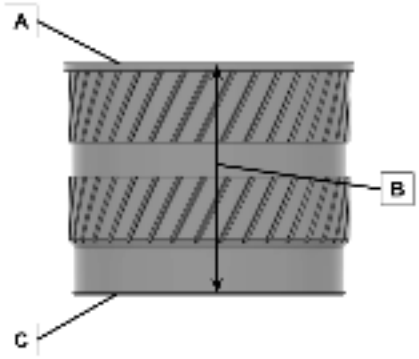
Designing for Heat Set Inserts

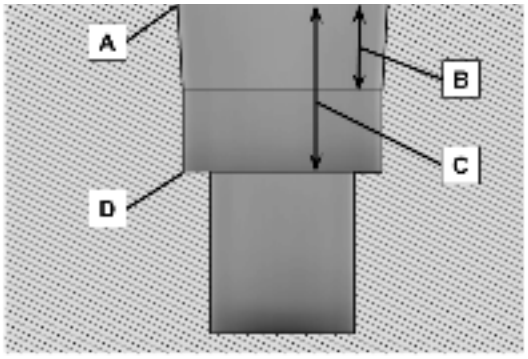
Heat set inserts are a great asset for Additive Manufacturing. They enable plastic printed parts to provide all of the benefits of 3D printing while including a better thread profile and longer lifetime for repeated use. They also provide significantly better pullout strength that allows plastics parts to be an alternative option to metal when considering material options.

The following equations have been developed as best practice methods for designing cavities for the installation of heat set inserts after printing. This process has progressed over time and should be regarded as a guideline and not a definitive process that works for every type of insert. It is important to note that there are a variety of insert manufacturers and insert types available on the market. Both of these factors can impact the best way to eventually design for an insert so results may vary.

For best results, we recommend designing for the inserts that we have available within our production process for continuity. We utilize McMaster-Carr Tapered Heat Set Inserts with dual knurled surfaces. We have found these to provide optimal pullout strength and good resistance to torque. Although this is our recommendation, any tapered heat set insert from other manufacturers should also adhere to these guidelines.



$$A = Max\ Dia$$
$$B = Length$$
$$C = Min\ Dia$$



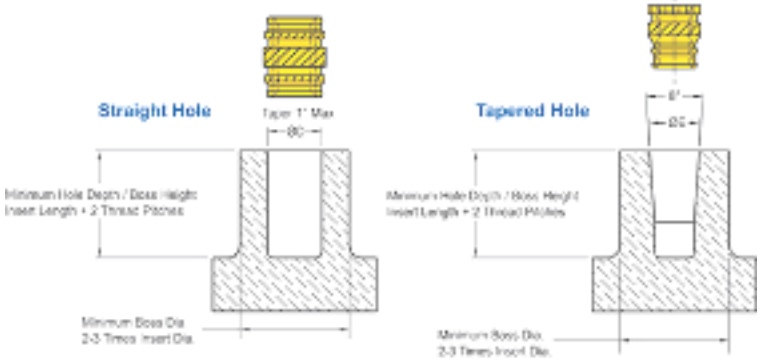
$$A = Max\ Dia + 100\ \mu m$$
$$B = 1/2 \times Length$$
$$C = Length + 100\ \mu m$$
$$D = Min\ Dia$$

HEAT-ULTRASONIC INSERTS *(Straight Holes)*

Thread Size		INS 19 Short		INS 19 Long		INS 29 Short		INS 29 Long	
Unified	Metric	Tensile lbs. (N)	Torque in-lbs. (N-m)	Tensile lbs. (N)	Torque in-lbs. (N-m)	Tensile lbs. (N)	Torque in-lbs. (N-m)	Tensile lbs. (N)	Torque in-lbs. (N-m)
2-56	M2	100 (445)	4 (0.4)	150 (665)	5 (0.5)	125 (555)	4 (0.4)	175 (780)	5 (0.5)
4-40	M2.5 M3	175 (780)	14 (1.5)	325 (1,445)	28 (3)	225 (1,000)	14 (1.5)	425 (1,890)	28 (3)
6-32	M3.5	275 (1,220)	30 (3.5)	500 (2,220)	55 (6)	325 (1,445)	30 (3.5)	625 (2,780)	55 (6)
8-32	M4	375 (1,670)	53 (6)	650 (2,900)	80 (9)	446 (2,000)	62 (7)	850 (3,800)	90 (10)
10-24 10-32	M5	550 (2,450)	90 (10)	850 (3,800)	125 (14)	650 (2,900)	100 (11)	1,100 (4,900)	135 (15)
1/4-20	M6	750 (3,350)	140 (16)	1,050 (4,650)	185 (21)	900 (4,000)	150 (17)	1,400 (6,200)	200 (23)
5/16-18	M8	900 (4,000)	250 (28)	1,300 (5,800)	290 (33)	1,200 (5,350)	250 (28)	1,800 (8,000)	310 (35)

HEAT-ULTRASONIC INSERTS *(Tapered Holes)*

Thread Size		INS 14 Short		INS 14 Long	
Unified	Metric	Tensile lbs. (N)	Torque in-lbs. (N-m)	Tensile lbs. (N)	Torque in-lbs. (N-m)
2-56	M2	50 (220)	3 (0.3)	125 (560)	9 (1)
4-40	M2.5	175 (780)	18 (2)	300 (1,330)	27 (3)
6-32	M3 M3.5	225 (1,000)	27 (3)	450 (2,000)	35 (4)
8-32	M4	300 (1,350)	30 (3.5)	575 (2,550)	45 (5)
10-24 10-32	—	450 (2,000)	45 (5)	750 (3,330)	70 (8)
—	M5	550 (2,450)	88 (10)	950 (4,200)	135 (15)
1/4-20	M6	850 (3,800)	140 (16)	1,300 (5,800)	220 (25)
5/16-18	M8	1,200 (5,350)	265 (30)	2,000 (8,900)	355 (40)



Chevron

- Better for brittle plastics
- Performs better on pullout
- Easy to source

Tapered

- Better for ductile plastics
- Easier to install
- More repeatable results