

STANLEY[®]
Engineered Fastening

HELI-COIL[®]
Pipe Thread Inserts

Technical Bulletin 903B

HeliCoil[®]

Heli-Coil® Pipe Thread Inserts

Improve all pipe connections with Heli-Coil® Brand Inserts

HELLI-COIL® Pipe Thread Inserts are precision formed screw thread coils of 18-8 Stainless Steel wire cold rolled into a sharp crescent diamond shaped cross section having a tensile strength in excess of 200,000 psi and a smooth surface of 8 to 16 micro inches.

Prior to installation, the Pipe Thread is larger in diameter than the tapped hole. When installed, it assumes the configuration of the tapped hole, whether NPT, ANPT or NPS. The outward forces resulting from the reduction of the free diameter anchors the insert permanently in place.

The same Heli-Coil® Insert is used for all three types of pipe thread assemblies. For NPT and NPSC assemblies, Handbook H28 requires gaging the tapped hole with the L₁ and L₃ gages is required. Complete details on installation of Heli-Coil® NPT are given on p.6.

Pipe Thread Inserts are typically used in OEM, production salvage and in repair & maintenance.

Note:

Heli-Coil® Pipe Thread inserts conform to:

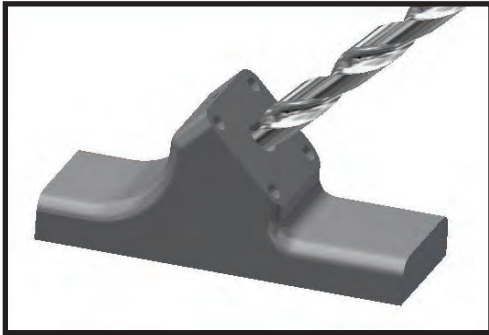
- National Pipe Taper Thread (NPT)
- Aeronautical National Pipe Taper Thread (ANPT)
- National Pipe Straight Coupling Thread (NPSC)

Features and Benefits:

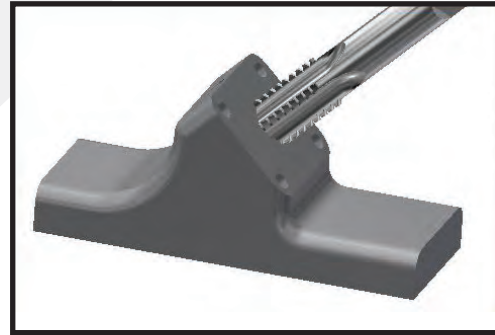
- **Provide Leak Proof Joints** when used with thread sealant and recommended torque
- **Eliminate Thread Failure** due to stripping, vibration, fatigue, corrosion or seizing
- **Prevent Thread Wear** even when after repeated disassembly and re-assembly
- **Greatly Increase Thread Strength** under all operating conditions
- **Yield Substantial Savings** in materials, weight and space, as minimum size bosses and flanges are permissible
- **Offer Speed And Economy** In repair and production salvage, providing better-than-original threads; and HELI-COIL® Pipe Thread Inserts retain original thread size
- **Permit the Use of Light Metals** instead of ferrous castings because connections will be protected by the inserts

Heli-Coil® Pipe Thread Inserts — How They Are Used

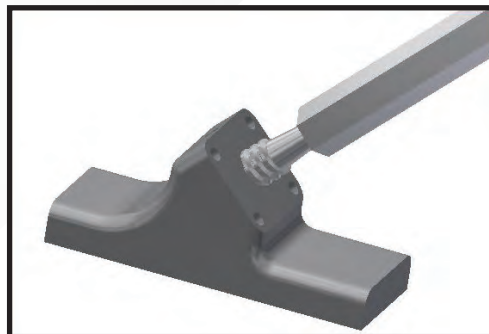
Heli-Coil® Pipe Thread inserts are quickly and easily installed following the steps in the Process Sheet on p.6. The procedure consists of these basic operations:



1. DRILL: Using a standard drill
(and ream for ANPT)



2. TAP: with a Heli-Coil® STI tap



3. GAGE: the hole to recommended
tolerance



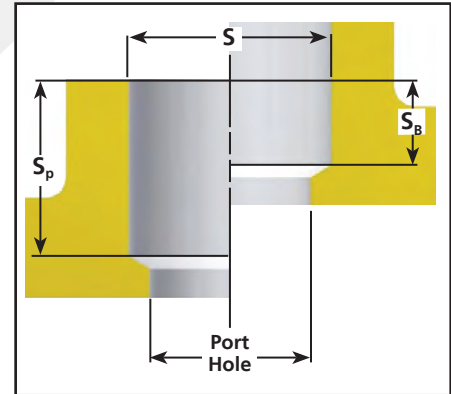
4. INSTALL: The insert with Heli-Coil®
hand or power inserting tools
and remove the tang

ASSEMBLY

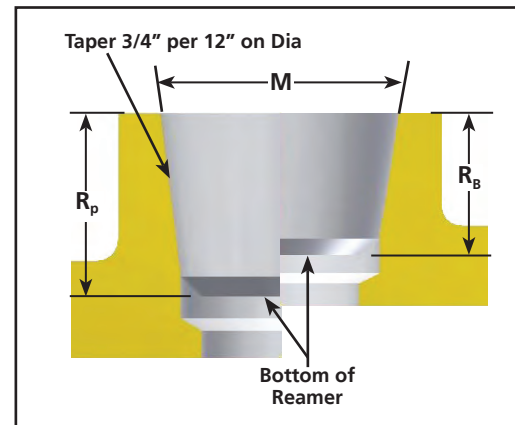
Extremes of truncation and pitch diameter tolerance can create crest and root (major and minor diameter) clearances which might allow a void and result in "spiral leakage". It is recommended that the normal practice of using sealing compounds be followed when making Heli-Coil® Pipe Thread Insert assemblies.

Design and Installation Data of Heli-Coil® Pipe Thread Inserts for NPT (per Handbook H28) and ANPT (per MIL-P-7105)

NOMINAL THREAD SIZE	DRILLED HOLE				
	S DIAMETER		MINIMUM DEPTH		
	REAMING (ANPT)	NO REAMING (NPT)	PLUG TAP (S _p)	BOTTOM TAP (S _b)	
	1	2	3	4	
1/16-27	K (.2810)	19/64 (.2969)	0.590	0.465	
1/8-27	U (.3680)	W (.3860)	0.592	0.466	
1/4-18	31/64 (.4844)	33/64 (.5156)	0.833	0.606	
3/8-18	0.625 (.6250)	21/32 (.6562)	0.840	0.619	
1/2-14	25/32 (.7812)	13/16 (.8125)	1.069	0.775	
3/4-14	63/64 (.9844)	1-1/64 (1.0156)	1.074	0.794	
1 - 11-1/2	1-1/4 (1.2500)	1-9/32 (1.2812)	1.302	0.972	
1-1/4 - 11-1/2	1- 9/32 (1.5937)	1-5/8 (1.6250)	1.330	0.992	
1-1/2 - 11-1/2	1-3/16 (1.8125)	1-55/64 (1.8593)	1.343	0.992	



REAMED HOLE			
M DIAMETER		MINIMUM DEPTH*	
MINIMUM	MAXIMUM	PLUG TAP (R _p)	BOTTOM TAP (R _b)
5	6	7	8
0.3038	0.3123	0.517	0.446
0.3963	0.4047	0.519	0.447
0.5265	0.5386	0.676	0.578
0.6619	0.674	0.684	0.590
0.8247	0.8247	0.841	0.726
1.0351	1.0494	0.846	0.745
1.2958	1.3125	1.005	0.892
1.6406	1.6572	1.033	0.912
1.8795	1.8962	1.046	0.912



Notes:

(*) Depths of reaming and tapping are reference dimensions only. Actual hole depths are governed by use of pipe thread gages.

D = Outside diameter of pipe – major diameter of pipe thread at L₂ from the end of pipe.

E₀ = Basic pitch diameter of thread at the end of pipe = D – (0.05D + 1.1) P.

E₁ = Basic pitch diameter of thread at the end of coupling = E₀ + 0.0625L₁

E₂ = Basic pitch diameter of thread at L₂ from end of pipe = E₀ + 0.0625L₂

E₃ = Basic pitch diameter of thread at L₃ from end of pipe = E₀ – 0.1875P.

L₁ = Normal engagement by hand between external and internal threads

L₂ = Effective length of external thread = P(0.8D + 6.8).

L₃ = Normal wrench take-up.

Effective length of internal threads

L₁ + L₃ = Nominal insert length

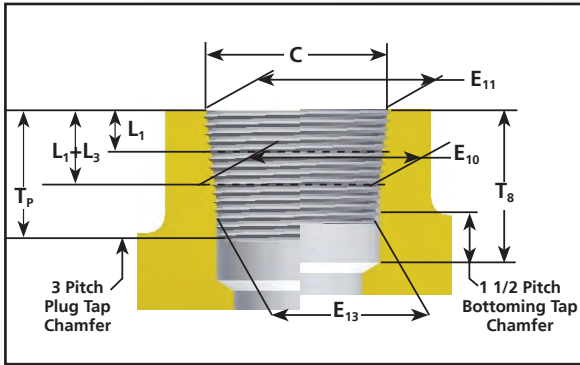
Minimum full thread depth in blind holes

Minimum boss thickness for through holes

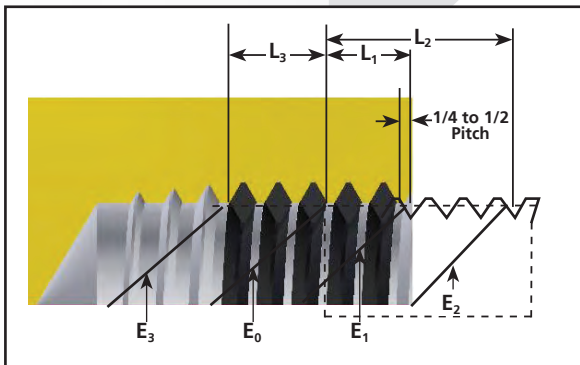
INSERT IDENTIFICATION

NOMINAL THREAD SIZE	PART NO.	NOMINAL LENGTH	FREE NO. OF COILS (From Notch)	FREE OUTSIDE DIAMETER	
				Maximum	Minimum
1-1/16-27	327-1	0.271	5-1/8	0.405	0.385
1/8-27	327-2	0.273	5-1/8	0.511	0.486
1/4-18	327-4	0.394	5	0.680	0.655
3/8-18	327-6	0.407	5-1/4	0.828	0.803
1/2-14	327-8	0.534	5-3/8	1.035	1.005
3/4-14	327-12	0.553	5-5/8	1.262	1.232
1-11-1/2	327-16	0.661	5-1/2	1.575	1.540
1-1/4-11-1/2	327-20	0.681	5-3/4	1.947	1.912
1-1/2-11-1/2	327-24	0.681	5-7/8	2.205	2.170

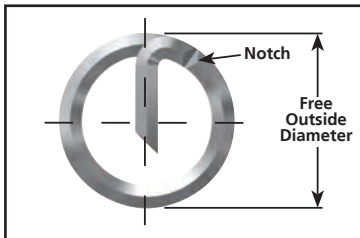
Design and Installation Data of Heli-Coil® Pipe Thread Inserts for NPT (per Handbook H28) and ANPT (per MIL-P-7105)



TAPPED HOLE					
PITCH DIAMETERS			MAJOR DIA. MAX (C)	MINIMUM DEPTH	
E10	E11	E13		PLUG TAP (Tp)	BOTTOM TAP (Tb)
10	11	12	13	14	15
.32528	.33528	.31834	.367	.534	.408
.41761	.42770	.41066	.459	.536	.409
.55967	.57391	.54925	.621	.749	.568
.69429	.70929	.68388	.757	.756	.580
.86579	.88579	.85240	.0947	.962	.740
1.0750	1.0962	1.0617	1.157	.966	.759
1.3453	1.3703	1.3290	1.445	1.172	.929
1.6888	1.7151	1.6725	1.790	1.200	.949
1.9278	1.9540	1.9115	2.029	1.213	.949



ASSEMBLED INSERT SPECIFICATIONS							
BASIC LENGTHS			BASIC PITCH DIAMETERS				D
L1	L2	L1, L3	E0	E1	E2	E3	
16	17	18	19	20	21	22	23
.160	.26111	.27111	.27118	.28118	.28750	.26424	.3125
.1615	.26385	.27261	.36351	.37360	.38000	.35656	.405
.2278	.40178	.39447	.47739	.49163	.50250	.46697	.540
.240	.40778	.40667	.61201	.62701	.63750	.60160	.675
.320	.53371	.53429	.75843	.77843	.79179	.74504	.840
.339	.54571	.55329	.96768	.98887	1.00179	.95429	1.050
.400	.68278	.66087	1.21363	1.23863	1.25630	1.19733	1.315
.420	.70678	.68087	1.55713	1.58338	1.60130	1.54083	1.660
.420	.72348	.68087	1.79609	1.82234	1.8410	1.77978	1.990






TOOL PART NUMBERS								
NOMINAL THREAD SIZE	REAMER	TAP*		GAGES			INSERTING TOOL	EXTRACTING TOOL
		PLUG	BOTTOM	PLAIN TAPER PLUG	L1 THREAD PLUG	L3 THREAD PLUG		
1/16-27	334-1	328-1	3328-1	332-1	330-1	331-1	3371-1	1227-6
1/8-27	334-2	328-2	3328-2	332-2	330-2	331-2	3371-2	1227-16
1/4-18	334-4	328-4	3328-4	332-4	330-4	331-4	3371-4	1227-16
3/8-18	334-6	328-6	3328-6	332-6	330-6	331-6	3371-6	1227-16
1/2-14	334-8	328-8	3328-8	332-8	330-8	331-8	3371-8	1227-16
3/4-14	334-12	328-12	3328-12	332-12	330-12	331-12	3371-12	1227-24
1-11-1/2	334-16	328-16	3328-16	332-16	330-16	331-16	3371-16	1227-24
1-1/4-11-1/2	334-20	328-20	3328-20	332-20	330-20	331-20	3371-20	1227-32
1-1/2-11-1/2	334-24	328-24	3328-24	332-24	330-24	331-24	3371-24	1227-32

*May also be used in aluminium, cast iron, mild steel, and brass for limited production. Production taps for these and other materials are available on special order.

PROCESS SHEET

Installation of HELI-COIL® Pipe Thread Inserts for NPT and ANPT

Operation	ANPT	NPT	PROCEDURE																					
	See pages 4-5																							
Drilling	Col.1	Col. 2	Standard shop practice is followed. Variations in material, drills and drilling equipment may make larger or smaller drills necessary to produce acceptable threads. Drill to depth given in Col. 3 or 4.																					
Taper Reaming	Col.24		Use standard reaming procedure. Check hole with plain taper plug gage (part number shown in Col 27). Ream to depth shown in Col. 7 or 8.																					
Tapping	Col.25 or 26		Follow standard tapping procedure. HELI-COIL® Pipe Tread taps are wrapped with a strand of copper wire to indicate approximate tapping depth. Actual depth and size must be controlled by gaging. Tap to depth given in Col. 14 or 15.																					
Gaging	Col.27		Plain taper plug: Used to check taper, roundness and diameter at the crest of thread																					
	Col.28		L₁ thread plug: Used to check diameter, lead, form ad taper of threads at that portion of thread which will be engaged when the male thread part is screwed in by hand. This is the only gage used when working to NPT. Tapped hole must be within MIN and MAX steps on L ₁ gage.																					
	Col.29		L₃ thread plug: Used to check diameter lead, form ad taper of threads at lower portion of hole – those threads that will be engaged by wrench pressure.																					
			ANPT GAGING PROCEDURE																					
			 <p>L₁ Gage ANPT gaging requires the use of L₁ and L₃ and plain taper plug gages. L₁ and L₃ gages have notches denoting Maximum (MX) Basic (B) and Minimum (MN). The plain taper plug gage has three additional notches which indicate truncation tolerances: Maximum Tolerance (MXt), Basic Tolerance (Bt) and Minimum Tolerance (MNt). The use of these gages establishes an acceptable threaded hole as Maximum, Basic or Minimum.</p>																					
			 <p>L₃ Gage First, gage the hole with the gage, noting the actual position of the steps in relation to the hole. If the Minimum step reaches the edge of the hole, the hole is classified Minimum. If L₁ stops at Basic or Maximum, the hole is classified either Basic or Maximum.</p>																					
			 <p>Plain Gage Now gage the hole with the L₃ gage checking that the proper step comes into the same relative position with the edge of the hole that the L₁ did. The L₃ gage must not vary more than ½ turn from the position established by the L₁ gage.</p>																					
			<p>Finally, check the hole with the plain taper gage. The edge of the hole must come between the Minimum (MN) and Minimum Tolerance (MNt) steps if Minimum is what the L₁ gage showed the hole to be. (If the L₁ showed the hole to be Basic, the plain plug would have to be between B and Bt; if L₁ were Maximum, the plain plug would have to be between MX and MXt).</p> <p>Gaging of the assembled insert is not necessary if this procedure has been followed.</p>																					
Inserts	Pages 4-5		The same HELI-COIL® Inserts are used for both ANPT and NPT.																					
Installation	Col.30		Threaded mandrel prewinder type inserting tools are used. Appropriate instructions are furnished with each tool. Install insert ¼ to ½ P below surface.																					
Tang Removal			Using long nosed pliers, grasp the tang. Push in and pull out to snap the tang off at the notch.																					
Assembly			It is recommended that an appropriate non-hardening paste type sealing compound be used with ANPT and NPT pipe threads. Service factors such as machining accuracy, type of fluid or gas flowing through the connection, pressures, temperature and pipe material will determine the type of sealant best suited for the individual application.																					
Torque			After applying thread compound to male thread, assemble male thread into installed insert using the following tightening torques, per MIL-T-5542:																					
			<table border="0"> <tr> <td>1/16-27</td> <td>100 Inch Pounds</td> <td>¾-14</td> <td>950 Inch Pounds</td> <td rowspan="5">} Tighten as necessary</td> </tr> <tr> <td>1/8-27</td> <td>150 Inch Pounds</td> <td>1-11½</td> <td>1800 Inch pounds</td> </tr> <tr> <td>1/4-18</td> <td>250 Inch Pounds</td> <td>1¼-11½</td> <td></td> </tr> <tr> <td>3/8-18</td> <td>450 Inch Pounds</td> <td>1½-11½</td> <td></td> </tr> <tr> <td>1/2-14</td> <td>600 Inch Pounds</td> <td></td> <td></td> </tr> </table>	1/16-27	100 Inch Pounds	¾-14	950 Inch Pounds	} Tighten as necessary	1/8-27	150 Inch Pounds	1-11½	1800 Inch pounds	1/4-18	250 Inch Pounds	1¼-11½		3/8-18	450 Inch Pounds	1½-11½		1/2-14	600 Inch Pounds		
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3/8-18	450 Inch Pounds	1½-11½																						
1/2-14	600 Inch Pounds																							

Heli-Coil® Inserts For Straight Pipe Thread Couplings (NPSC)

The NPSC system was developed for the use of a straight internal thread with a tapered external thread. The thread form and the truncation are the same as those in the NPT system, and NPT gages are used. Internal NPSC threads are straight (parallel), made by NPSC taps. These threads are for low-pressure usage, and require sealants or lubricants.

DRILLING AND TAPPING

NPSC threads have pitch diameter tolerances larger than major and minor diameter truncations limits. Consequently, to obtain tapped holes within specifications, proper drill size selection is important. In most cases, the drill sizes recommended in Table II on p.8 will be satisfactory.

Shop conditions, equipment and the type of parent material can affect drilling and tapping results, causing oversize or undersize holes. Therefore, NPSC taps specifically designed and manufactured by Heli-Coil® are recommended for controlled root tapping.

GAGING

L₁ taper thread plug gagers are used in NPSC threads. The gage must enter the tapped hole within plus or minus 1-1/2 turns of the Basic notch. It is not necessary to gage the assembled insert because of the precision of the Heli-Coil® wire form.

ASSEMBLY

The use of an appropriate non-hardening, paste-type sealing compound is recommended in all Pipe Thread Insert connections. Service factors such as machining accuracy, type of fluid or gas flowing through the connection, pressures, temperature and pipe material will determine the type of sealant best suited for the individual application.

1/16-27	100 Inch Pounds	¾-14	950 Inch Pounds
1/8-27	150 Inch Pounds	1-11½	1800 Inch pounds
1/4-18	250 Inch Pounds	} Tighten as necessary	
3/8-18	450 Inch Pounds		1¼-11½
1/2-14	600 Inch Pound		1½-11½

Design and Installation Data of HELI-COIL® Pipe Thread Inserts for NPSC (per Handbook H28)

Table I: Insert Identification

NOMINAL THREAD SIZE	PART NO.	NOMINAL LENGTH	FREE # OF COILS (Counted From Notch)	FREE OUTSIDE DIAMETER	
				Maximum	Minimum
1/8-27	327-2	.273	5-1/8	.511	.486
1/4-18	327-4	.394	5	.680	.655
3/8-18	327-6	.407	5-1/4	.828	.803
1/2-14	327-8	.534	5-3/8	1.035	1.005
3/4-14	327-12	.553	5-5/8	1.262	1.232
1-11-1/2	327-16	.661	5-1/2	1.575	1.540

Table II: Tapped Hole Specifications

NOMINAL THREAD SIZE	MINOR DIAMETER MINIMUM	SUGGESTED DRILL SIZE	MINIMUM DRILL DEPTH* (for plug tap)	PITCH DIAMETER		MAJOR DIAMETER MAXIMUM (ref.)	FULL TAPPED THREADS (L ₁ + L ₃)
				Minimum	Maximum		
1/8-27	.392	X (.3970)	.476	.4247	.4307	.461	.273
1/4-18	.522	17/32 (.5312)	.700	.5692	.5786	.623	.394
3/8-18	.657	21/32 (.6562)	.712	.7046	.7140	.759	.407
1/2-14	.820	13/16 (.8125)	.927	.8796	.8920	.950	.534
3/4-14	1.030	1-1/32 (1.031)	.946	1.0901	1.1025	1.160	.553
1-11-1/2	1.290	1-19/64 (1.297)	1.139	1.3627	1.3780	1.448	.661

*Drilling depths given are basic depths for tapping conditions indicated, and allow for insert installation 1/4 to 1/2 pitch below surface of boss. Depths of countersinking, which is optional, should be added to the applicable drilling and tapping depths. A 120° included angle countersink, to the tap major diameter ± .015, is recommended. This countersink will have an approximate depth of 1/2 pitch.

Table III: Tool Part Numbers

NOMINAL THREAD SIZE	PLUG TAP	L ₁ THREAD PLUG GAGE	INSERTING TOOL	EXTRACTING TOOL
1/8-27	848-2	330-2	3371-2	1227-16
1/4-18	848-4	330-4	3371-4	1227-16
3/8-18	848-6	330-6	3371-6	1227-16
1/2-14	848-8	330-8	3371-8	1227-16
3/4-14	848-12	330-12	3371-12	1227-24
1-11-1/2	848-16	330-16	3371-16	1227-24

