STANLEY®
Engineered Fastening

HELI-COIL®
Wire Inserts vs. Traditional Threaded Assemblies
Weight-Strength Comparative Study

Technical Bulletin HC1050

HeliCoil®

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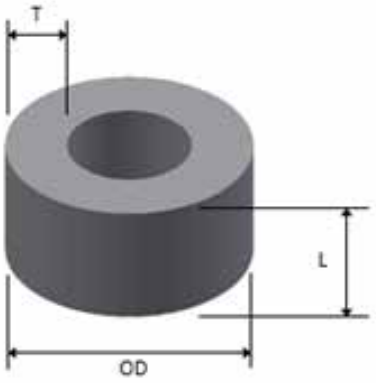
Background

In the automotive industry both weight and cost reductions have become major priorities. With increasingly demanding government regulations affecting fuel economy and safety, and consumer demands for low cost – high quality vehicles, studies have been conducted to address these issues. The most common solution at hand involves the use of lightweight materials, one of the most popular choices being aluminum. Designing in lightweight materials will require that special attention is paid to strength requirements. Threaded joints may require bulkier boss designs to achieve the necessary strength values. As space may not always allow for larger boss designs and even further weight reductions may be achieved, an analysis was conducted to determine if Heli-Coil® inserts are the solution.

Scope

To determine if the Heli-Coil® assembly would provide increased strength while at the same time reducing the boss size and weight, a series of calculations were performed. Using basic boss design concepts seen in many automotive applications, sample boss dimensions consisting of a given height, outside diameter, and internal thread parameters were used. This data would then be compared to that of the Heli-Coil® Assembly. Classic weight and strength calculations were utilized.



Analysis / Results

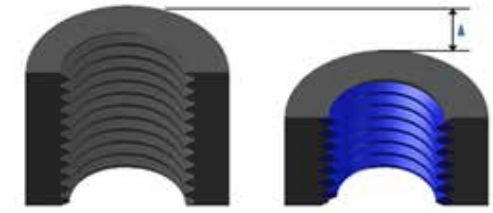
Calculations involved taking a given boss height based off of previous customer applications direct from the field, for four different sizes and determining the weight of that assembly based on the density of the parent material and boss geometry. Please see the calculation and data table below.

Weight = Density*(OD²-(OD-(2xT))²)*L*(3.14/4000)					
Size	L (mm)	OD (mm)	T (mm)	Density (g/cm^3) Al-6061	Original Boss Weight (g)
M6	13	8.6	1.605	2.71	1.241
M8	16	11.2	2.01	2.71	2.515
M10	21	14.5	2.72	2.71	5.726
M12	21	16.8	3.025	2.71	7.446

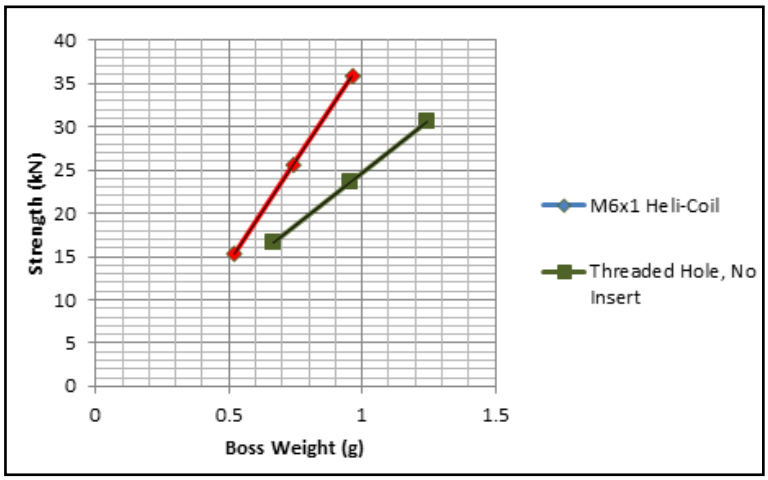
To determine if there is a benefit using the Heli-Coil® assembly, a similar calculation was run. Assumptions included:

- keeping the outside diameter the same as that of the customer boss despite that varying from standard recommendations and using that data in conjunction with the tensile graphs
- the exclusion of the weight of the insert due to the extra material cut out for the tapped hole and countersink
- the slight degradation in tensile values if a countersink were included in the hole preparation.

Strength – Weight Comparison
% Weight Reduction



M6 Strength – Weight Comparison
22.3% Weight Reduction

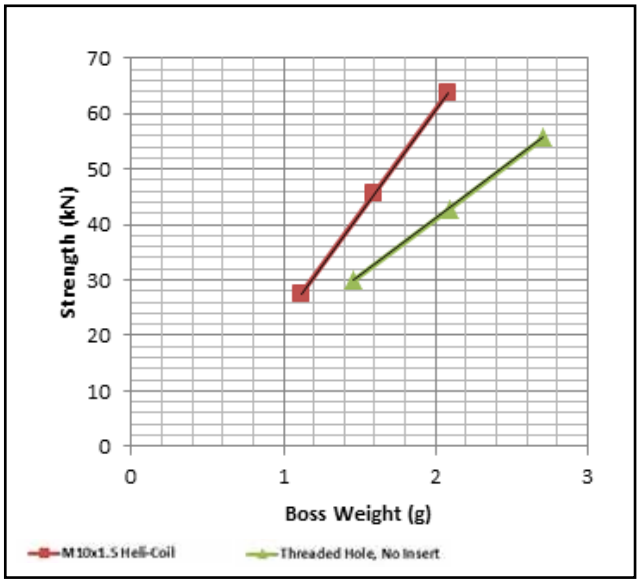


Overall it was determined that the Heli-Coil® assembly would exceed the tensile strength of a standard prepared hole and provide a significant reduction in weight. In an effort to provide more data points, and determine if a benefit would be achieved across the board, the weight-strength calculation was performed for 1, 1.5, and 2 diameter length inserts using the Heli-Coil® recommended hole preparation and associated minimum tapping depth lengths. Using those same lengths, the calculations were then performed for a plain tapped hole revealing that there is a real benefit to designing in the Heli-Coil® insert assembly. Please see the following table and associated figures.

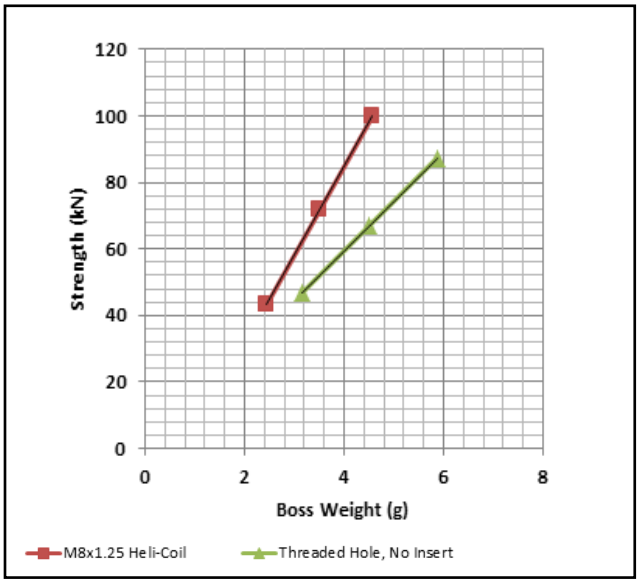
Strength – Weight Results for Both Heli-Coil and Plain Threaded Assemblies

Size/ Assembly	Tensile (kN)	L (mm)	OD (mm)	T (mm)	Density (g/cm^3) Al-6061	Original Boss Weight (g)
M6 HC (1 D)	15.33	7.0	8.6	1.175	2.71	0.521
M6 Plain	16.52	7.0	8.6	1.605	2.71	0.669
M6 HC (1.5 D)	25.602	10.0	8.6	1.175	2.71	0.742
M6 Plain	23.59	10.0	8.6	1.605	2.71	0.955
M6 HC (2 D)	35.88	13.0	8.6	1.175	2.71	0.965
M6 Plain	30.67	13.0	8.6	1.605	2.71	1.242
M8 HC (1 D)	27.62	9.3	11.2	1.45	2.71	1.11
M8 Plain	29.94	9.3	11.2	2.01	2.71	1.46
M8 HC (1.5 D)	45.75	13.3	11.2	1.45	2.71	1.6
M8 Plain	42.82	13.3	11.2	2.01	2.71	2.09
M8 HC (2 D)	63.88	17.3	11.2	1.45	2.71	2.08
M8 Plain	55.69	17.3	11.2	2.01	2.71	2.72
M10 HC (1 D)	43.5	11.5	14.5	2.00	2.71	2.45
M10 Plain	46.68	11.5	14.5	2.72	2.71	3.14
M10 HC (1.5 D)	71.69	16.5	14.5	2.00	2.71	3.51
M10 Plain	66.98	16.5	14.5	2.72	2.71	5.5
M10 HC (2 D)	99.88	21.5	14.5	2.00	2.71	4.57
M10 Plain	87.28	21.5	14.5	2.72	2.71	4.5
M12 HC (1 D)	62.95	13.8	16.8	2.15	2.71	3.7
M12 Plain	67.5	13.8	16.8	3.025	2.71	4.89
M12 HC (1.5 D)	103.41	19.8	16.8	2.15	2.71	5.31
M12 Plain	96.85	19.8	16.8	3.025	2.71	7.02
M12 HC (2 D)	143.88	25.8	16.8	2.15	2.71	6.92
M12 Plain	126.2	25.8	16.8	3.025	2.71	7.02

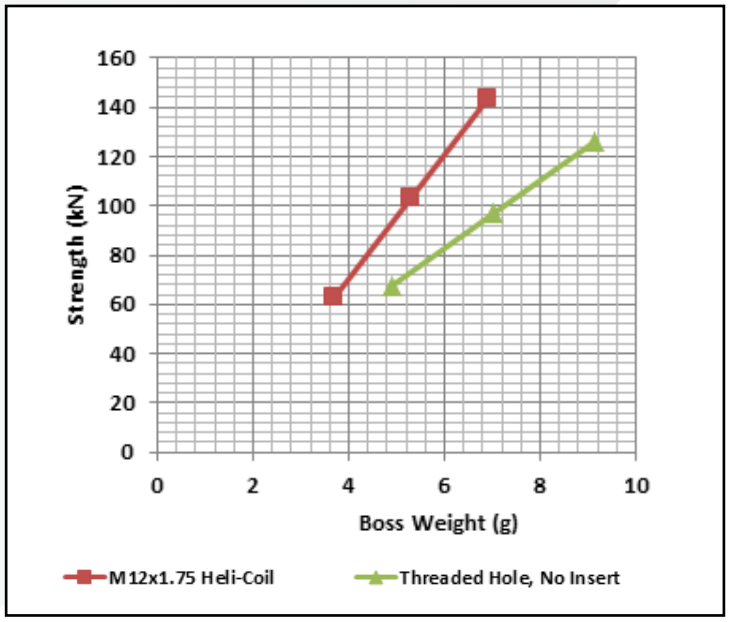
M8 Strength – Weight Comparison
26.3% Weight Reduction



M10 Strength – Weight Comparison
37.5% Weight Reduction



M12 Strength – Weight Comparison
30.6% Weight Reduction



Based upon these calculations, it is apparent that the automotive industry would benefit by designing in Heli-Coil® assemblies to both increase strength and decrease weight.

If you have any questions, you can consult with STANLEY Engineered Fastening's Applications Engineering at (866) 364-2781.

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