08-5.38

All dimensions in millimeters

BOSS DIMENSIONS



(see page 5 for diagram)

All dimensions in inches

INCH	Thread Size	Boss Diameter B	Hole Diameter, H		Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
			Plastic Flexural Modulus				
			< 200 KSI	200-400 KSI			
2-32	.174-.261	.0670	.0700	.095	.031-.063	.261	
3-28	.200-.300	.0730	.0781	.108	.036-.071	.300	
4-24	.220-.330	.0810	.0860	.118	.042-.083	.330	
5-20	.244-.366	.0935	.0995	.130	.050-.100	.366	
6-19	.280-.420	.1015	.1100	.148	.053-.105	.420	
7-19	.306-.459	.1200	.1250	.161	.053-.105	.459	
8-18	.330-.495	.1200	.1285	.173	.056-.111	.495	
9-18	.360-.540	.1290	.1380	.188	.056-.111	.540	
10-16	.380-.570	.1360	.1440	.198	.063-.125	.570	
12-16	.430-.645	.1570	.1660	.223	.063-.125	.645	
1/4-15	.510-.765	.1890	.2010	.263	.067-.133	.765	
5/16-14	.624-.936	.2380	.2500	.320	.071-.143	.936	

(1) Dimensions are for reference only and may be affected by several variables. PENCOM strongly encourages testing in the application.

All dimensions in millimeters

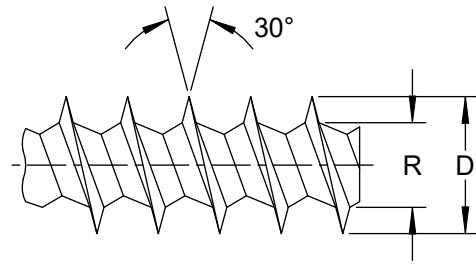
METRIC	Thread Size	Boss Diameter B	Hole Diameter, H		Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
			Plastic Flexural Modulus				
			< 1,380 Mpa	1,380-2,760 Mpa			
M2.2 x 0.79	4.42-6.63	1.702	1.778	2.41	0.79-1.58	6.63	
M2.5 x 0.91	5.08-7.62	1.854	1.984	2.74	0.91-1.82	7.62	
M2.9 x 1.06	5.59-8.38	2.057	2.184	2.99	1.06-2.12	8.38	
M3.2 x 1.27	6.20-9.30	2.375	2.527	3.30	1.27-2.54	9.30	
M3.5 x 1.34	7.11-10.67	2.578	2.794	3.76	1.34-2.68	10.67	
M3.8 x 1.34	7.77-11.66	3.048	3.175	4.09	1.34-2.68	11.66	
M4.2 x 1.41	8.38-12.57	3.048	3.264	4.39	1.41-2.82	12.57	
M4.5 x 1.41	9.14-13.72	3.277	3.505	4.77	1.41-2.82	13.72	
M4.8 x 1.59	9.65-14.48	3.454	3.658	5.03	1.59-3.18	14.48	
M5.5 x 1.59	10.92-16.38	3.988	4.216	5.66	1.59-3.18	16.38	
M6.3 x 1.69	12.95-19.43	4.801	5.105	6.68	1.69-3.38	19.43	
M8 x 1.81	15.85-23.77	6.045	6.350	8.12	1.81-3.62	23.77	

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PF

FEATURES AND BENEFITS

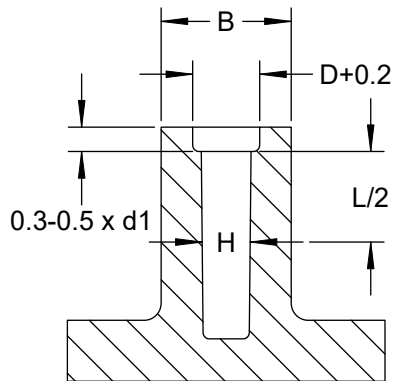
PENCOM's PF screws have a unique thread forming design conceived expressly for use in a wide variety of thermoplastic materials. The distinctive thread profile allows reduced boss wall thickness, maintains clamp load and resists loosening during vibration, reduces drive torque while increasing stripping torque, and reduces hoop stresses.



THREAD DIMENSIONS

Thread Size	K15	K18	K20	K22	K25	K30	K35	K40	K50	K60	K70	K80
D	1.5	1.8	2.0	2.2	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0
R	0.89	1.04	1.15	1.25	1.40	1.66	1.91	2.17	2.68	3.19	3.70	4.21

BOSS DIMENSIONS



(see page 7 for diagram)

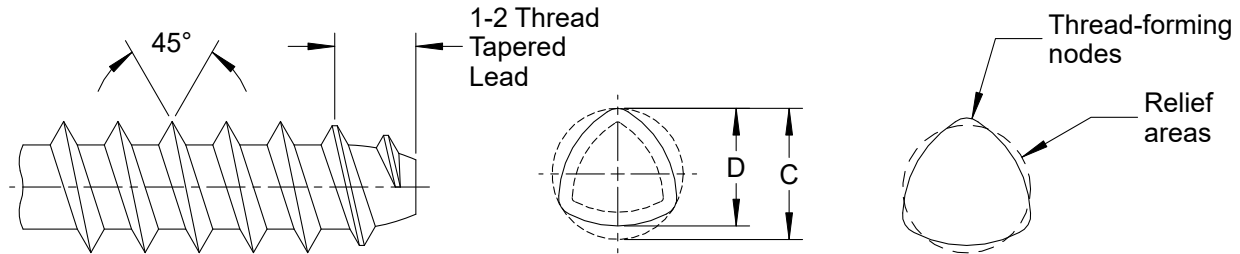
Material	Boss Diameter B	Hole Diameter H	Min. Thread Engagement Length L
Acrylonitrile Butadiene Styrene (ABS)	2.00 x D	.80 x D	2.00 x D
Acrylonitrile Butadiene Styrene (ABS) / Polycarbonate (PC) Blend	2.00 x D	.80 x D	2.00 x D
Acrylonitrile Styrene Acrylate (ASA)	2.00 x D	.78 x D	2.00 x D
Nylon 4/6	1.85 x D	.73 x D	1.80 x D
Nylon 4/6 30% Glass Filled	1.85 x D	.78 x D	1.80 x D
Nylon 6	1.85 x D	.75 x D	1.70 x D
Nylon 6 30% Glass Filled	2.00 x D	.80 x D	1.90 x D
Nylon 6/6	1.85 x D	.75 x D	1.70 x D
Nylon 6/6 30% Glass Filled	2.00 x D	.82 x D	1.80 x D
Polyamide (PA) 15% Glass Filled	2.00 x D	.82 x D	2.00 x D
Polybutylene Terephthalate (PBT)	1.85 x D	.75 x D	1.70 x D
Polybutylene Terephthalate (PBT) 30% Glass Filled	1.80 x D	.80 x D	1.70 x D
Polycarbonate (PC)	2.50 x D	.85 x D	2.20 x D
Polycarbonate (PC) 30% Glass Filled	2.20 x D	.85 x D	2.00 x D
Polyethylene (PE)	2.00 x D	.70 x D	2.00 x D
Rigid Polyethylene (PE)	1.80 x D	.75 x D	1.80 x D
Polyethylene Terephthalate (PET)	1.85 x D	.75 x D	1.70 x D
Polyethylene Terephthalate (PET) 30% Glass Filled	1.80 x D	.80 x D	1.70 x D
Polyoxymethylene (POM/Acetal)	1.95 x D	.75 x D	2.00 x D
Polymethyl Methacrylate (PMMA)	2.00 x D	.85 x D	2.00 x D
Polypropylene (PP)	2.00 x D	.70 x D	2.00 x D
Polypropylene (PP) 20% Talc Filled	2.00 x D	.72 x D	2.00 x D
Polyphenylene Oxide (PPO/Noryl)	2.50 x D	.85 x D	2.20 x D
Polystyrene (PS)	2.00 x D	.80 x D	2.00 x D
Rigid Polyvinyl Chloride (PVC)	2.00 x D	.80 x D	2.00 x D
Styrene Acrylonitrile (SAN)	2.00 x D	.77 x D	1.90 x D

(1) Dimensions are for reference only and may be affected by several variables. PENCOR strongly encourages testing in the application.
(2) Ref.: ATF, Inc.

PLAST45

FEATURES AND BENEFITS

PLAST45 screw threads have a sharp 45° flank angle and extra wide spacing to reduce and disperse stress in a plastic member while maintaining high stripping resistance. The body cross-section uses a Tri-Nodular™ design that allows plastic material to fill in behind the thread node relief areas creating resistance to vibrational loosening. These screws are particularly suited for hard plastics.



THREAD DIMENSIONS

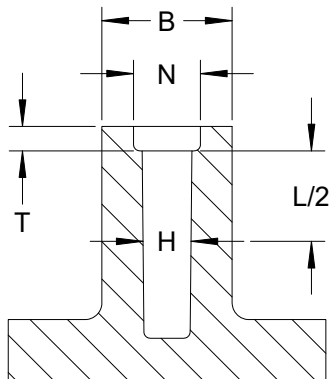
INCH	Thread Size	Theoretical Diameter C	Cross-Section Depth D
	2-19	.0835-.0875	.0805-.0845
	3-18	.0970-.1010	.0940-.0980
	4-17	.1095-.1145	.1060-.1110
	5-15	.1225-.1275	.1185-.1235
	6-13	.1360-.1410	.1320-.1370
	7-12	.1480-.1530	.1435-.1485
	8-11	.1610-.1670	.1560-.1620
	9-10	.1730-.1790	.1680-.1740
	10-9	.1880-.1940	.1830-.1890
	12-9	.2140-.2200	.2085-.2145
	1/4-8	.2470-.2530	.2410-.2470
	5/16-8	.3080-.3160	.3010-.3090

All dimensions in inches

METRIC	Thread Size	Theoretical Diameter C	Cross-Section Depth D
	M1.6 x 0.6	1.61-1.69	1.54-1.61
	M2 x 1.35	1.92-2.04	1.87-1.99
	M2.5 x 1.4	2.41-2.53	2.37-2.49
	M3 x 1.5	2.92-3.04	2.87-2.99
	M3.5 x 1.65	3.42-3.54	3.34-3.46
	M4 x 1.75	3.89-4.04	3.79-3.94
	M4.5 x 2	4.39-4.54	4.28-4.43
	M5 x 2.2	4.89-5.04	4.79-4.94
	M5 x 2.3	4.89-5.04	4.79-4.94
	M6 x 2.5	5.89-6.04	5.78-5.93
M8 x 3	7.86-8.04	7.71-7.89	

All dimensions in millimeters

BOSS DIMENSIONS



(see page 9 for diagram)

All dimensions in inches

INCH	Thread Size	Boss Diameter B	Hole Diameter H	Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
	2-19	.214-.257	.065-.073	.094	.013-.026	.171-.257
	3-18	.248-.297	.076-.084	.107	.014-.028	.198-.297
	4-17	.280-.336	.087-.096	.120	.015-.029	.224-.336
	5-15	.313-.375	.099-.108	.133	.017-.033	.250-.375
	6-13	.346-.416	.102-.114	.147	.019-.038	.277-.416
	7-12	.376-.452	.114-.127	.159	.021-.042	.301-.452
	8-11	.410-.492	.126-.139	.172	.023-.045	.328-.492
	9-10	.440-.528	.135-.149	.184	.025-.050	.352-.528
	10-9	.478-.573	.150-.165	.199	.028-.056	.382-.573
	12-9	.543-.651	.170-.186	.225	.028-.056	.434-.651
	1/4-8	.625-.750	.198-.216	.258	.031-.063	.500-.750
5/16-8	.780-.936	.255-.275	.320	.031-.063	.624-.936	

(1) Dimensions are for reference only and may be affected by several variables. PENCOM strongly encourages testing in the application.
(2) Ref.: Research Engineering and Manufacturing, Inc.

All dimensions in millimeters

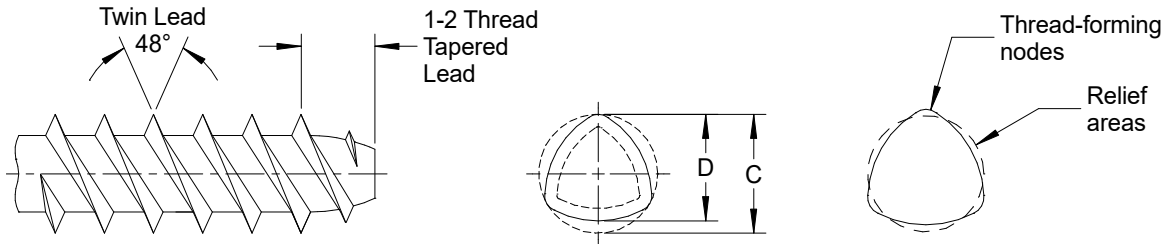
METRIC	Thread Size	Boss Diameter B	Hole Diameter H	Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
	M1.6 x 0.6	4.13-4.95	1.09-1.29	1.85	0.15-0.30	3.30-4.95
	M2 x 1.35	4.95-5.94	1.40-1.60	2.18	0.34-0.68	3.96-5.94
	M2.5 x 1.4	6.18-7.41	1.85-2.05	2.67	0.35-0.70	4.94-7.41
	M3 x 1.5	7.45-8.94	2.30-2.50	3.18	0.38-0.75	5.96-8.94
	M3.5 x 1.65	8.70-10.44	2.75-3.00	3.68	0.41-0.83	6.96-10.44
	M4 x 1.75	9.91-11.90	3.20-3.45	4.17	0.44-0.88	7.93-11.90
	M4.5 x 2	11.16-13.40	3.60-3.90	4.67	0.50-1.00	8.93-13.40
	M5 x 2.2	12.41-14.90	3.70-4.10	5.17	0.55-1.10	9.93-14.90
	M5 x 2.3	12.41-14.90	3.70-4.10	5.17	0.58-1.15	9.93-14.90
	M6 x 2.5	14.91-17.90	4.70-5.10	6.17	0.63-1.25	11.93-17.90
M8 x 3	19.88-23.85	6.50-7.10	8.15	0.75-1.50	15.90-23.85	

(1) Dimensions are for reference only and may be affected by several variables. PENCOM strongly encourages testing in the application.
(2) Ref.: Research Engineering and Manufacturing, Inc.

PLAST48-2

FEATURES AND BENEFITS

PLAST48-2 screws have twin lead threads with 48° flank angles. The sharp thread profile reduces plastic boss stress while providing excellent holding strength. A steeper thread helix angle due to the twin lead design allows for faster engagement and provides for a greater difference between failure and thread forming torques which can simplify drive tool adjustments. The body cross-section uses a Tri-Nodular™ design that allows plastic material to fill in behind the thread node relief areas creating resistance to vibrational loosening. These screws are suitable for use in a wide variety of soft to moderately hard plastics.



THREAD DIMENSIONS

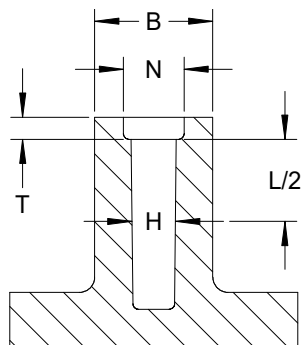
INCH	Thread Size	Theoretical Diameter C	Cross-Section Depth D
	00-51	.0466-.0496	.0445-.0475
	0-42	.0635-.0665	.0605-.0635
	1-32	.078-.081	.075-.078
	2-28	.086-.092	.083-.089
	3-24	.104-.110	.100-.106
	4-20	.121-.127	.117-.123
	6-19	.141-.147	.137-.143
	7-18	.160-.166	.154-.160
	8-16	.179-.185	.173-.179
	9-15	.193-.199	.187-.193
	10-14	.206-.212	.202-.208
	12-11	.229-.235	.224-.230
	12-14	.226-.232	.220-.226
	1/4-10	.270-.276	.262-.268
5/16-9	.335-.345	.325-.335	

All dimensions in inches

METRIC	Thread Size	Theoretical Diameter C	Cross-Section Depth D
	M1.12 x 0.50	1.18-1.26	1.13-1.21
	M1.59 x 0.60	1.61-1.69	1.54-1.61
	M1.91 x 0.79	1.98-2.06	1.91-1.98
	M2.26 x 0.91	2.18-2.34	2.11-2.26
	M2.63 x 1.06	2.64-2.79	2.54-2.69
	M3.12 x 1.27	3.07-3.23	2.97-3.12
	M3.63 x 1.34	3.58-3.73	3.48-3.63
	M4.06 x 1.41	4.03-4.22	3.91-4.06
	M4.55 x 1.59	4.55-4.70	4.39-4.55
	M4.90 x 1.69	4.90-5.05	4.75-4.90
	M5.28 x 1.81	5.23-5.38	5.13-5.28
	M5.74 x 1.81	5.74-5.89	5.59-5.74
	M5.74 x 2.31	5.74-5.89	5.59-5.74
	M6.81 x 2.54	6.86-7.01	6.65-6.81
M8.51 x 2.82	8.51-8.76	8.26-8.51	

All dimensions in millimeters

BOSS DIMENSIONS



(see page 11 for diagram)

All dimensions in inches

INCH	Thread Size	Boss Diameter B	Hole Diameter H		Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
			Soft Ductile Materials	Brittle Materials			
	00-51	.120-.144	.043	.046	.056	.005-.010	.096-.144
	0-42	.163-.195	.056	.060	.073	.006-.012	.130-.195
	1-32	.199-.239	.067	.072	.088	.008-.016	.159-.239
	2-28	.223-.267	.076	.080	.097	.009-.018	.178-.267
	3-24	.268-.321	.088	.094	.115	.010-.021	.214-.321
	4-20	.310-.372	.100	.106	.132	.013-.025	.248-.372
	6-19	.360-.432	.122	.128	.152	.013-.026	.288-.432
	7-18	.408-.489	.134	.142	.171	.014-.028	.326-.489
	8-16	.455-.546	.149	.158	.190	.016-.031	.364-.546
	9-15	.490-.588	.162	.172	.204	.017-.033	.392-.588
	10-14	.523-.627	.175	.185	.217	.018-.036	.418-.627
	12-11	.580-.696	.195	.206	.240	.023-.045	.464-.696
	12-14	.573-.687	.195	.205	.237	.018-.036	.458-.687
	1/4-10	.683-.819	.224	.240	.281	.025-.050	.546-.819
	5/16-9	.850-1.02	.286	.303	.348	.028-.056	.680-1.02

(1) Dimensions are for reference only and may be affected by several variables. PENCOM strongly encourages testing in the application.
 (2) Ref.: Research Engineering and Manufacturing, Inc.

All dimensions in millimeters

METRIC	Thread Size	Boss Diameter B	Hole Diameter H		Counterbore Diameter N	Counterbore Depth T	Thread Engagement Length L
			Soft Ductile Materials	Brittle Materials			
	M1.12 x 0.50	3.05-3.67	1.092	1.168	1.42	0.13-0.25	2.44-3.67
	M1.59 x 0.60	4.13-4.95	1.422	1.524	1.85	0.15-0.30	3.30-4.95
	M1.91 x 0.79	5.05-6.06	1.702	1.829	2.22	0.20-0.40	4.04-6.06
	M2.26 x 0.91	5.65-6.78	1.930	2.032	2.46	0.23-0.46	4.52-6.78
	M2.63 x 1.06	6.79-8.15	2.235	2.388	2.92	0.27-0.53	5.44-8.15
	M3.12 x 1.27	7.87-9.45	2.540	2.692	3.35	0.32-0.64	6.30-9.45
	M3.63 x 1.34	9.14-10.97	3.099	3.251	3.86	0.34-0.67	7.32-10.97
	M4.06 x 1.41	10.35-12.42	3.404	3.607	4.34	0.35-0.71	8.28-12.42
	M4.55 x 1.59	11.56-13.87	3.785	4.013	4.82	0.40-0.80	9.25-13.87
	M4.90 x 1.69	12.45-14.94	4.115	4.369	5.18	0.42-0.85	9.96-14.94
	M5.28 x 1.81	13.27-15.93	4.445	4.699	5.51	0.45-0.91	10.62-15.93
	M5.74 x 1.81	14.73-17.68	4.953	5.232	6.09	0.45-0.91	11.79-17.68
	M5.74 X 2.31	14.54-17.45	4.953	5.207	6.02	0.58-1.16	11.63-17.45
	M6.81 X 2.54	17.34-20.80	5.690	6.096	7.13	0.64-1.27	13.87-20.80
	M8.51 X 2.82	21.59-25.91	7.264	7.696	8.84	0.71-1.41	17.27-25.91

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