

Self-Locking & Self-Sealing Fasteners Handbook

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Custom Solutions to Special Problems
in Fastener Engineering

Long-Lok Fasteners Corporation

Long-Lok Fasteners Corp.

From Missiles to Skateboards... Laundry Equipment to Coffeepots... Precision Instruments to Heavy Machinery

Thank you for looking to Long-Lok! We've been solving fastener problems for engineers and buyers for more than 40 years. And you'll find we're ready today to fill any requirement you have for self-locking and self-sealing fasteners or threaded components.

Today, Long-Lok fasteners are found around the world and even above it. We're securing and sealing the appliances in our homes, the cars and trains that get us to work, the satellites that allow us to communicate, and the vehicles that mine the Earth and explore her ocean's depths.

Now we want to be on your project! This handbook provides you with a good overview of our products. In most cases you will be able to order with the information contained on the following pages. But keep in mind our ability to develop custom fastening products and to work directly with your specialty components. So, if you don't see it here...call us; most likely we can make it!

You'll find at Long-Lok a group of individuals dedicated to seeing your project succeed. You won't find another fastener company with the capability, the array of locking and sealing methods offered, or the determination to be the standard of excellence for locking and sealing fasteners. So, contact us today and leave it to Long-Lok!

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What They Are and How They Work

Threaded parts have a great...

Advantage: Parts which have been joined by threaded fasteners can be disassembled and reassembled when they must be serviced or replaced.

Disadvantage: Threaded fasteners unintentionally back off when the assembly is in use, and the consequences are usually inconvenient, costly and may present serious legal implications for product warranties.

Definitions

Prevailing Torque Type — Threaded fastener frictionally resistant to rotation due to a built-in wedge. This type of fastener retains its locking ability independent of axial tension or pre-load.

Seating Torque — Sometimes referred to as “Loading Torque”. Typically measured in “inch pounds”, a value of torque applied to a fastener to induce a compressive load under the head bearing surface. Results in creating an axial load (pre-load) that imparts tension or a stretching/elongation characteristic to a male threaded part.

Breakaway Torque — The torque necessary to start relative rotation between a locking fastener and its mating thread with no axial load on the screw. This will change with reuse and be referred to as the “1st Off”, “5th Off” torque and so forth. This is the torque due to the locking element only.

Breakloose Torque — The amount of torque required to start disassembly of an axially loaded fastener. The torque due to clamp load only.

Installation Torque — The highest reading indicated by a torque measuring device while the screw or nut is being fully engaged but prior to any axial loading

Locking Torque — The resistance to rotation. A measure of the performance of the self-locking device. Does not include the torque necessary to induce or remove any axial load in the fastener.

Prevailing “Off” Torque —
(a) Maximum.

The highest reading indicated by a torque measuring device while the screw or nut is being backed off throughout the first 360 degrees of rotation after the axial load is reduced to zero after breakaway.

(b) Minimum.

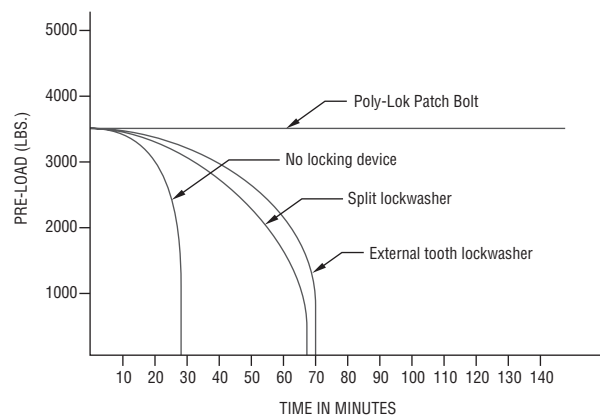
The lowest reading indicated by a torque measuring device while the screw or nut is being backed off throughout the first 360 degrees of rotation after the axial load is reduced to zero after breakaway. (NOTE: The use of a memory device on the torque wrench makes it easy to record the maximum prevailing torque, but the indicator must be watched carefully in order to record the minimum prevailing torque.)

An additional Glossary of terms is found on Page 9.

How they work

The self-locking fastener was developed to retain the advantage of reusability while preventing the problems of accidental disassembly when pre-load is lost. Self-locking fasteners virtually eliminate the possibility of a bolted assembly coming apart during operation. To achieve this benefit, the self-locking fastener has to be properly designed, engineered and installed.

When pre-load is lost, as shown in the chart below, a standard fastener quickly vibrates out, causing the assembly to loosen. The self-locking fastener’s primary function is to prevent backing off when the initial axial tension is lost.

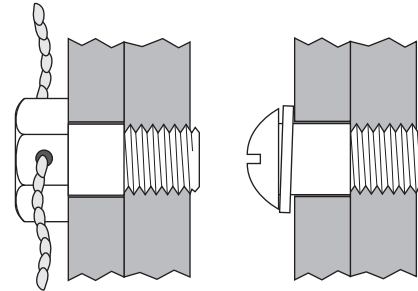


Time to vibrate out after pre-load loss.

By doing so, self-locking helps maintain a tight joint and also helps prevent fatigue failure in the joint. Self-locking fasteners resist rotation on the first installation and on subsequent installations and removals. In addition, self-locking fasteners also decrease the tendency of the fastener to fatigue by reducing the vibration transferred to the fastener.

The Common Alternatives

Jam nuts, cotter pins, lock nuts, lock washers and similar devices also prevent the loss of the bolt or nut by back off but they result in added weight, inconvenience and cost. They do not reduce the tendency to fatigue when loose.



Further, the insecurity of conventional mechanical locks are reason enough for most designers to reject them. Such insecurity arises from the frequency of split-type washers breaking, damage to surface areas caused by external locking devices, and the ineffectiveness of such devices when adjustments are needed.

Basic Types of Self-Locking Fasteners

Chemical Additive Type



This type involves two alternative methods of application, pre-applied and applied-in-place. These fasteners have a lower assembly torque than that achievable from prevailing torque type fasteners. Additionally, high breakaway torques are achieved due to the solid fill from the adhesive coating after full cure.

Both pre-applied and applied-in-place chemical adhesives offer the locking reliability characteristics of most other self-locking fastener types.

In-place chemical application, however, of chemical additives offer just “one-time” use and additional assembly time

is required to coat the fastener with the additive. Downtime, application errors and contamination of other assembly parts are all inherent risks with in-place application of chemical additive fasteners.

Pre-applied chemical additive fasteners are manufactured with the adhesive coating pre-applied via a sophisticated micro-encapsulation process. The adhesives are usually an anaerobic type, or a two part epoxy, with the material positioned in a band around the threads and dry to the touch. When the fastener is rotated against its mating part the capsules of adhesive burst, releasing the material in and around the thread flanks, which then cures and forms the locking bond.

Since the adhesive coating is pre-applied, the assembly time for these fasteners is substantially less than for applied-in-place coatings. The bond also is more consistent.

Multiple reuse of a pre-applied chemical locking fastener is unlikely, since the relocking action depends upon the amount of reusable adhesive left on the bolt after the first installation. Most engineers design for a maximum of one installation before the bolt must be recoated.

Prevailing Torque Type



The prevailing torque-type fastener is the only fastener that retains its locking torque independent of an axial load. When pre-load is lost, the prevailing torque fastener can prevent loosening of an assembly subjected to continued shock or vibration.

Prevailing torque fasteners are of two primary kinds - the deflected or distorted thread type and the material additive type. Both require additional installation torque to assemble the fastener before engaging the bearing surface.

Deflected or Distorted Thread Type (All-Metal):

The deflected or distorted thread type fastener provides some reuse. However, most do not share the high reuse characteristics of the material additive types. Additionally, since distorted thread locking fasteners are designed to lock via an irregularity of thread conformity, they are highly sensitive to hole size.

The design engineer must carefully specify the mating hole and the class of thread fit as defined in ANSI-B 18.2.2. Further, sizes above .312 frequently experience galling because of the masses of metal involved as the distorted thread meets the mating thread flanks.

For these reasons the design engineer has to provide a rigorous and tight specification for the mating hole and factory quality control has to ensure meeting that specification whenever using deflected or distorted thread type fasteners.

Material Additive Types:

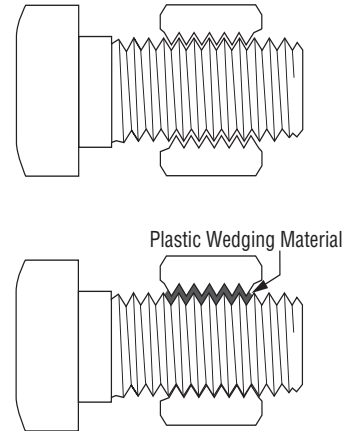
Material additive fasteners work by wedging the fastener into close proximity with the mating thread, causing a metal-to-metal drag in the circumferential direction directly opposite to the material locking device. The material used to produce the wedge customarily is an engineered plastic. A metal wedge can be used for highly demanding applications.

Figure 1 shows an ordinary threaded fastener with a Class 2A or 2B thread. Note the space between the male threaded fastener and its mating part.

Figure 2 shows what happens when a plastic wedge is added mak-

ing the fastener a prevailing torque-type. Note how the plastic forces the opposite side of the male threaded fastener to wedge tightly against the previously open thread spaces.

The material additive, usually in the form of a patch, pellet, or strip on the fastener itself, tends to fill the open thread spaces between two coaxially oriented parts. The longer the locking feature, the greater the fastener assembly locking torque due to engaging more threads of the locking device. Also, the overall length of the locking element can assist in situations where various degrees of engagements are required for adjustment purposes.



Once the design engineer specifies the fastener material (tensile strength), the acceptable limits of the installation torque and the required prevailing "off" torque, the locking fastener engineer determines what type of additive and how much must be applied to achieve the desired results. So that Long-Lok engineers can do this, the design engineer must answer the following questions:

- What material is the bolt? From this, the Long-Lok engineers determine its tensile strength.
- What is the acceptable on-torque (installation torque)? The answer should always be lower than the maximum torque of an automatic tool if used to install the fastener.
- What torque is required to keep the assembly together? This must be calculated based on the particular application.

To assist in establishing these requirements, commercial and military standards are available. Refer to the latest revisions of IFI 124 if a commercial item is used, or to MIL-DTL-18240 if a military fastener is required.

In axially loaded applications, the externally threaded fastener must contain a self-locking feature having a minimum of two complete threads beyond the hole, slot, or groove used for the locking feature engaged with the mating part. This rule does not apply to patch-type self-locking fasteners.

Application – Problems and Solutions

This section deals with some specific fastener applications. When explaining a solution to an application problem we have suggested certain types of Long-Lok fasteners. This is not to suggest that the fastener mentioned is recommended only for that specific application or that, in some cases, other fastener types could not be used.

The following examples incorporate the use of Long-Lok products as suggested solutions to commonly encountered fastening problems. They are offered as suggestions only since your own experience, unique set of application conditions, and use of Long-Lok's extensive experience will solve your specific problem. Other companies may offer similar products, but only Long-Lok provides "Custom Solutions to Special Problems in Fastener Engineering."

Problem: An outside truck mirror vibrates loose after a limited amount of rough driving.

Solution: Either Poly-Lok® or Long-Lok® can be used to solve this type of problem.

Reliability of assembly in a high vibration environment is required. The resilient insert or patch type fastener is ideally suited since it does not rely on axial tension in the assembly to insure staying in place.

In general, the resilience of the plastic holds the fastener in place without adhesives or thread distortion, and provides locking action in the thread instead of at the bearing surface. The resilient nature of the locking plastic maintains fastener lock due to its vibration dampening characteristics.

Problem: Carburetor adjustment screws that must be able to operate in a high temperature environment vibrate out of adjustment.

Solution: The Poly-Lok plastic additive fastener is best suited to solve this problem.

Here the requirement is for the plastic insert to be able to operate at 380° F. Nylon inserts cannot be used because nylon is limited to 250° F. Only Poly-Lok, made of polyethylene terephthalate (a Long-Lok patented exclusive), meets the requirement of unusually high temperature, multiple reuse characteristics in accordance with MIL-DTL-18240 and IFI 124, and economical purchase characteristics.

In general, when optimum torque is necessary plus the ability to withstand an unusually high temperature range, plus a relatively low cost of purchase, self-locking prevailing torque Poly-Lok is best suited for the job. The Poly-Lok fastener maintains torque performance through temperatures as high as 400° F and as low

as -100° F, and is not affected by hydrocarbons.

Problem: Engine cycling requires a self-locking part that is capable of withstanding cycling from ambient to 500° F and still meet multiple reuse requirements.

Solution: The Dual-Lok™ plastic additive fastener is used to meet this requirement. In this application high-temperature Vespel® engineered plastic is captured in a unique, patented manner. With Dual-Lok, two locking surfaces are exposed to better maintain required torques under severe conditions.

The Dual-Lok method can be used with a wide variety of insert materials depending upon the application requirements. This dual locking element means of capturing the insert material eliminates strip fall out and is just one more of the unique products developed by Long-Lok engineers for special requirements.

Problem: A steel fastener has to be used to attach an electronic assembly to a cast aluminum housing.

Solution: A T-Sert® thin wall self-locking insert supplies a strong locking support in the soft metal. The T-Sert is inserted into the soft metal hole and locked in place by its prevailing torque value. When the fastener is installed, it too is locked in place by the insert plastic so that the entire assembly becomes a prevailing torque assembly. The one-piece, solid wall construction of T-Sert provides the ultimate in both torque and tensile strength, exceeding the requirements of MIL-N-25027 and MIL-I-45932.

The design of the T-Sert self-locking insert reduces its cost to substantially below other types of inserts. Further, because of the ease of installation, the T-Sert has lower installed cost than all other types of insert devices. T-Sert installation can be made from either end resulting in additional savings in time. No special drills, taps or gauges are required for installation.

Because it does not require swaging or driving of rings the T-Sert causes no undue stresses due to installation and edge distances are not critical.

Problem: Small lock washers used in the assembly of an electronic part work loose after the product has been sold. It is identified that the normal expansion and contraction of the assembly resulting from component heating is causing the problem.

Solution: Prevailing torque type fasteners are a popular solution to this problem. All lock washers require maintenance of the pre-load to maintain positive locking performance. Unfortunately, even normal temperature changes, in addition to shock or vibration, can cause pre-load loss which, in turn, eliminates any locking action.

Self-locking fasteners are designed to put the locking action in

the thread, where it is needed. Since the locking action is in the thread, prevailing torque remains even as the pre-load changes with temperature.

Problem: A mechanical assembly must be fastened on the hot side of a gas turbine.

Solution: For applications up to 1200° F Dyna-Thred® II, an all metal lock is called for. The Dyna-Thred II lock is achieved by forming a close tolerance hole axially into the bolt end of a standard thread form. Then a controlled area of the cavity is dilated to expand the periphery of the controlled thread area. The pitch diameter of the first thread is left unchanged for starting ease.

The result is an easily installed, highly reliable, self-locking fastener that meets all performance requirements of MIL-F-8961.

Problem: A mass produced toy that will take very hard use must be fastened at the lowest possible cost. The relatively light weight components, and the speed of application, require low driving torque type fasteners. High breakaway torque is needed to stand the rough use.

Solution: Dri-Loc®, a chemical additive self-locking fastener, is called for. Dri-Loc fasteners are coated with a micro-encapsulated anaerobic adhesive. When the fastener is rotated in the mating part, the inert micro-encapsulated adhesive is released and forms a bond which, when it hardens, both locks and seals the assembly. Additionally, since Dri-Loc fasteners require very low on-torque, assembly is faster and more economical. See specification IFI 125 for torque performance requirements.

Problem: In place fastener cost reduction is required to relieve rising inventory and assembly costs.

Solution: Replace bolts and lock washers with one piece self-locking fasteners. A self-locking fastener is, in effect, a lock washer and bolt all in one piece. That means you inventory fewer items.

A self-locking fastener is easier and faster to install. The result is less assembly time and lower assembly costs, and no margin of error. It adds up to savings in-place.

Problem: A borescope plug cap has to be fastened on the hot side of a jet engine with multiple reuse and multiple rework capabilities.

Solution: Omni-Lok™ solves this problem.

Omni-Lok is a patented process in which a longitudinal hole is drilled and a metal pin is installed in such a fashion that the pin extends above the root diameter of externally threaded parts but still is contained wholly within the major diameter. The pin provides an effective wedge which provides the prevailing torque

feature.

Omni-Lok is especially suited for those threaded components which require a prevailing torque locking element which has one or more of the following characteristics:

It has high prevailing torque and can be used in unusual or non-conventional configurations. It withstands (1) very high (1200° F or more) or very low (cryogenic) temperatures, (2) greater than normal stress and vibration conditions, and (3) severe corrosion conditions. It conforms to MIL-F-8961 requirements.

Problem: An aircraft panel requires over 300 reuses of a self-locking prevailing torque type fastener.

Solution: Poly-Lok® II meets this requirement. Poly-Lok II not only provides high temperature capability but can achieve more than 300 reuses and still meet the MIL-DTL-18240 and the IFI 124 minimum torque requirements.

Engineers should be particularly interested in specifying Poly-Lok II where the application calls for multiple reuses above the minimum of 15 called out by MIL-DTL-18240. A number of military applications can now be handled by a simple fastener that previously required complex mechanical locks or locking assemblies.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Application Considerations

Consideration of the following factors will eliminate the majority of application problems encountered when using self-locking fasteners. Review them carefully and consult the factory for any unanswered questions.

1. Use only self-locking devices which are MIL-Spec and/or Q.P.L. approved and manufactured by a qualified Long-Lok facility.
2. Control quality and design of both self-locking and mating parts within the limits of applicable standard thread specifications.
3. Countersink the female mating part or chamfer the male mating part end point as described in the installation data.
4. Mating parts must be clean and free of all foreign material.
5. Use of self-locking elements in mating parts with keyway, slots, cross holes, or other thread form interruptions are not recommended and can adversely affect locking torque performance and reusability characteristics.
6. Manufacture of some commercial strip type fasteners may produce a very slight metal burr at the engagement end of the longitudinal slot. These parts are usually acceptable for 90% of self-locking applications. By adding the suffix "E" to the part numbers when ordering Long-Lok strip type fasteners, end burrs will be removed. (See "Options", Page 46; also see definition of Burr Free in "Glossary of Terms").
7. Extensive, independent test data demonstrates that when used properly, the tensile strength of Long-Lok strip and pellet type fasteners are not adversely affected by the milled slots or drilled holes used to accommodate their respective locking elements.

ments.

Sizes of 1/4" diameter and smaller may exhibit a very slight reduction directly in the slotted or drilled hole area. However, similar test data has shown that a high tensile strength margin remains; all parts still meet minimum specification requirements. Torsional strength for these parts is only affected in sizes smaller than #8, and then only when tightened beyond yield strength. Shear strength is not lost in any size; high shear bolt grips are not altered. For strip type parts the ends of the insert slot are radiused to prevent "notch effect" or stress risers.

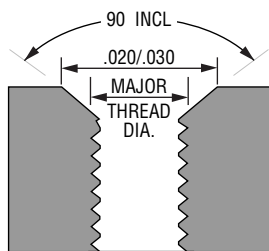
8. Torsional resistance to turning (prevailing "on" torque) is greatest at the initial installation of the self-locking component with the mating thread form. This results from the thread form being worked into the locking feature, along with burnishing of the surface roughness of the threads. The second and third installations continue these actions to a lesser degree. The resulting torque value through subsequent repeated cycling will be reduced much more gradually, the degree of which will depend on the wear factor of the mating materials and resilience of the locking feature used. This is demonstrated by the graph on Page 25.

9. For externally threaded parts, tap drills should be sized to develop a 65% to 75% theoretical thread height in the mating hole. All holes should be tapped with a cut thread and not a rolled thread tap to insure quality of the mating thread and optimum prevailing torque performance.

Installation Data

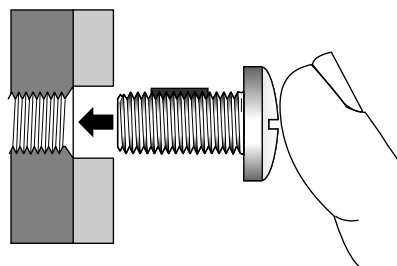
Applicable to material additive type locking screws (Poly-Lok Patch, Long-Lok Strip, Dual-Lok and Tek-Lok Pellet fasteners) pre-applied adhesive type (Dri-Loc fasteners) and thread sealing type (Vibra-Seal fasteners).

Countersink



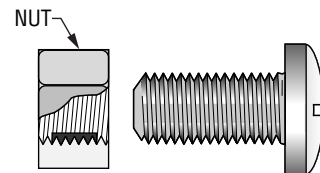
To maximize prevailing torque performance and prevent potential shearing of the locking material at installation in the mating thread form, the tapped hole should be countersunk.

Clearance Hole



Locking elements on externally threaded components typically protrude to .003 over the maximum major diameter; they pass through normal clearance holes with finger pressure. Consult factory if flush installation is required.

Chamfer



For locking features applied to internal thread forms use of a mating fastener or component with a chamfered end point is recommended.

Empirical Torque Adders

The Empirical Torque Values shown below approximate the additional prevailing torque developed by Material Additive type fasteners when compared to non-locking fasteners. Add these values to standard non-locking fastener seating torque values to calculate the torque required to develop a given tension (pre-load) in the assembly. Values do not apply to all-metal types (Dyna-Thred II). Consult factory for appropriate values or alternative design considerations for all-metal types.

Size	Empirical Value	Size	Empirical Value	Size	Empirical Value	Size	Empirical Value	Size	Empirical Value
#0	2.0 Inch-Oz.	#4	1.5 Inch-Lbs	#10	6.0 Inch-Lbs.	3/8"	32.0 Inch-Lbs.	5/8"	120.0 Inch-Lbs.
#1	4.0 Inch-Oz.	#5	2.0 Inch-Lbs.	#12	8.0 Inch-Lbs.	7/16"	40.0 Inch-Lbs.	3/4"	160.0 inch-Lbs.
#2	9.0 Inch-Oz.	#6	3.0 Inch-lbs.	1/4"	12.0 Inch-Lbs.	1/2"	60.0 Inch-Lbs.	7/8"	240.0 inch-Lbs.
#3	1.0 Inch-Lbs.	#8	4.0 Inch-Lbs.	5/16"	24.0 Inch-Lbs.	9/16"	80.0 Inch-Lbs.	1"	320.0 Inch-Lbs.

Example: If a non-locking No.10 screw requires 30 inch pounds of torque to develop desired tension: a Long-Lok No.10 screw requires the same torque plus 6 inch pounds or 36 inch pounds to develop the same tension.

Glossary of Terms

Breakaway Torque: Also known as “Off Torque” or “Removal Torque”. Torque required to begin relative rotation between the part and mating thread absent an axial load. Subject to change with usage cycling. Considered the critical performance characteristic of a self-locking component.

Breakloose Torque: Amount of torque required to overcome the axial load of a seated fastener (pre-load), relieving the tension, initiating movement in the off direction. A value unrelated to prevailing torque.

Burr Free: In the context of self-locking components, this reference applies to the milled area of strip and pellet installation areas. MIL-DTL-18240 allows for, “Burr in the area of the locking feature not adversely affecting torque performance”. Long-Lok Fasteners offers a higher quality standard that provides an absence of significant burrs in the region of the milled slot or drilled hole feature as viewed under five power magnification. Additionally, the mechanical verification of this condition is the thread’s ability to freely accept a “Go” ring gage after removal of the locking strip or pellet insert. This higher standard is specified by adding the suffix code “HQ” to the Long-Lok part number when ordering.

Clamp Load — A measure of compressive force in a joint or assembly, resulting from the existing pre-load of a fastener. Typically measured in “pounds”, a value of clamping force imparted by the elastic tension of the fastener in the assembled mating parts.

Cold Flow — Continued deformation of a material under stress.

Elastomer — Any synthetic or natural material with a resilience characteristic or “memory” sufficient to cause it to return to its original shape or form after major or minor distortion.

Installation Torque: Also known as “On-Torque”. Highest value of prevailing or running torque exhibited by a part while installing or engaging to the mating thread form prior to start of any axial

load (pre-load).

Locking Torque: A measure of the performance of a self-locking device, i.e. resistance to rotation. Typically in the “off” direction, not to include torque required to induce or relieve a parts axial load (pre-load). See Breakaway Torque.

Permeability — The rate at which a liquid or gas, under pressure, passes through a solid material by diffusion and solution. As related to elastomers, it is the rate of gas flow expressed in atmospheric cubic centimeters per second (ATM CC/CM²/CM/SEC).

Pre-Load — A measure of the axial load imparted on a fastener. A result of the amount of the applied seating torque, typically measured in pounds per square inch (psi) to create tension in the fastener. Commonly accepted to be 80-85% yield strength.

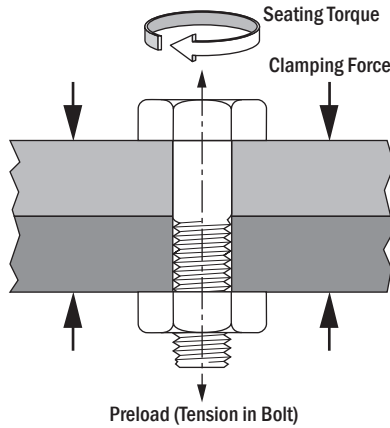
Prevailing Torque: Also known as “Running Torque”. Unique to self-locking fasteners or components. A measure of the inherent ability of a part to produce frictional resistance to rotation in a mating thread form. Exists independent of clamp load, inclusive of both installation and removal torque

Running Torque: Typically an average measure of a parts prevailing torque characteristic in either the installation or removal cycle, independent of clamp load. See “Prevailing Torque”.

Seating Torque — Sometimes referred to as “Loading Torque”. Typically measured in “inch pounds”, a value of torque applied to a fastener to induce a compressive load under the head bearing surface. Results in creating an axial load (pre-load) that imparts tension or a stretching/elongation characteristic to a part.

Torque Calculations

The concept of "Seating Torque" is typically a primary design consideration in any given fastener application. Any designated value for seating torque will have a direct affect on the resulting amount of fastener pre-load (tension) and associated desired clamping force in the assembly.



Following are commonly applied formulae used to derive specific seating torque values associated with design pre-load requirements. Please note that these are offered for example purposes only. As such, they should not be used as the sole basis for specific design criteria of a given application or assembly.

Desired Preload

Preload is calculated using the following formula:

$$F_{by} = S_{yb} A_s$$

Where: F_{by} = Tension in a bolt at yield (lbs.).

S_{yb} = Yield strength of the bolt (psi).

A_s = Cross sectional area of the tensile stress area of the threaded portion of a bolt (in²).

A_s for steels up to 100,000 psi

$$A_s = \frac{\pi}{4} \left[D - \frac{.974}{n} \right]^2$$

A_s for steels over 100,000 psi

$$A_s = \pi \left[\frac{D_{pe}}{2} - \frac{.162}{n} \right]^2$$

Where: D = Nominal diameter of bolt.

N = Number of threads per inch.

D_{pe} = Min. pitch diam. of ext. threads.

Seating Torque (Without locking element)

Seating Torque is calculated using the following formula:

$$T = KDF_{by} \text{ (No locking element)}$$

Where: T = Torque (in.-lbs.).

D = Nominal diameter of bolt (in.).

K = Coefficient of friction factor.*

F_{by} = Tension in bolt at yield (Preload in.-lbs.)

*K Factor

The pre-load value results from the amount of applied seating torque. The torque coefficient of friction factor (K) is measure of the lubricity of a fastener. As such, it must be considered for compensation of numerous design variables such as configuration, size, surface texture, etc. For example, since cadmium plating adds lubricity, it has a smaller "K Factor" than plain steel. Therefore, to develop the same desired pre-load value, a cadmium plated part would require less applied seating torque than the same part in plain finish.

Note: The following "K Factors" are averages offered for example purposes only. The accuracy of any selected "K Factor" is subject to many application variables not discussed here.

Finish	K Factor
Plain Steel	.20
Zinc	.21 to .33
Cadmium	.15 to .20
Black Oxide	.16 to .19
Dry Film Lube, Grease, Oil or Wax	.12

present)

Seating Torque for fasteners incorporating a locking element is calculated using the following formula:

$$(T = KDF_{by}) + x$$

Where x = Empirical Torque Adder (See page 9)

As discussed on Page 9, the average prevailing torque value produced by the presence of a self-locking element must be added to the non-locking seating torque value to achieve the desired pre-load value.

Example Seating Torque Calculation:

1. Calculate Preload: $F_{by} = S_{yb} A_s$

Where: F_{by} = Tension in a bolt at yield (lbs.).

S_{yb} = Yield strength of the bolt (psi).

A_s = Cross sectional area of the tensile stress area of the threaded portion of a bolt (in²).

If: $S_{yb} = 100,000 \text{ PSI.}$
 $A_s = \pi \left[\frac{D_{pe}}{2} - \frac{.162}{n} \right]^2$ for steel over 100,000 psi.

D_{pe} = Minimum pitch diameter of external threads.

n = Number of threads per inch.

$A_s = \pi \left[\frac{.2243}{2} - \frac{.162}{n} \right]^2 = .0355 \text{ in}^2.$

Then: $F_{by} = (100,000 \text{ psi}) (.0355 \text{ in}^2) = 3,550 \text{ lbs.}$

2. Calculate seating torque value required for desired tension (pre-load) for non-locking fastener: $T = KdF_{by}$

Where: T = Torque in.-lb.

d = Nominal diameter of bolt.

F_{by} = Tension in bolt at yield (preload in pounds).

K = Coefficient Factor.

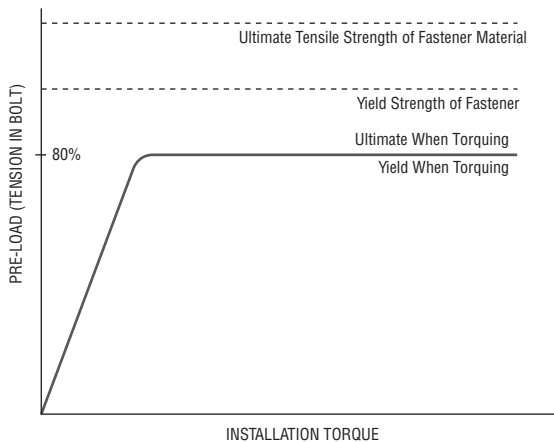
Then: $T = (.08) (.250) (3,550) = 71 \text{ in.-lbs.}$

3. Add Empirical Torque Adder for self-locking fastener: $[T = (.08) (.250) (3,550)] + x$

Where: $x = 12.0 \text{ in.-lbs.}$

Then: $71 \text{ in.-lbs.} + 12 \text{ in.-lbs.} = 83 \text{ in.-lbs.}$

Total Seating Torque = 83 in.-lbs.



Fastener Torque Ranges

No lubrication on threads. Torque values are based on friction coefficients of 0.12 between threads and 0.14 between nut and washer or head and washer, as manufactured (no special cleaning).

Size	Root area, in. ²	Torque range (Class 8, 150 ksi, bolts ^a)
10-24	.0145	23 to 34 in.-lb.
10-32	.0175	29 to 43 in.-lb.
1/4-20	.0269	54 to 81 in.-lb.
1/4-4-28	.0326	68 to 102 in.-lb.
5/16-18	.0454	117 to 176 in.-lb.
5/16-24	.0524	139 to 208 in.-lb.
3/8-16	.0678	205 to 308 in.-lb.
3/8-24	.0809	230 to 345 in.-lb.
7/16-14	.0903	28 to 42 ft.-lb.
7/16-20	.1090	33 to 50 ft.-lb.
1/2-13	.1257	42 to 64 ft.-lb.
1/2-20	.1486	52 to 77 ft.-lb.
9/16-12	.1620	61 to 91 ft.-lb.
9/16-18	.1888	73 to 109 ft.-lb.
5/8-11	.2018	84 to 126 ft.-lb.
5/8-18	.2400	104 to 156 ft.-lb.
3/4-10	.3020	^b 117 to 176 ft.-lb.
3/4-16	.3513	^b 139 to 208 ft.-lb.
7/8-9	.4193	^b 184 to 276 ft.-lb.
7/8-14	.4805	^b 213 to 320 ft.-lb.
1-8	.5510	^b 276 to 414 ft.-lb.
1-14	.6464	^b 323 to 485 ft.-lb.
1 1/8-7	.6931	^b 390 to 585 ft.-lb.
1 1/8-12	.8118	^b 465 to 698 ft.-lb.
1 1/4-7	.8898	^b 559 to 838 ft.-lb.
1 1/4-12	1.0238	^b 655 to 982 ft.-lb.

^a The values given are 50 and 75 percent of theoretical yield strength of a bolt material with a yield of 120 ksi. Corresponding values for materials with different yield strengths can be obtained by multiplying these table values by the ratio of the respective material yield strengths.

^b Bolts of 0.75 in. diameter and larger have reduced allowables (75 percent of normal strength) owing to inability to heat treat this large a cross section to an even hardness.

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Guide to MS and NAS Self-Locking Fasteners

NAS

Print No.	Description
NAS 608	SHCS
NAS 662	100° Flat Hd.
NAS 1081	Setscrew
NAS 1161-1168	100° Flat Hd. - Torque Set
NAS 1171-1178	Pan Hd. - Torque Set
NAS 1181-1188	Flat Fillister Hd. - Torque Set
NAS 1189	100° Flat Hd. - Full Threaded
NAS 1190	Pan Hd. - Full Threaded
NAS 1191	Flat Fillister Hd. Full Threaded
NAS 1216	Pan Hd. - Hi Torque Recess Full Thread
NAS 1217	Pan Hd. - Hi Torque Recess Short Thread
NAS 1218	Pan Hd. - Hi Torque Recess
NAS 1219	100° Flush Hd. Hi Torque Recess Full Thread
NAS 1220	100° Flush Hd. Hi Torque Recess Short Thread
NAS 1221	100° Flush Hd. Hi Torque Recess
NAS 1223-1235	Hex Hd. Bolt, Shear
NAS 1351	SHCS
NAS 1352	SHCS
NAS 1578	Bolt, Flat Pan Head
NAS 1635	Pan Hd. - Full Thread
NAS 1741	100° Flat Hd. Full Thread - Patch Type
NAS 1741	Pan Hd. Full Thread - Patch Type
NAS 1743	Flat Fillister Hd. Full Thread - Patch Type
NAS 4104-4116	(Bolt-Long Thread) 100° Hd. - Tri-Wing Recess - Alloy
NAS 4204-4216	(Bolt-Long Thread) 100° Hd. - Tri-Wing Recess - A-286
NAS 4304-4316	(Bolt-Long Thread) 100° Hd. - Tri-Wing Recess - Titanium
NAS 4400-4416	(Bolt-Short Thread) 100° Hd. - Tri-Wing Recess - Alloy
NAS 4500-4516	(Bolt-Short Thread) 100° Hd. - Tri-Wing Recess - A-286
NAS 4600-4616	(Bolt-Short Thread) 100° Hd. - Tri-Wing Recess - Titanium
NAS 5000-5006	(Bolt-Short Thread) Pan Hd. Tri-Wing Recess - Alloy

NAS 5100-5106	(Bolt-Short Thread) Pan Hd. Tri-Wing Recess - A-286
NAS 5200-5206	(Bolt-Short Thread) Pan Hd. Tri-Wing Recess - Titanium
NAS 5300-5306	(Screw-Full Thread) Flat Fillister - Tri-Wing Recess - Alloy
NAS 5400-5406	(Screw-Full Thread) Flat Fillister - Tri-Wing Recess - A-286
NAS 5500-5506	(Screw-Full Thread) Flat Fillister - Tri-Wing Recess - Titanium
NAS 5600-5606	(Screw-Full Thread) 100° Flt. Hd. Tri-Wing Recess - Alloy
NAS 5700-5706	(Screw-Full Thread) 100° Flt Hd. Tri-Wing Recess - A-286
NAS 5800-5806	(Screw-Full Thread) 100° Flt Hd. Tri-Wing Recess - Titanium
NAS 6203-6220	(Short Thread) Hex Hd. Bolt - Alloy
NAS 6303-6320	(Short Thread) Hex Hd. Bolt - A-286
NAS 6403-6420	(Short Thread) Hex Hd. Bolt - Titanium
NAS 6500-6506	(Screw-Full Thread) 100° Oval Hd. Tri-Wing Recess - A-286
NAS 6603-6620	(Long Thread) Hex Hd. Bolt - Alloy
NAS 6703-6720	(Long Thread) Hex Hd. Bolt - A-286
NAS 6803-6820	(Long Thread) Hex Hd. Bolt - Titanium
NAS 6900-6906	(Full Thread) Pan Hd. Tri-Wing Recess - A-286
NAS 7103-7116	(Long Thread) 100° Flt Hd. Phillips Recessed - Alloy
NAS 7203-7216	(Long-Thread) 100° Flt Hd. Phillips Recessed - A-286
NAS 7303-7316	(Long Thread) 100° Flt Hd. Phillips Recessed - Titanium
NAS 7400-7416	(Short Thread) 100° Flt Hd. Phillips Recessed - Alloy
NAS 7500-7516	(Short Thread) 100° Flt Hd. Phillips Recessed - A-286
NAS 7600-7616	(Short Thread) 100° Flt Hd. Phillips Recessed - Titanium
NAS 7700-7706	(Short Thread) Pan Hd. Phillips Recessed - Alloy
NAS 7800-7806	(Short Thread) Pan Hd. Phillips Recessed - A-286
NAS 7900-7906	(Short Thread) Pan Hd. Phillips Recessed - Titanium
NAS 8000-8006	(Full Thread) Pan Hd. Phillips Recessed - Alloy
NAS 8100-8106	(Full Thread) Pan Hd. Phillips Recessed - A-286
NAS 8200-8206	(Full Thread) Pan Hd. Phillips Recessed - Titanium
NAS 1283	Self-Locking Male Fastener Specification which relates back to MIL-DTL-18240 and MS 15981 (limitations of use)

Print No.

MS

Print No.	Description
MS 3212	Pan Hd. Screw, CRES, Self-Sealing, Silicone O-Ring
MS 3213	Pan Hd. Screw, CRES, Self-Sealing, Fluorosilicone O-Ring
MS 18153	Hex Hd. Capscrew, Gr. 8, UNF
MS 18154	Hex Hd. Capscrew, Gr. 8, UNC
MS 18063	Setscrews, Cup Pt. - Alloy
MS-18164	Setscrews, Cup Pt. - 18-8
MS 18065	Setscrews, Flat Pt. - Alloy
MS 18066	Setscrews, Flat Pt. - 18-8
MS 18067	Setscrews, Cone Pt. - Alloy
MS 18068	Setscrews, Cone Pt. - 18-8
MS 21090	Pan Hd. Screw, Steel
MS 21091	100° Flush Hd., Bolt Steel
MS 21092	100° Flush Hd., Bolt, Cres.
MS 21093	100° Flat Hd. Screw, Steel
MS 21094	Hex Hd. Bolt, Steel
MS 21095	Hex Hd. Bolt, Cres.
MS 21096	Pan Hd. Bolt, Steel
MS 21097	Pan Hd. Bolt, Cres.
MS 21098	12 Pt. Hex Hd., Alloy Steel

Print No.	Description
MS 21099	12 Pt., Hex Hd., Cres.
MS 21262	SHCS, Alloy Steel
MS 21295	SHCS, Cres
MS 51021	Setscrew, Cup Pt., Cres-UNC Threads
MS 51023	Setscrew, Cup Pt., Cres-UNF Threads
MS 51029	Setscrews, Flat Pt., Cres-UNC Thread
MS 51031	Setscrews, Flat Pt., Cres-UNF Threads
MS 51038	Setscrews, Cone Pt., Cres.
MS 51095	Hex Hd. GR. 5 UNC Thds.
MS 51096	Hex Hd. GR 5 UNF Thds.
MS 51963	Setscrew, Cup Pt. Alloy UNC Thds.
MS 51964	Setscrew, Cup Pt. Alloy UNF Thds.
MS 51965	Setscrew, Flat Pt., Alloy UNF Thds.
MS 51966	Setscrew, Flat Pt., Alloy UNF Thds.
MS 51973	Setscrew, Cone Pt. Alloy UNC Thds.
MS 51974	Setscrew, Cone Pt., Alloy UNF Thds.
MS 90727	Hex Hd., GR 8 UNF Thds.
MS 90728	Hex hd., GR 8 UNC Thds.

Specifications

MIL-DTL-18240: Performance specification for prevailing torque type fasteners performing to +250°F – both external and internal threads. Defines patch, strip, and pellet type configurations and offers 5 cycle reusability and torque performance requirements.

IFI 124: Industrial Fastener Institute commercial performance standard and test procedure for prevailing torque type fasteners using non-metallic locking elements. Offers 5 cycle reusability and torque performance requirements.

IFI 524: Same as IFI 124, but for metric size thread forms.

NAS 1283: Design standard for male threaded self-locking fasteners. Incorporates MIL-DTL-18240 performance standards and test requirements by reference.

MS 15981: Design standard for design and usage limitations of externally threaded self-locking fasteners. Incorporates MIL-DTL-18240 performance standards and test requirements by reference.

MIL-F-8961: Design and performance standard for high tempera-

ture (450°F + 1200°F) externally threaded self-locking fasteners. Offers 15 cycle reusability and torque performance requirements.

MIL-I-45932: Design and performance standard for thin wall, self-locking screw thread inserts. Includes design, performance and torque requirements for integral locking device type, both metallic and non-metallic.

MIL-S-82496A: Procurement specification for integral O-ring, self-sealing machine screws. Offers design, performance and test requirements for self-sealing fasteners including reusability and minimum pressure sealing capability.

IFI 125: Industrial Fastener Institute commercial performance and test procedure for chemically coated (pre-applied and assembly-applied adhesive) lock screws. Offers prevailing and breakaway torque performance criteria

IFI 525: Same as IFI 125, but for metric size thread forms.

Manufacturing Standards

Following are industry accepted manufacturing standards for the commercial fastener types listed. In lieu of MS, NAS or customer specifications, these can be used for inspection/acceptance criteria:

Category (Head Styles)	Long-Lok Style Code	Mfr. Standard
Machine Screws-includes Round, Pan, Oval, Flat, Binder, Fillister, Truss & Hex	A,D,F,G,J,M,N,T,V,	ANSI B18.6.3
Socket Screws-includes Button, Socket Cap, & Flat Socket	B,G,J,U,X	ANSI B18.3
Finished Bolts-includes Hex Cap	W	ANSI B18.2.1

Cage Code for Long-Lok Fasteners

Cincinnati – 16941

Los Angeles – 03038

Federal stock code, Self-Locking Fasteners – 5305, 5306

If you wish to use a Long-Lok self-locking element in a fastener that, under the AN, MS or NAS part number is non-locking, simply substitute the desired Long-Lok insert prefix for the AN, MS or NAS prefix.

Long-Lok, over the years, has worked closely with the U.S. Military, the Industrial Fastener Institute and the National Aerospace Standards Committee to insure that our products meet, or exceed, the stringent requirements of these technical bodies. Not all manufacturers can meet these requirements.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Selection Guide

Self-Locking Fasteners								Self-Locking Inserts	Self-Sealing Fasteners	
Product Name	Material Additive					All-Metal	Chemical Additive	Material Additive	O-Ring Seal	Coated Thread
	Poly-Lok	Long-Lok	Tek-Lok	Dual-Lok	Omni-Lok	Dyna-Thred	Dri-Loc	T-Sert	Self-Seal	Vibra-Seal
Page Number	16	18	20	22	23	24	28	30	34	42
Locking Element Material										
Nylon		◆	◆					◆	◆	
Kel-F®		◆	◆					◆	◆	
Vespel®		◆	◆	◆					◆	
Stainless Steel		◆			◆				◆	
Copper		◆							◆	
Polyester	◆								◆	
Fastener Material						◆				
Custom Alloys					◆					
Anaerobic Resin							◆			
Sealing Material										
Nitrile									◆	
Fluorosilicone									◆	
Silicone									◆	
Viton®									◆	
Ethylene Propylene									◆	
Acrylic Coating										◆
Applicable to...										
Straight Male Threads	◆	◆	◆	◆	◆	◆	◆		◆	◆
Straight Female Threads	◆		◆		◆		◆		◆	
NPT Male Threads	◆	◆	◆				◆			◆
NPT Female Threads	◆		◆				◆			
Operating Temperatures										
Minimum	-100°F	-320°F	-320°F	-450°F	Limited Only by Fastener Material		-65°F	-320°F	-400°F	-65°F
Maximum	+400°F	+1200°F	+500°F	+500°F			+400°F	+390°F	+1200°F	+300°F
Standards										
MIL-DTL-18240	◆	◆	◆	◆	◆					
IFI 124/IFI 524	◆	◆	◆	◆	◆					
MIL-F-8961						◆				
MIL-I-45932								◆		
IFI 125/IFI 525							◆			
MIL-S-82496									◆	

Special Thread Locking



Not every thread form is part of a fastener. And no one knows this better than Long-Lok!

Every year we process some very sophisticated components... large and small. What they all have in common is a thread form that must stay secured when assembled.

With our Poly-Lok® Patch, Long-Lok® Strip, Tek-Lok® Pellet and our Dri-Loc® Adhesive, we are confident we can live up to our motto, "Custom Solutions to Special Problems in Fastener Engineering." Our strip and pellet inserts are available in a variety of materials including Kel-F® and Vespel®. For even more control over prevailing or locking torque loads, Long-Lok can custom formulate both Poly-Lok patch material and Dri-Loc adhesive resins. This broad range of locking options combined with our unmatched fastener engineering experience enable us to offer capabilities unavailable from any other company.

So don't think of Long-Lok only when considering common locking fasteners! As you can see from the components pictured here, we can apply a thread locking method to an endless variety of thread forms. These include internal thread forms ranging from standard hex nuts to specially designed internally threaded components. In many cases we can manufacture the entire component, but we welcome you to send your components to us for self-locking processing only.

With the aid of a sketch, drawing or, better yet, an actual sample part from you, a Long-Lok sales engineer will gladly assist you in determining the locking method best suited to your component's application requirements.



Exclusive, Poly-Lok® Polyester Patch – Precise, consistent and controlled application of our exclusive resilient polyester material. Excellent temperature and reusability characteristics.

The original Long-Lok® Strip – Nylon, Kel-F®, Vespel®, or stainless steel insert.



Tek-Lok® Pellet – Nylon, Kel-F® or Vespel®

Material Additive Types

Poly-Lok® Patch Type

- -100°F to +400°F
- **Reusability greater than IFI 124, IFI 524 and MIL-DTL-18240**
- Made of polyethylene terephthalate



Poly-Lok® is today's most advanced, most reliable prevailing torque type self-locking fastener. And it's all due to the unique polyester patch material that is more resilient, has higher strength, and can be reused more often with higher retained torque values than any other patch material.

Even the Poly-Lok manufacturing process is unique. The patch material is applied by a patented process of consistent amount, controlled as never before possible with this type of locking method. Thanks to this engineered proprietary control of patch size and location, dependable prevailing torque performance is achieved consistently from part to part. This exclusive Poly-Lok patch area control capability allows us to

produce non-standard torque values custom tailored to your requirements; a control not attainable with spray-on patch methods. It all adds up to extra-reliability and dependability in almost any threaded fastening application.

The versatility and locking characteristics of the Poly-Lok patch open up a whole new range of fastener applications. From the aerospace to automotive market, engineers everywhere are finding out how well Poly-Lok self-locking fasteners can solve their assembly problems.

What Makes Our Polyester Patch Superior

Vibration and Shock Resistance.

The Poly-Lok self-locking principle incorporates a polyester patch permanently bonded to the fastener threads. When mating threads are engaged, the polyester patch is compressed. The coefficient of friction and modulus of the material as well as the patch volume controls the prevailing torque value achieved. The added prevailing torque keeps the parts locked together. Poly-Lok fasteners won't work loose even under extreme shock and vibration conditions.

Elevated Temperature Capability.

Other plastic additive type self-locking fasteners have limited temperature range capabilities. The Poly-Lok patch has changed all that. It can maintain torque and clamp-load performance through a temperature range of -100° to +400°F.

Built-In Thread Seal.

The Poly-Lok patch acts as a dam to prevent liquid leakage along the thread helix. It provides excellent sealing properties between the load bearing and non-load bearing flanks of the mating threads. The Poly-Lok patch formulation is impervious to most chemical solutions, acids, solvents, oils, brake fluid, and anti-freeze solutions. It can withstand hydraulic pressures and offer effective sealing properties with most liquids.

Low Sensitivity to Thread Fit Variations.

In any mass assembly operation, a Poly-Lok patch offers the best of both worlds. Poly-Lok fasteners lock whether seated or not, and the resiliency and strength of the locking polyester patch is insensitive to thread fit variations. They conform to all 2A-2B and 3A-3B thread fitting tolerances within IFI 124, IFI 524 and MIL-DTL-18240 and NAS1283 torque requirements.

Poly-Lok Patch is Non-Toxic.

Unlike other patch type locking methods Poly-Lok is non-toxic. This allows its use in applications where toxicity is a problem, such as food processing equipment.

Superior Outgassing Performance Capability.

Poly-Lok products have been approved by NASA for space and vacuum environment applications requiring low outgassing characteristics. They have been tested and proven to meet and exceed the requirements of ASTM-E-595-93 and NASA SP-R-0022A test specifications.

Extended Reusability Feature

Use of the specially processed Poly-Lok II patch provides extended reusability characteristics far exceeding those required by IFI 124 of MIL-DTL-18240. Under ideal conditions, Poly-Lok II has demonstrated over 300 cycle reusability.

Custom Applications and Internal Thread Forms.

Its unique application process enables the Poly-Lok patch to solve almost any type of thread locking problem, including internal thread forms. In fact, Poly-Lok is widely used on hex nuts to provide the special torque, high temperature, or outgassing properties required. In addition, special lengths of the polyester locking material ... special thread fit tolerances ... special torque requirements or clamp loads ... or related mating part characteristics can be specified.

Whatever your special needs are, a Poly-Lok patch can provide the solution. It's the most versatile self-locking fastener available today. Only Poly-Lok, made of polyethylene terephthalate, (A Long-Lok patented exclusive) meets all requirements. For special application considerations, see Page 15.

Patch Material

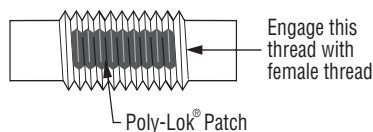
Material	Color Code	Operating Temperature Range	Material Specification
Polyester	Green	-100° F to +400° F	AMS 3612

How to Specify

Please turn to the inside back cover of this catalog for standard product selection and Part Number specification.

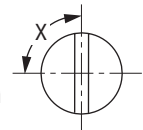
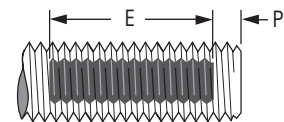
For application of Poly-Lok® patch type locking material to special threaded components, please follow the recommendations below. Remember, Long-Lok Fasteners can manufacture the complete fastening component, or if you prefer, send your parts for processing.

1. Specify "Poly-Lok Patch." Add to drawing notes: "to be installed by Long-Lok Fasteners Corporation."
2. If part could be engaged from either end, note intended direction of engagement.
3. If patch length "L"



is to be greater than the lengths for standard parts, specify as length "E". It is not necessary to specify "L" if standard patch length is satisfactory (See "Standard 'L' Dimensions" tabulated below).

4. If patch is to be placed in a special location, specify "P" Dimension, where P = Distance from thread-engagement end of part to start of locking insert.
5. If patch must be located diametrically in relation to another point, this location should be dimensioned as in "X".
6. If special torque is required, please consult with factory.



Standard "L" Dimensions

Thread Size	#0	#1	#2	#3	#4	#6	#8	#10	1/4
"L" Patch Length	1/8	1/8	1/8	1/8	3/16	3/16	3/16	1/4	5/16
Thread Size	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
"L" Patch Length	5/16	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4

The locking element dimensions shown are approximate and for engineering information only. Consult factory for patch lengths on fasteners with diameters greater than 1 inch.

Design Notes

1. Applicable Standards:
 - Military Specifications: MIL-DTL-18240
 - Military Standards: MS15981, MS16995-16998, MS18063-18068, MS18153, MS18154, MS21090-21099, MS21262, MS21295, MS51021, MS51023, MS51029, MS51031, MS51095, MS51096, MS90727, MS90728
 - Aerospace Standards: NAS662, NAS1081, NAS1161-1168, NAS1171-1178, NAS1181-1188, NAS1189, NAS1190, NAS1191, NAS1223-1235, NAS1283, NAS1351, NAS1352, NAS1635, NAS1741, NAS1742, NAS1743, NAS4104-4116, NAS4204-4216, NAS4304-4316, NAS4400-4416, NAS4500-4516, NAS4600-4616,

- Aerospace Standards continued: NAS5000-5006, NAS5100-5106, NAS5200-5206, NAS5300-5306, NAS5400-5406, NAS5500-5506, NAS5600-5606, NAS5700-5706, NAS5800-5806, NAS6203-6220, NAS6303-6320, NAS6403-6420, NAS6500-6506, NAS6603-6620, NAS6704-6720, NAS6804-6820, NAS6900-6906
- Commercial Standards: IFI 124, IFI 524 (Metric)
- Test Specifications: ASTM-E-595-93, NASA SP-R-0022A, NASA MSFC-HDBK-527

2. See page 8 for hole preparation and other installation information.

Material Additive Types

Long-Lok[®] Strip Type

- -320°F to +500°F
- Reusability per IFI 124, IFI 524 and MIL-DTL-18240



SELF-LOCKING FASTENERS

The Long-Lok strip fastener is a universally accepted, prevailing torque type self-locking fastener, with excellent vibration resistance. Over 35 years of use in thousands of proven applications attest to the wide acceptance of the Long-Lok strip. These fasteners are available in a wide range of sizes – from miniature eyeglass screws to fasteners for the heaviest of highway equipment.

Long-Lok strip fasteners are manufactured by forming a narrow longitudinal slot long enough to assure engagement with the female thread in an otherwise normal bolt or screw, and com-

pressing a special locking material in the slot. The resiliency of the locking insert holds it in place without adhesives or thread distortion, allows it to recover slightly when disengaged, and provides vibration resistance on re-installation. This prevailing torque characteristic can provide re-usability performance in excess of 5 installation/removal cycles.

Several insert materials are available for operating temperatures ranging from -400°F to +500°F. Long-Lok also offers a specially designed stainless steel, rolled-tube insert for temperature requirements in excess of 1200°F.

Strip Materials

Materials	Color Code	Operating Temperature Range	Material Specification
Polycap Nylon	Green	-60°F to +250°F	ASTM-D-4066
Kel-F [®] *	Blue	-320°F to +390°F	AMS 3650
Vespel [®]	Brown	-450°F to +500°F	—
Hot-Lok [™] * (Stainless Steel Tube)	Silver	-400°F to +1200°F	—

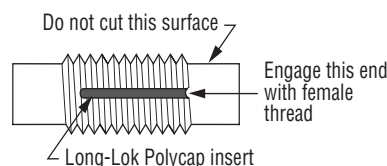
*These inserts are not recommended for reuse. Consult factory for technical details.

How to Specify

Please turn to the inside back cover of this catalog for standard product selection and Part Number specification.

For application of Long-Lok strip type locking inserts to special threaded components, please follow the recommendations below. Remember, Long-Lok Fasteners can manufacture the complete fastening component, or if you prefer, send your parts for processing.

1. Specify “Long-Lok [Polycap, Kel-F[®], or Vespel[®]] Insert.” Add to drawing notes: “to be installed by Long-Lok Fasteners Corporation.”
2. If part could be engaged from either end, note intended direction of engagement.

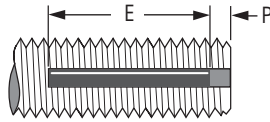


3. If there are any surfaces which should not be cut by Long-Lok slotting mills, denote same on drawing.

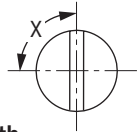
- a. Normally maximum depth of slot is 0.020 below thread minor diameter. If depth must be less than this amount, contact Long-Lok.
4. If insert length “L” is to be greater than the lengths for standard parts (See “Standard ‘L’ Dimensions” tabulated on next page), specify as length “E”. It is not necessary to specify “L” if standard length is satisfactory.

How to Specify – continued

- 5. If insert is to be placed in a special location, specify “P” Dimension, where P = Distance from thread-engagement end of part to start of locking insert.



- 6. If insert must be located diametrically in relation to another point, this location should be dimensioned as in “X”.



- 7. If special torque is required, please consult with factory.
- 8. No dimensions are to be specified for the width and depth of slot, or for the size of insert.

Standard “L” Dimensions

Thread Size	#0	#1	#2	#3	#4	#6	#8	#10	1/4
“L” Insert Length	.125	.125	.185	.185	.240	.285	.320	.320	.355
Thread Size	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
“L” Insert Length	.420	.480	.530	.562	.562	.625	.750	.750	.75

The locking element dimensions shown are approximate and for engineering information only. Consult factory for insert lengths on fasteners with diameters greater than 1 inch.

Design Notes

- 1. Long-Lok strip type, self-locking fasteners have been tested and approved to the following standards and specifications:

Military Specifications: MIL-DTL-18240, QPL-18240
 Military Standards: MS15981, MS16995-16998, MS18063-18068, MS18153, MS18154, MS21090-21099, MS21262, MS21295, MS51021, MS51023, MS51029, MS51031, MS51095, MS51096, MS90727, MS90728
 Aerospace Standards: NAS662, NAS1081, NAS1161-1168, NAS1171-1178, NAS1181-1188, NAS1189, NAS1190, NAS1191, NAS1223-1235, NAS1283, NAS1351, NAS1352, NAS1635 NAS4104-4116, NAS4204-4216, NAS4304-4316, NAS4400-4416, NAS4500-4516, NAS4600-4616, NAS5000-5006, NAS5100-5106, NAS5200-5206, NAS5300-5306, NAS5400-5406, NAS5500-5506, NAS5600-5606, NAS5700-5706, NAS5800-5806, NAS6203-6220, NAS6303-6320, NAS6403-6420, NAS6500-6506, NAS6603-6620, NAS6704-6720, NAS6804-6820, NAS6900-6906
 Commercial Standard: IFI 124, IFI 524 (Metric)

- 2. Plating: Users should consider the following in planning plating or replating of Long-Lok strip type fasteners or threaded components after locking device is inserted.
 - a. Locking devices must never be removed by the end user. Removal and replacement of the insert destroys its effectiveness.
 - b. Locking inserts can be damaged by some plating process or surface treatments. As such, they should never be applied after insert installation. Consult the factory for appropriate processing procedures.
- 3. Manufacture of some commercial strip type fasteners may produce a very slight metal burr at the engagement end of the longitudinal slot. These parts are usually acceptable

for 90% of self-locking applications. By adding the suffix “E” to the part numbers when ordering Long-Lok strip type fasteners, end burrs will be removed. (See “Options”, Page 46; also see definition of Burr Free in “Glossary of Terms”).

- 4. Extensive, independent test data demonstrates that when used properly, the tensile strength of Long-Lok strip type fasteners are not adversely affected by the milled slots used to accommodate the locking element. Sizes of 1/4” diameter and smaller may exhibit a very slight reduction directly in the slotted area. However, similar test data has shown that a high tensile strength margin remains; all parts still meet minimum specification requirements. Torsional strength for these parts is only affected in sizes smaller than #8, and then only when tightened beyond yield strength. Shear strength is not lost in any size; high shear bolt grips are not altered. Ends of the insert slot are radiused to prevent “notch effect” or stress risers.
- 5. See page 8 for hole preparation and other installation information.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we’ll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Material Additive Types

Tek-Lok® Pellet Type

- **-320°F to +500°F**
- **Reusability per IFI 124, IFI 524 and MIL-DTL-18240**



SELF-LOCKING FASTENERS

Tek-Lok® self-locking threaded fasteners obtain locking action from an engineered plastic pellet compressed into a hole drilled in the threaded region of the fastener, to a depth slightly below the root of the thread. Pellet size and location are standard but can be altered to meet special requirements.

The locking action, partly produced by friction developed between the pellet and the mating thread, results from the metal-to-metal friction opposite the locking pellet. The pellet

acts as a wedge and creates a counter-thrust when deformed, while the inherent memory of the pellet strives to regain its original shape, causing positive locking. And since the lock action exists at all times, Tek-Lok fasteners are ideal for “adjusting” applications, when it’s essential that the fastener stays in a specific position without being seated. Tek-Lok fasteners are produced in both military and commercial grades, and are offered in a variety of insert materials for cryogenic to high temperature applications.

Pellet Materials

Materials	Color Code	Operating Temperature Range	Material Specification
Polycap Nylon	Green	-60° F to +250° F	ASTM-D-4066
Kel-F®*	Blue	-320° F to +390° F	AMS 3650
Vespel®	Brown	-450° F to +500° F	—

*These inserts are not recommended for reuse. Consult factory for technical details.

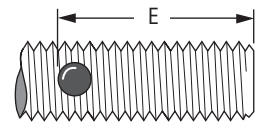
How to Specify

Please turn to the inside back cover of this catalog for standard product selection and Part Number specification.

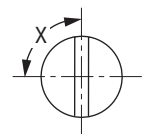
For application of Tek-Lok locking pellets to special threaded components, please follow the recommendations below. Remember, Long-Lok Fasteners can manufacture the complete fastening component, or if you prefer, send your parts for processing.

1. Specify “Tek-Lok [Nylon, Kel-F®, or Vespel®] Pellet.” Add to drawing notes: “to be installed by Long-Lok Fasteners Corporation.”

2. If pellet is to be position further from the end of the part than standard “L” Dimension indicates (see “Standard ‘L’ Dimensions”, following page), specify as length “E”. It is not necessary to specify “L” if standard length is satisfactory.



3. If pellet must be located diametrically in relation to another point, this location should be dimensioned as in “X”.



4. If special torque is required, consult with factory.

Standard "L" Dimensions

Thread Size	#0	#1	#2	#3	#4	#6	#8	#10	1/4
"L" Pellet Location	.06	.07	.08	.09	.14	.16	.17	.19	.24
Thread Size	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
"L" Pellet Location	.27	.30	.31	.33	.38	.41	.47	.52	.52

Note: The locking pellet location dimensions are approximate and are for engineering information only

Design Notes

- Applicable Standards:
 - Military Specifications: MIL-DTL-18240
 - Military Standards: MS15981
 - Commercial Standards: IFI 124, IFI 524 (Metric)
- All standard nuts and most female threaded items can be made self-locking by drilling through the wall of the part and installing and swaging in place a nylon pellet. In some applications the pellet can be installed from the inside without drilling through the wall. Contact Long-Lok prior to specifying this design.
- Special parts can be produced with Tek-Lok pellets. Contact Long-Lok's engineering group for unusual thread sizes, materials, thin wall conditions, short parts—where standard pellets do not appear applicable.
- The locking element in Tek-Lok commercial fasteners can protrude above the crest of the thread, to approximately .010" over the maximum major diameter of the fastener. Therefore, a clearance hole of about .015" larger than the maximum major diameter of the fastener is recommended to allow for passage of the locking element, and the mating thread should be chamfered .020/.030 over the major diameter to insure good compression and locking action of the insert. Consult factory for special clearance hole or chamfer requirements.
- Ideal performance of Tek-Lok commercial fasteners is obtained when the locking element has engaged the mating thread for five revolutions (threadpitches) or more. However, in many applications excellent performance is obtained with considerably less engagement. In general, the minimum length standard Tek-Lok fastener readily obtained can be determined by noting that two full pitches of thread should exist beyond the locking element (L dimension) for either proper performance or manufacturing ease.
- Extensive, independent test data demonstrates that when used properly, the tensile strength of Tek-Lok pellet type fasteners are not adversely affected by the drilled holes used to accommodate the locking element.

Sizes of 1/4" diameter and smaller may exhibit a very slight reduction directly in the drilled hole area. However, similar test data has shown that a high tensile strength margin remains; all parts still meet minimum specification requirements. Torsional strength for these parts is only affected in sizes smaller than #8, and then only when tightened beyond yield strength. Shear strength is not lost in any size; high shear bolt grips are not altered.
- See page 8 for hole preparation and other installation information.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Other Self-Locking Designs

Dual-Lok®

- Vespel® Locking Insert
- High Temperature Capability
- Dual Locking Surfaces

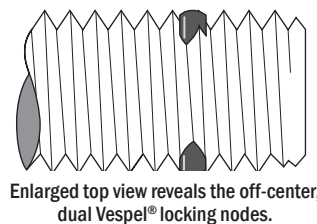
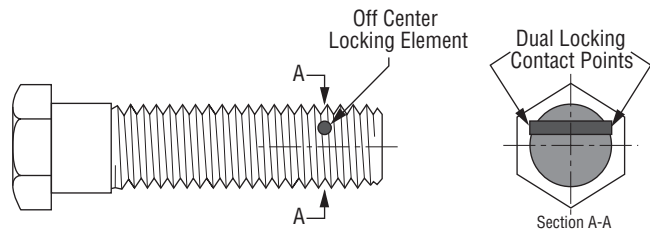
Totally New—Totally Unique

First, what is it? The patented Dual-Lok process is a newly developed self-locking feature designed specifically for use in higher temperature applications. Using Vespel® inserts as its locking element, Dual-Lok fasteners have the capability to withstand high to low temperature cycling (-450°F to +500°F) throughout at least 15 removals. Dual-Lok fasteners meet all of the requirements of IFI 124, IFI 524 and MIL-DTL-18240.

The Dual-Lok design incorporates a specially formed locking element pressed into an off-center through-hole prepared in the threaded section of an externally threaded fastener. This unique design provides these features:

- Positive insert retention and no glue required.
- Advantage over pellets due to smaller drill hole and element diameter required to develop torque due to having two locking surfaces exposed.
- Prevailing torque performance meeting the requirements of MIL-DTL-18240
- Withstands high temperature requirements for non-metallic self-locking elements.
- Withstands high vibratory and stress conditions placed on external threaded parts.

Every project is special. After discussions between Long-Lok Technical Service personnel and your engineers, a torque requirement specification will be established and a formula developed for your company's individual needs for the Dual-Lok process.



See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Omni-Lok™

- Temperatures to 1200°F
- Ideal for short thread engagements
- Wide range of locking element materials

Designed to Improve Product Integrity.

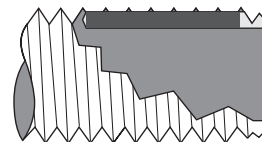
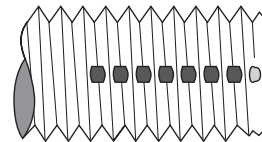
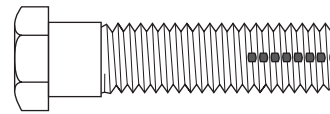
The Omni-Lok process is a patented method to make bolts and nuts stay in place, regardless of the extent of vibration or temperature stress. Omni-Lok fasteners meet all specifications of MIL-DTL-18240, including those requiring as many as fifteen reuses.

Omni-Lok fasteners incorporate single or multiple pins, fully contained in holes located within the thread, and held parallel to the longitudinal axis. The pin is precisely located in such a manner that the O.D. of the pin extends above the root diameter of external threads—and below the minor diameter of internal threads—at a controlled height. This provides the required torque, creating an effective wedge in the threaded assembly for frictional resistance to rotation, i.e. prevailing torque.

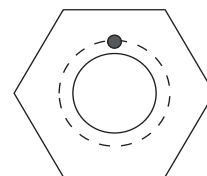
The Omni-Lok process is well-suited for special threaded components which require a locking element but have one or more of the following difficult-to-deal with situations;

- Withstand high temperature (up to 1200° F), or low temperature (cryogenic) requirements.
- Withstand high vibratory and stress conditions placed on external and internal threaded parts.
- Conforms to MIL-F-8961 requirements.
- Enable parts with a short thread engagement to utilize a self-locking feature.
- High prevailing torque requirement.
- Unusual and non-conventional configurations
- Severe corrosion environmental conditions.
- Omni-Lok pins can be fabricated from an almost endless list of materials such as high temperature resisting alloys and soft ductile materials in order to provide a controlled and consistent torque for severe applications.

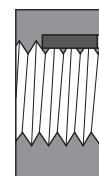
Every Omni-Lok project is special. After discussions between Long-Lok Technical Service personnel and your engineers, a torque requirement specification will be established and a formula developed to control the Omni-Lok process. One or more holes are then formed longitudinally in the bolt at a specified distance inward of the major diameter. One or more pins of proper diameter to fit the hole are then inserted.



Omni-Lok Bolt Configuration



Omni-Lok Nut Configuration



Dyna-Thred® II All-Metal Type

- **-400°F to +1200°F**
- **Reusability per IFI 124 and MIL-F-8961**



The unique, all-metal Dyna-Thred II design is a technological breakthrough in reliable self-locking fasteners. Extensive tests prove that the locking action of Dyna-Thred II fasteners maintains minimum torque requirements after more than 15 re-uses. The patented Dyna-Thred lock is formed of the fastener itself and requires use of no additional locking element materials. Locking action takes place in a full hoop, 360° around the thread, providing an equal load on all sides.

The useful temperature range of Dyna-Thred II fasteners is limited only by the physical characteristics of the parent bolt material. From cryogenic applications to sustained high temperatures, Dyna-Thred II fasteners stay locked in. And, of course, Dyna-Thred II fasteners are available in a wide variety of head styles, materials, finishes, and sizes.

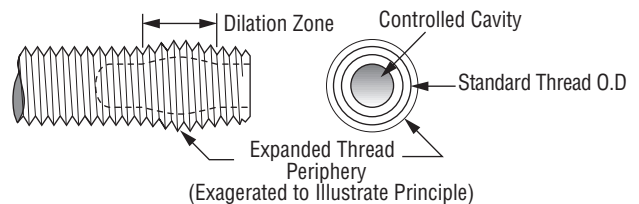
Typical Applications

Use Dyna-Thred II fasteners whenever extreme heat and punishing vibration loosen or destroy other fasteners.

- Airborne turbo-prop engines
- Ground-based turbines
- Commercial appliances such as restaurant coffee urns, etc.
- Commercial and military aircraft braking systems
- Auxiliary power units
- Rapid transit and rail subsystems

The Dyna-Thred II Principle

The Dyna-Thred II lock is made by forming a close tolerance hole axially into the threaded end of a fastener. A controlled area of the cavity is dilated to expand the periphery of a controlled thread area. The pitch diameter of the first thread is left unchanged for starting ease. The result: an easily installed, highly reliable, self-locking bolt or screw. Dyna-Thred II bolts meet all the performance requirements of, and is qualified to, Specification MIL-F-8961.



Dyna-Thred II Materials and Finishes

Materials	Tensile Strength, PSI	Maximum Temperature
Grade 5, Alloy Steel	125,000 minimum	up to 1200 ° F
Grade 8, Alloy Steel	150,000 minimum	up to 1200 ° F
A-286 CRES	160,000-170,000	up to 1200 ° F
Mild Carbon Steel	55,000 minimum	up to 1200 ° F
300 CRES	75,000 minimum	up to 1200 ° F
Inconel®	185,000 minimum	up to 1200 ° F

Finishes
Cadmium
Silver Plate
Dry Film Lube
Passivate
Plain

Performance

Laboratory Tests were independently conducted.*

Static Tensile Strength Tests

Dyna-Thred engagement was affected 2 threads above the cavity area. Comparisons were made between standard NAS1004 and Dyna-Thred at room temperature and Dyna-Thred alone at 1200°F. Tests proved that essentially no tensile strength difference existed between NAS1004 bolts and Dyna-Thred bolts.

Specimen No.	Part Type	Nom. Dia. & Thread 3A	Ult. Tensile Load Req't Lbs. Min.	Results Ult. Tensile Test Lbs.	Location of Failure	Test Temp. °F
1	Dyna-Thred	1/4-28	5150	6360	Bolt Thread	74
2	Dyna-Thred	1/4-28	5150	6240	Bolt Thread	74
3	Dyna-Thred	1/4-28	5150	6540	Bolt Thread	75
4	NAS1004	1/4-28	5150	6580	Bolt Thread	74
5	NAS1004	1/4-28	5150	6540	Bolt Thread	74
6	NAS1004	1/4-28	5150	6380	Bolt Thread	75
7	Dyna-Thred	1/4-28	—	4395	Bolt Thread	1200
8	Dyna-Thred	1/4-28	—	4425	Bolt Thread	1200

Tension-Fatigue Tests

Dyna-Thred was tested with the essentially comparable NAS1004 bolt to determine their strength characteristics. No appreciable strength difference between the two types of bolts was noted.

Specimen No.	Part Type †	Nom. Dia. & Thread 3A	Stress PSI High Ten. Load	Fatigue Loading Lbs.		Number of Cycles to Failure	Location of Failure
				Low Ten. Load ± 2%	High Ten. Load ± 2%		
1	Dyna-Thred	1/4-28	83,100	271	2710	65,000	Bolt Head
2	NAS1004	1/4-28	83,100	271	2710	58,000	Bolt Head
3	Dyna-Thred	1/4-28	61,350	200	2000	176,000	Bolt Head
4	NAS1004	1/4-28	61,350	200	2000	189,000	Bolt Head

Stress Rupture Tests

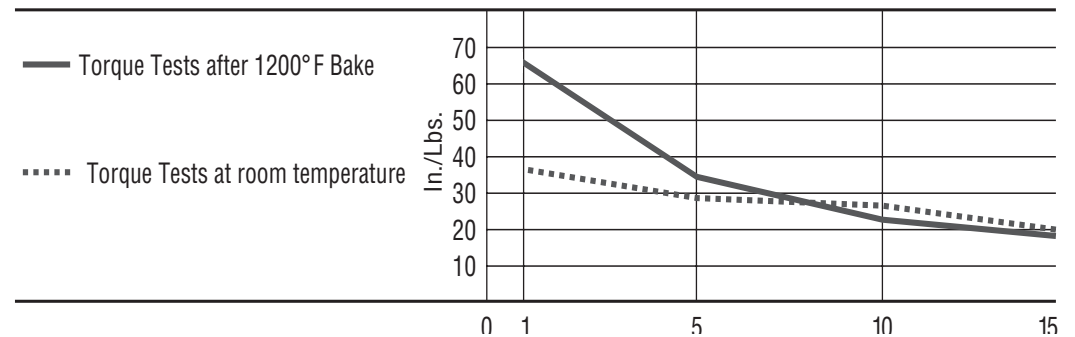
Dyna-Thred bolts were positioned so that 1-1/2 threads protruded through the end of the nut. The bearing face of the nut was within approximately 3 threads of the runout. The Dyna-Thred bolt and nut assembly was heated to 1200°F during the test period of 23 hours. All test bolts satisfactorily met stress rupture test requirements of Specification AMS 7478.

Specimen No.	Part Type †	Nom. Dia. & Thread 3A	Tensile Stress Area Sq. In.	Test Load Lbs.	Tensile Strength PSI	Rupture Life Hours	Location of Failure
1	Dyna-Thred	1/4-28	0.03553	2310	65,000	23.0	No Fail
2	Dyna-Thred	1/4-28	0.03553	2310	65,000	23.0	No Fail
3	Dyna-Thred	1/4-28	0.03553	2310	65,000	23.0	No Fail

† All Dyna-Thred bolts were corrosion-resistant steel fabricated from A286 and silver plated. Unplated hexagon A286 nuts were used in accordance with dimensions specified in MIL-F-18240D.

15-Cycle Locking Torque Tests**

Tests described were run at room temperature and after 1200°F bake for six hours, in accordance with military specification MIL-F-8961. All bolts tested were manufactured from A-286 CRES, and were Dyna-Thred part number DTF1004-21A, which has a 1/4-28 UNF-3A thread. Results indicated are minimum breakaway values measured in inch-pounds.



* Laboratory tests were conducted by Almay Research & Testing Corporation, Los Angeles, California. Complete certified test results available on all tests.

** Meets MIL-F-8961 Torque Requirements.

How to Specify — Dyna-Thred II All Metal Type

Dyna Thred II bolts and screws may be ordered using AN, MS or NAS specification numbers by using the part number scheme below. All other types may be specified by constructing a commercial part number using the tables at right. Either method is simple.

Options

Long-Lok offers optional Headmarking (six or more dots raised or recessed 0.010", maximum, in a circular pattern) at a nominal additional cost. Add the letter "M" at the end of the part number to order this option. Please consult with factory for other special requirements.

Metric Sizes

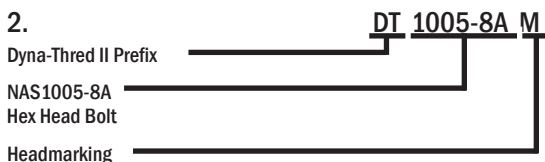
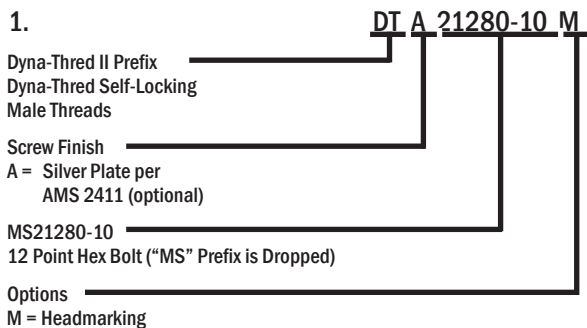
Though not cataloged here, metric size equivalents for most of our self-threaded fasteners are available. Please call Long-Lok if your application calls for metric dimensioned parts. We are prepared to handle your requirements!

AN, MS and NAS Part Numbers

1. Add a "DT" prefix in place of the "AN", "MS", "NAS" or other specification callouts of basic screws or bolts.
2. Add the following after DT when applicable:
 F = Dry lubrication finish per MIL-L-46010, Type 1
 A = Silver plate per AMS 2411
 C = Cadmium plating per QQ-P-416, Type II, Class 2
3. Add the following to the end of the part number when applicable:
 M = Headmarking - six or more dots raised or depressed 0.010 max.

Examples:

Note: Part Numbers here are spread apart for clarity. Please do not add spaces between codes when constructing your Part Number.

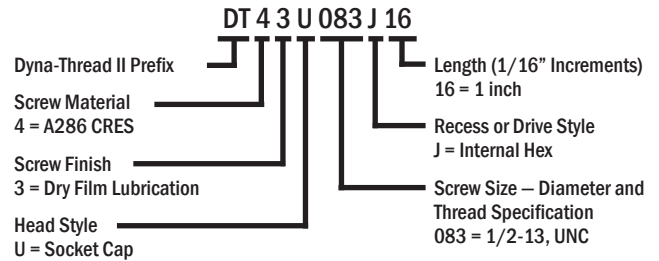


Commercial Part Numbers

Follow the structure shown below to construct a complete Part Number for commercial grade Dyna-Thred II self-locking bolts and screws.

Example:

Note: Part Numbers here are spread apart for clarity. Please do not add spaces between codes when constructing your Part Number.



Screw Material	
Description	Code
Steel Grade 5 (125M psi Minimum)	1
Steel Grade 8 (150M psi Minimum)	2
	3
A-286 CRES	4
Steel, Mild Carbon (55 psi Minimum)	5
300 CRES	6
Inconel™	8

Screw Finish	
Description	Code
Cadmium per QQ-P-416, Type II, Class 2	1
Silver Plate per AMS 2411 (1200°F)	2
Dry Film Lubrication per MIL-L-46010, Type I	3
Passivate per QQ-P-35	4
Plain, No Finish*	5

*While available with no finish, application of a lubricating coating is recommended to prevent part seizure in the mating thread form at time of installation.

See for Yourself

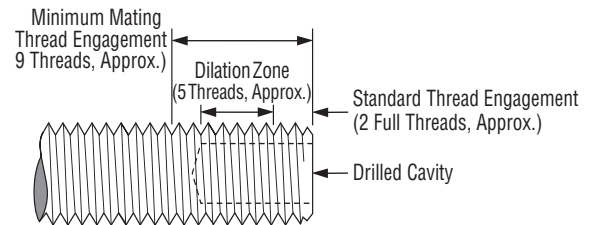
Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Design Notes

- Applicable Standards:
 - Military Specification: MIL-F-8961
 - Commercial Standards: IFI 124, IFI 524 (Metric)
- Additional Materials and Finishes are available upon request.
- Not all Material/Finish combinations are available for every head style.
- Consult factory for minimum thread lengths.
- Consult factory for additional details.
- Note: Unless otherwise specified, thread fit classes and configuration envelope dimensions are per the applicable head style ANSI/ASME commercial standard. See Appendix.
- Studies have shown that the greatest percentage of tensile load of a fastener is carried in the first two threads of engagement in the mating thread form. As evidenced by the static tensile test described on Page 25, DynaThred fasteners easily meet minimum tensile strength requirements when used in this way.

As shown in Figure 1 below, the standard drilled cavity depth of a typical Dyna-Thred fastener is approximately 7 thread pitches. For this reason, mating thread engagement of 9 threads minimum is required to ensure tensile strength performance consistent with test results on Page 25. Prevailing torque performance, however, can be achieved with thread engagement of 7 threads, minimum.

Figure 1



DT 4 3 U 083J 16

Head Style		
Description		Code
Round		A
Button		B
Pan		D
Oval		F
100° Flat		G
82° Flat		J
Binder		M
Fillister		N
Truss		T
Socket Cap		U
Hex Tap Bolt		V
Hex Cap Screw		W

Screw Size			
Coarse Thread		Fine Thread	
Size	Code	Size	Code
6-32	62	6-40	60
8-32	82	8-36	86
10-24	04	10-32	02
1/4-20	040	1/4-28	048
5/16-18	058	5/16-24	054
3/8-16	066	3/8-24	064
7/16-14	074	7/16-20	070
1/2-13	083	1/2-20	080
9/16-12	092	9/16-18	098
5/8-11	101	5/8-18	108
3/4-10	120	3/4-16	126
7/8-9	149	7/8-14	144
1-8	168	1-12	162

Recess or Drive Style		
Description (Applicable Head Style Codes)		Code
Cruciform (A, D, F, G, J, M, N, T)		P
Spline Socket (B, U)		K
Slotted Recess (A, D, F, G, J, M, N, T, V, W)		S
External Hex (V, W)		H
Internal Hex (B, G, J, U)		J
Offset Cruciform (A, D, F, G, J, M, N, T)		T

Length	
Description	Code
Lengths in increments of 1/16"; tolerances per applicable specifications. Consult Long-Lok for applicable minimum thread lengths.	
Examples:	
1/4"	4
5/16"	5
3/8"	6

SELF LOCKING FASTENERS

Chemical Additive Types

Dri-Loc® Pre-Applied Adhesive

- -65°F to +400°F
- **Reusability per IFI 125 and IFI 525 (Single Use Only)**



SELF-LOCKING FASTENERS

Long-Lok is proud to offer Dri-Loc® adhesive coatings for standard fasteners and other threaded components. Dri-Loc adhesives (from Loctite Corporation), applied to threaded parts, form a unique coating that converts ordinary fasteners into self-locking fasteners. Dry to the touch, Dri-Loc adhesives become an integral part of the fastener and stay inert until parts are used. During the assembly process, Dri-Loc adhesive is activated by assembly forces, releasing anaerobic adhesive which locks parts securely.

Dri-Loc adhesives are applied to the full circumference of the fastener. Resin fills all voids in the threads when installed, and cures to form an excellent seal to both liquids and gases. (For pre-applied non-locking thread sealant, see Vibra-Seal® information beginning on Page 42.)

Dri-Loc adhesives are designed for applications where specific shear strengths, temperature range and substrate types are necessary. All Dri-Loc adhesives harden in the absence of air on ferrous and nonferrous metals without primer, activators or heat.

They exhibit controlled lubricity, low on torque and are dry to touch for ease of assembly with automatic or hand tools.

For convenience, coatings are color coded to indicate strength range and for easy inspection. Bolts with diameters of 1/16" through 3/4" and with shank lengths of 3/8" to 6" can be coated with our specially developed equipment.

Specifications

Resin (anaerobic)	Dimethacrylate
Flashpoint (Cleveland open cup)	Above 200°F (93°C)
On-Part Life at 68°F (±20°F and 50% RH)	Four Years
Toxicity	Low
Specific Gravity	1.05 to 1.15
Cure Speed @ 70°F	10 Minutes Fixture: Full Cure in 72 Hours
On-Torque	25% of IFI 124 and Lower than IFI 125

Torque Tension

The tension in the fastener can be reasonably controlled by controlling the torque. For any given fastener the torque tension relationship can be stated as follows:

$$T = KDF$$

where T = Torque, lb.-in. (N • m)

D = Nominal bolt diameter, in. (m)

F = Tension or clamping force, lbs. (N)

K is a universal constant for all sizes which can be established empirically.

(You can find safe stresses for bolts in manufacturers' fasteners specifications or tool engineers' handbooks.)

K Values for Dri-Loc® Adhesives

	K Value
Zinc Phosphate/oil	0.11
Dri-Loc 200	0.12
Dri-Loc 201	0.15
Dri-Loc 202	0.13
Dri-Loc 203	0.11
Dri-Loc 204	0.18

(Example: Dri-Loc 200 on 3/8"-16, Grade 5, Zinc Phosphate bolt: $T = 0.12 \times .375 \times 5000 = 225 \text{ lb.-in.}$)

Performance

Listed below are the standard Dri-Loc adhesive formul. In addition, Long-Lok can formulate custom Dri-Loc adhesives to meet your application's particular requirements for locking

and sealing performance. These special formulations are created in response to your specific requirement.

Formula	Color Code	Strength Range	Shear Strength (psi shear)	Temperature Range	Sample Breakaway/Prevailing Torque Value (lb-in.)					
					Fastener Size					
					1/4-20	5/16-18	3/8-16	7/16-14	1/2-13	5/8-11
200	Yellow	High	2400	-65°F to +300°F (-54°C to +150°C)	80/25	190/95	220/105	470/200	860/350	1140/520
201	Yellow	High	2700	-65°F to +400°F (-54°C to +204°C)	60/45	190/95	245/130	415/265	685/380	1200/900
202	Green	Medium	2200	-65°F to +300°F (-54°C to +300°C)	63/45	160/65	200/105	385/160	600/300	820/380
203	Silver	Mild	1800		50/30	120/60	160/75	280/130	480/140	540/340
204	Red	High	3100		80/60	220/180	280/250	470/340	860/600	1500/1400

Notes for Breakaway Torque, Shear Strength, and Prevailing Torque Data:

1. Values are typical of batches; individual components may vary as much as ±25%. Values listed are meant for comparative purposes only; consult with Long-Lok Fasteners before designing, specifying or purchasing Dri-Loc fasteners.
2. Values obtained on Grade 5 bolts with phosphate and oil finish; Dri-Loc adhesive coating was cured for 72 hours @ 70°F.
3. For test data on other fastener sizes and finishes, please contact Long-Lok Fasteners.

Solvent Resistance

	Test Temperature	% Retention				
		200	201	202	203	204
Air Reference	188°F	100	100	100	100	100
Glycol/Water	188°F	100	100	95	40	100
Isopropyl Alcohol	188°F	100	100	100	65	95
Gasoline	188°F	100	95	100	70	100
10W30 Oil	188°F	100	90	100	55	90
Phosphate Ester	188°F	100	90	100	100	100
Toluene	188°F	100	95	100	60	100
Air Refence	75°F	100	100	100	100	100
Water	75°F	100	100	100	100	100
10W30 Oil	300°F	80	100	90	30	80
Automatic Transmission Fluid	300°F	75	100	85	35	80

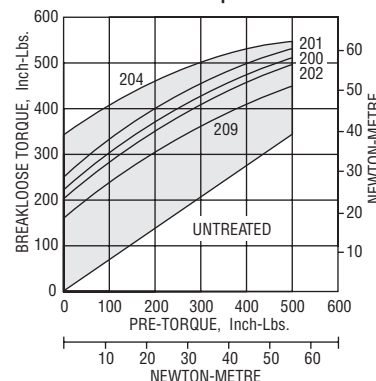
How to Specify

Dri-Loc coated fasteners are produced to order by Long-Lok Fasteners Corp. Long-Lok processes your supplied parts, or we can supply complete products, including the basic fastener. To order Dri-Loc coated fasteners, or to request a quote, please call Long-Lok and speak directly with one of our Sales Engineers.

Design Notes

1. Applicable Standards:
Commercial Standards: IFI 125 (Meets IFI 124 for On-Torque)
2. Second use of a Dri-Loc coated fastener gives approximately 30% of original strength.
3. Sample tests are recommended for fastener surfaces other than those listed.
4. Normal loosening of a UNC bolt will be about 70% of the torque to which it has been tightened (UNF = 80%). The application of a threadlocking compound adds to or augments the normal loosening torque. The amount it does this is called the torque augmentation. This is shown in the shaded area.
5. Dri-Loc adhesives are slightly acidic and may stain or discolor some metals. However, the effect on performance of the adhesive has been shown to be inconsequential. Dri-Loc adhesives are not recommended for use on copper or brass.
6. Excessive or repeated skin contact with the liquid anaerobic resin squeezed from Dri-Loc treated fasteners may cause dermatitis in sensitive persons. In case of skin contact, remove promptly by washing with mild soap and water. In case of skin reaction, discontinue contact with product. If skin reaction persists, see a physician. KEEP MATERIAL AWAY FROM CHILDREN.

Breakloose Torque



Data obtained on 3/8"-16, Grade 5, phosphate and oil nuts and bolts, cured for 72 hours at room temperature.

SELF-LOCKING FASTENERS

Material Additive Types

T-Sert® Self-Locking Inserts

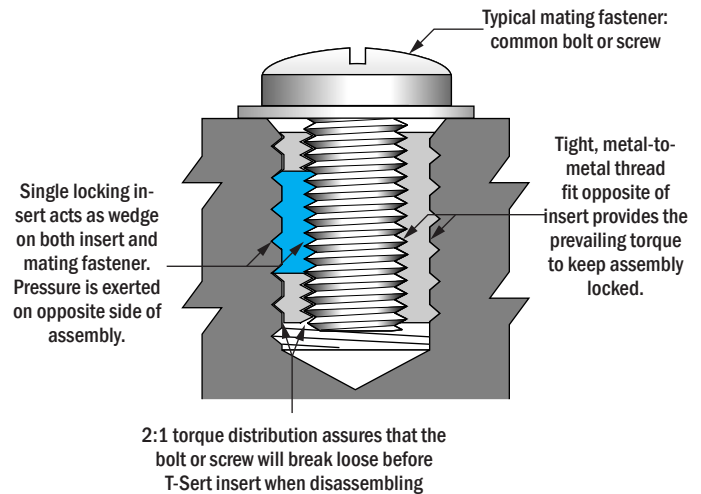
- Additional joint strength in low tensile materials such as **aluminum, magnesium and plastics**.
- Self-locking internal threads.
- Wear-resistant internal threads in soft materials.

T-Sert® inserts require no locking rings or other separate locking devices. An integral, self-locking element extends longitudinally through the wall of the insert, and provides simultaneous locking action for both internal and external threads in accordance with MIL-I-45932. The torque developed by the T-Sert locking element provides approximately twice as much torque on the external as on the internal diameter, precluding the possibility of unintentional rotation after installation.

During installation of the mating fastener the T-Sert self-locking element flows into the thread root, forcing the fastener threads into metal-to-metal contact with the threads of the T-Sert insert, thus holding it securely. Because the T-Sert locking action is prevailing, and does not depend upon the seating of the mating fastener, it does not loosen with severe vibration or shock. Mating fasteners need no lockwashers, adhesives or lock wiring or any other expensive additional devices.



SELF-LOCKING FASTENERS



What Makes T-Sert Inserts Superior to Other Threaded Inserts?

Economical

Because of inherent simplicity of design, T-Sert inserts cost substantially less than all other types of solid wall, self-locking inserts. And with easy installation the installed cost of T-Sert inserts is less than that of all other inserts; particularly wire-type inserts. Either-end installation means that T-Sert inserts can be installed more quickly than other insert types since they do not have to be oriented, permitting additional economy in time-saving. All this makes T-Sert inserts the most economical insert available.

Reusable

T-Sert inserts internal thread lock can be reused a minimum of fifteen times. Extremely low cold flow and exceptional memory in the T-Sert locking element assures reusability that meets the requirements of MIL-I-45932.

High Strength

One piece, solid wall construction gives T-Sert inserts the ultimate in both torque and tensile strength.

Excellent Corrosion Protection

T-Sert inserts do not break the surface coating on the parent material as do key, ring, swage-locked or self-tapping inserts.

Easier, Quicker To Install

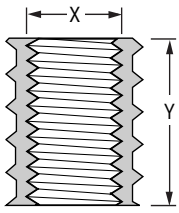
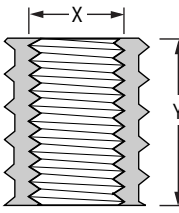
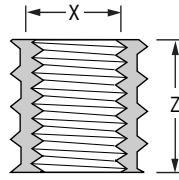
T-Serts inserts require no special hole preparation, no special counterbores, tapes or gages, no indexing or referencing operations. The inserts are installed by utilizing the internal thread of the insert and a simple driving tool. And, because they do not require a swaging or ramming home of keys or rings, T-Sert inserts cause no undue stresses due to installation.

Locking Element Material

Material	Color Code	Operating Temperature Range	Material Specification
Polycap Nylon	Green	-60°F to +250°F	ASTM-D-4066
Kel-F®	Blue	-320°F to +390°F	AMS 3650

Size Variations

For each thread size offered, T-Sert inserts are available in the three variations illustrated here.

Variation	Standard	Heavy Wall	Short
T-Sert Prefix*	T	TH	TS
T-Sert Form Cutaway			
Comparable MIL-I-45932 Series Number	100	200	400

*These prefixes are seen in Table 2, and used in the final Part Number.

Installation Procedure

It's easy as one-two-three. Drill, countersink and tap the mating hole. Then use recommended T-Sert driver to install the T-Sert quickly and easily.



1. T-Sert insert is threaded onto the driver.
2. The T-Sert driver installs T-Sert flush to .010-.020 below the surface of the parent material.
3. Driver is backed off, leaving the insert permanently installed.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

Material Additive Types

How To Specify

Use the material tabulated in Tables 1 below, and Table 2 opposite, to build complete Part Number for T-Sert inserts per the example shown here. Please do not use spaces or dashes.

Example:

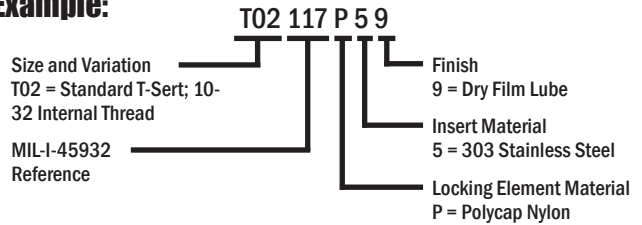


Table 1

T02 117 P 5 9

Size and Variation	MIL-I-45932 Reference	Locking Element Material	Code	Insert Material	Code	Finish	Code
See Table 2	See Table 2	Polycap Nylon	P	303 CRES In Accordance with FED. STD. No. 66	5	Cadmium per QQ-P-416, Type II, Class 3	5
		Kel-F®	L	17-4 CRES per AMS 5643	7	Plain	7
						Dry Film Lube per MIL-L-46010	9

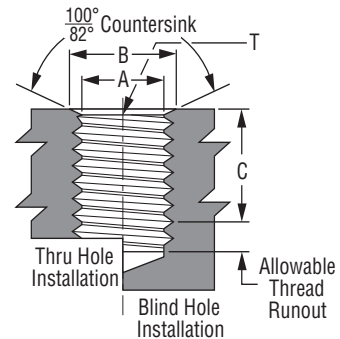
SELF LOCKING FASTENERS

Hole Preparation

Hole preparation for T-Sert inserts is accomplished with standard drills and taps. For added wall strength, however, T-Sert inserts are manufactured with a modified external minor thread diameter. To ensure proper fit and function use the drill and tap sizes specified in Table 2 for each T-Sert insert size.

1. Locate and drill with standard drill to "A" Dia.
2. Countersink with standard countersink (82° - 100°), to "B" Dia.
3. Tap with standard unified thread series tap, "T" dimension.

Figure 1



T-Sert Driver

Hand- or power tool-operated, T-Sert Drivers are simple and trouble free. Made of heat treated steel.

How To Specify: Recommended driver number for each T-Sert size is shown in Table 2.

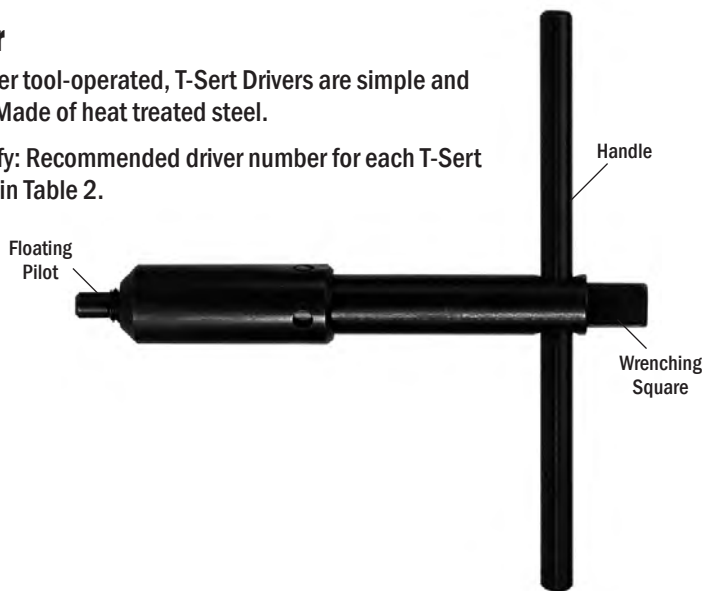


Table 2

T-Sert Sizes				Hole Preparation (See Figure 1)						T-Sert Driver Part No.
Internal Thread UNJ-3B	Length ±.010	T-Sert Size and Variation Code	MIL-I-45932 Type A Reference	A Tap Drill Dia.	B C'Sink Dia. x 90° ±.010	Minimum Drill Depth			T Thread Tap Size UN-3B	
						C Min. Full Thd. Depth	Bottoming Tap	Plug Tap		
.086-56	.19	T26	104	.112-.117	.178	.220	.280	.340	.138-40	TSDR-26
	.19	TH26	204	.139-.144	.204	.220	.300	.360	.164-32	
	.15	TS26	404	.112-.117	.178	.180	.240	.300	.138-40	
.112-40	.19	T40	108	.139-.144	.204	.220	.300	.360	.164-32	TSDR-40
	.19	TH40	208	.165-.170	.230	.220	.320	.381	.190-32	
	.15	TS40	408	.139-.144	.204	.180	.260	.321	.164-32	
.138-32	.21	T62	112	.165-.170	.230	.240	.320	.381	.190-32	TSDR62
	.21	TH62	212	.190-.195	.256	.240	.330	.401	.216-28	
	.15	TS62	412	.165-.170	.230	.180	.260	.321	.190-32	
.164-32	.25	T82	114	.190-.195	.256	.280	.370	.441	.216-28	TSDR82
	.25	TH82	214	.220-.225	.290	.280	.370	.446	.250-28	
	.21	TS82	414	.190-.195	.256	.240	.330	.401	.216-28	
.190-24	.29	T04	116	.220-.225	.290	.325	.410	.486	.250-28	TSDR04
	.29	TH04	216	.280-.285	.372	.325	.430	.510	.3125-24	
	.21	TS04	416	.220-.225	.290	.240	.330	.406	.250-28	
.190-32	.29	T02	117	.220-.225	.290	.325	.410	.486	.250-28	TSDR02
	.29	TH02	217	.280-.285	.372	.325	.430	.510	.3125-24	
	.21	TS02	417	.220-.225	.290	.240	.330	.406	.250-28	
.250-20	.38	T040	118	.280-.285	.372	.415	.519	.602	.3125-24	TSDR040
	.38	TH040	218	.342-.347	.435	.415	.519	.602	.375-24	
	.25	TS040	418	.280-.285	.372	.280	.389	.472	.3125-24	
.250-28	.38	T048	119	.280-.285	.372	.415	.519	.602	.3125-24	TSDR048
	.38	TH048	219	.342-.347	.435	.415	.519	.602	.375-24	
	.25	TS048	419	.280-.285	.372	.280	.389	.472	.3125-24	
.3125-18	.47	T058	120	.342-.347	.435	.505	.609	.693	.375-24	TSDR058
	.47	TH058	220	.403-.408	.497	.505	.630	.730	.4375-20	
	.31	TS058	420	.342-.347	.435	.345	.450	.530	.375-24	
.3125-24	.47	T054	121	.342-.347	.435	.505	.609	.693	.375-24	TSDR054
	.47	TH054	221	.403-.408	.497	.505	.609	.730	.4375-20	
	.31	TS054	421	.342-.347	.435	.345	.450	.530	.375-24	
.375-16	.56	TH066	222	.467-.472	.560	.595	.720	.820	.500-20	TSDR066
.375-24	.56	TH064	223	.467-.472	.560	.595	.720	.820	.500-20	TSDR064
.500-13	.75	TH083	226	.577-.582	.685	.795	.889	1.035	.625-18	TSDR083
.500-20	.75	TH080	227	.577-.582	.685	.795	.890	1.035	.625-18	TSDR080

Head Sealing Types

Self-Seal® O-Ring Sealing Fasteners

- **Positive Sealing—Pressure and Vacuum**
- Cold-Formed for Superior Strength and **Uniformity**
- **High Re-Usability**
- **Optional Self-Locking Capability**

Self-Seal® fasteners, manufactured exclusively by Long-Lok, are designed to provide the optimum combination of sealing and fastening in one complete unit. They are cold formed for strength and uniformity, and then assembled with O-rings capable of sealing almost any fluid or gas.

With Self-Seal fasteners, these resilient O-rings are positioned under the head in a precision-engineered groove, and are affected little by repeated assembly and disassembly. They provide a superior degree of sealing and re-usability to the common alternative techniques of chemical coatings or plastic washers that attempt to seal the threadform. And, unlike these common alternatives, with Self-Seal fasteners you're not limited to a few compatible finishes or hampered by extra parts that need stocking, inventory and assembly.

Long-Lok offers a wide selection of materials, finishes and O-rings to configure an endless variety of Self-Seal Fasteners and custom components capable of withstanding operating temperatures from -300°F to +500°F.



Typical Applications

- Motors
- Cabinets and enclosures
- Sensors and instrumentation
- Internal combustion engines
- Gear pumps
- Fuel tanks
- Transmissions
- Gear boxes
- Air cylinders
- Pressure gauges
- Computer disk drives
- Motion control valves
- Missile tank
- Wet wings

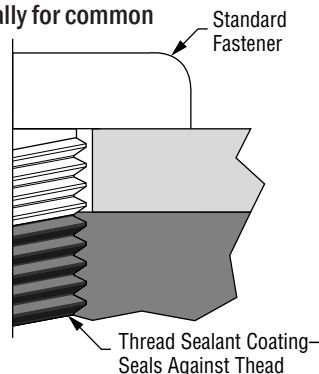
SELF SEALING FASTENERS

Self-Seal® Method and Advantages

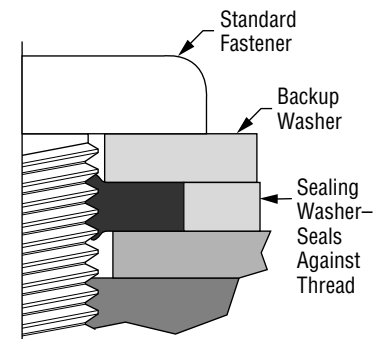
To understand why Long-Lok Self-Seal® fasteners are the most complete answer to combined fastening and sealing operations, it helps to know where the alternatives fall short. The two main alternatives are thread coatings (liquids or tapes), and external plastic washers.

Conventional Sealing Techniques

Coatings, such as Vibra-Seal®, which we also offer (following this section) are cost-effective for moderate performance applications... especially for common fluid fittings where repeated disassembly is uncommon. But, since the coating is applied directly to the thread form, sealing properties deteriorate with reuse. Also, coatings are not compatible with all finishes.



Plastic Washers also get their sealing properties through direct interaction with the threadform. Like thread coatings, they are prone to deterioration due to the cutting action of the thread it's trying to seal, thus limiting their re-usability. Additionally, sealing washers, prone to cold flow, are separate components that must be assembled onto the fastener (typically with other washers), and calculated into the assembly dynamics and measurements; a consideration to factor into your actual installed cost.

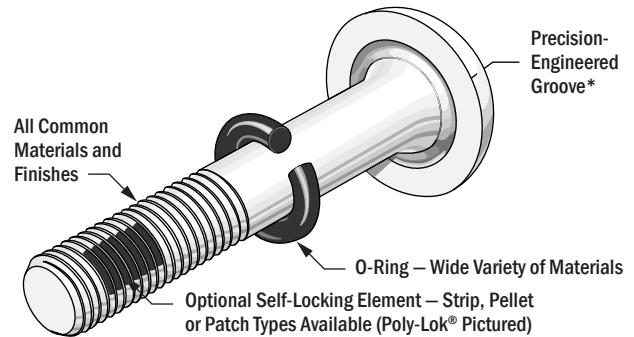


Self-Seal® Sealing Technique

Self-Seal® fasteners overcome all these limitations by placing an O-ring under the head for sealing. With this elegant solution, Self Seal fasteners offer these unique advantages:

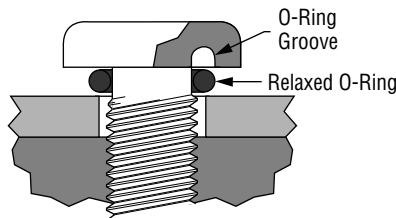
- Assemble mating components using standard torque values.
- Specify any common surface finish.
- Metal-to-metal contact.
- High re-usability.
- Positive sealing from either side of the assembly.

Self-Seal fasteners are designed and manufactured with a cold-formed groove beneath the head of the fastener. As the fastener is tightened, the O-ring is compressed, squeezing the O-ring between the groove and mating surface to complete the seal. The design of the groove controls the amount of compression to the O-ring. And because O-rings retain their elastic memory, Self-Seal fasteners are reusable time after time. The O-Ring groove is optional for 100° flathead fasteners. Standard 100° flatheads are without the O-Ring groove. See page 39 when ordering.

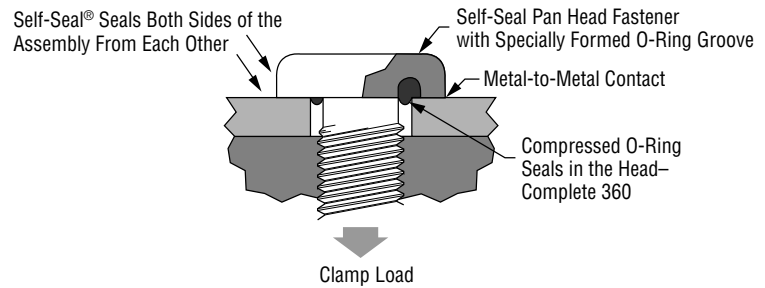


* groove optional on 100° flathead fasteners.

Before Installation



Installed



Performance

Laboratory Tests were independently conducted.*

Pressure Failure Test

Each size 10-32 Self-Seal test specimen was installed into a test fixture and torqued to 23 inch-pounds. The assembly was then slowly pressurized until rupture or failure. Test specimens utilized silicone O-Rings.

Specimen No.	Failure Pressure (PSIG)	Specimen No.	Failure Pressure (PSIG)
1	25,000	7	20,000
2	24,000	8	19,000
3	20,000	9	22,500
4	20,000	10	20,500
5	22,500	11	20,000
6	25,000	12	27,000

Average Failure Pressure = 24,136 PSIG.

* Laboratory tests were conducted by ITL Independent Testing Laboratories, Costa Mesa, California. Complete certified test results available on all tests.

Helium Mass-Spectrometer Leakage Test

Results: Using a Buna-N O-Ring there were no indications of helium leakage in excess of 5.0 x 10-5 SCC/Sec.

MIL-S-82496A Test

Twelve MS3212-43 Self-Seal specimens were subjected to the series of consecutive performance tests as specified in MIL-S-82496A.

Test	Parameter	Time	Results
Installation	23 In./Lbs.	—	Complied
Proof	1,500 PSIG	1 Minute	No Leakage
Soak	200°F	70 Hours	Complied
Leakage	1,000 PSIG	5 Minutes	No Leakage
Reverse Leakage	1,000 PSIG	5 Minutes	No Leakage
Endurance	15 Cycle*	—	Complied
Both Leakages	5,10,15 Cycle	5 Minutes	No Leakage

Summary: Self-Seal® fasteners complied with no leakage.

Self-Seal O-Ring Materials

Materials	Description	Key Uses	Temperature Range (Dry Heat Only)	Color
Buna-N (Nitril)	Most common seal material. Excellent resistance to petroleum-based oils and fuels, silicone greases, hydraulic fluids, water and alcohols. Low compression set, high tensile strength, and high abrasion resistance.	<ul style="list-style-type: none"> • Oil resistant applications. • Low temperature military uses. • Automotive, marine, aircraft fuel systems. • Can be compounded for FDA applications. 	-40°F to +250°F	Black
Viton® (Fluorocarbon)	High temperature resistance and outstanding chemical resistance. Low gas permeability and high resistance to swelling in gasoline and gasoline/alcohol blends. Resists ozone and U.V. light. Perhaps the “ideal” O-ring material.	<ul style="list-style-type: none"> • Aircraft engine sealing. • Automotive fuel handling systems. • Hard vacuum service. • Wide chemical exposure situations. • High temperature/Low compression set applications. 	-20°F to +400°F	Black
Silicone	Made from silicone, oxygen, hydrogen and carbon. Excellent retention of flexibility and low compression set characteristics. One of the widest temperature ranges for elastomers.	<ul style="list-style-type: none"> • Static seal in extreme temperatures. • Medical devices. • Meets FDA regulations. 	-75°F to +450°F	Red
Ethylene Propylene	Ethylene/propylene copolymer (EPM), sometimes combined with a third comonomer (EPDM). Excellent ozone and chemical resistance characteristics. Provides effective resistance to steam (400°F) hot water, silicone oils and greases, dilute acids and alkalies, alcohols and automotive brake fluids.	<ul style="list-style-type: none"> • Outdoor weather resistance. • Hydraulic and automotive brake systems. • Automobile cooling systems. • Water appliances. 	-60°F to +300°F	Black
Fluorosilicone	Combines the good high and low temperature stability of silicone with the fuel, oil, and solvent resistance of fluorocarbon (Viton®). Suitable for exposure to air, sunlight, ozone, chlorinated and aromatic hydrocarbons.	<ul style="list-style-type: none"> • Aerospace fuel systems. • Fuel emission control systems. • Static sealing applications. 	-70°F to +400°F	Blue
Neoprene (Chloroprene)	One of the earliest of the synthetic materials to be developed as an oil resistant substitute for natural rubber. A homopolymer of chloroprene (Chlorobutadiene). Good resistance to ozone, sunlight and oxygen aging; low compression set.	<ul style="list-style-type: none"> • Components in transportation industry. • Recommended for exposure to weathering. • Preferred material for refrigeration industry. • FDA approved for food and beverage industry. 	-45°F to +250°F	Black

How to specify

Self-Seal® fasteners are available in both standard and custom configurations. Ordering part numbers are compiled using the codes for standard Self-Seal fasteners tabulated on the following pages. Below you'll find information on custom Self-Seal products, and how to order them from Long-Lok Fasteners Corp.

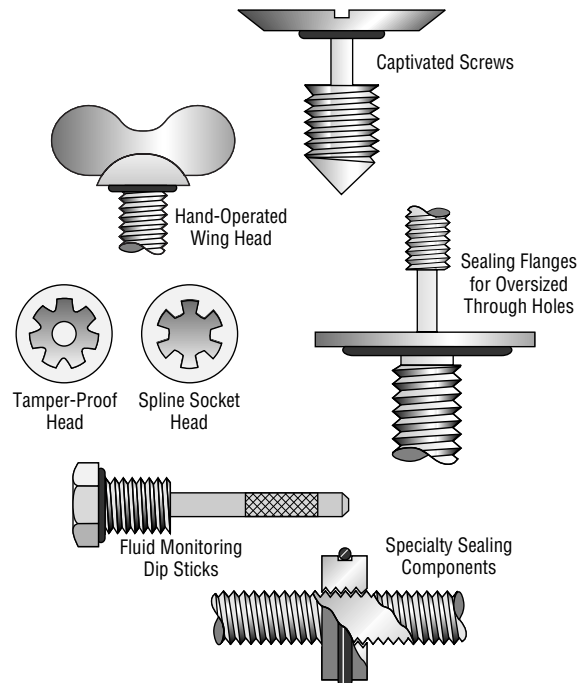
Custom Self-Seal Products

It doesn't have to be exotic to be custom. Self-Seal "customs" simply may be basic fastener types manufactured in a material or finish not offered as standard. Or, Self-Seal "customs" may be highly engineered, non-fastening, multi-piece components of your design, manufactured by Long-Lok. Whichever of these descriptions fit your custom requirements, remember: If it needs to seal tight and seal right, each and every time, Self-Seal products are your best choice.

In addition to the materials and finishes listed in the ordering tables on the following page, Long-Lok can manufacture Self-Seal® fasteners and components using most other common materials and finishes; just let us know if you need something not listed. Most common thread forms, including metric, can be supplied. For materials, finishes or threadforms not referenced, please consult with Long-Lok engineers.

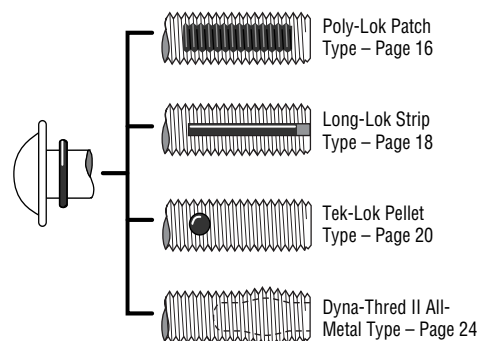
Finally, listed here are items for consideration when thinking of specifying custom Self-Seal fasteners or components. Review these, and then call Long-Lok with your application requirements.

- Type of joint to be sealed
- Fastener length and grip
- Clearance hole size
- Cyclic fatigue stress
- Fastener material
- Fastener finish
- Corrosive conditions
- Shear and tensile strengths
- Head style
- Drive style
- Self-locking requirement
- Captive capability
- Thread class and style
- Environmental conditions for seal
- Fluid to be sealed
- Temperature extremes
- Internal and external pressures



Self-Locking Options for Self-Seal® Fasteners

When shock or vibration are present in your application, consider specifying Self-Seal fasteners manufactured with one of Long-Lok's self-locking methods. In addition to strip and pellet type locking devices, your options include Long-Lok Fastener's exclusive Poly-Lok® patch and Dyna-Thred® II all-metal process. Descriptions of these self-locking options are all within this catalog.



Note: Some self-locking methods may be limited by fastener size.

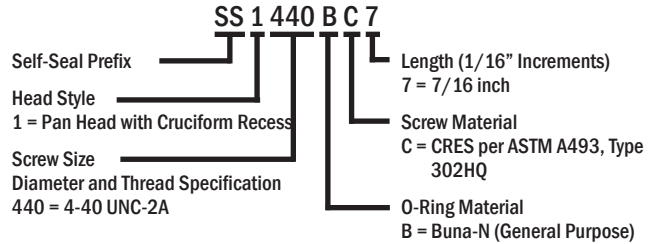
Head Sealing Types

How to specify — Standard Self-Seal Fasteners

Use the tabulated material on these two pages to build part numbers per the examples shown below. Please do not use spaces or dashes.

Example 1:

Note: Part Numbers here are spread apart for clarity. Please do not add spaces between codes when constructing your Part Number.



SELF SEALING FASTENERS

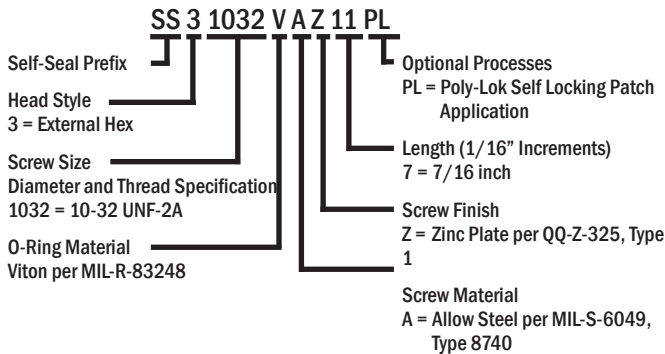
Head Style		
Description		Code
Pan with Cruciform Recess		1
Pan with Slotted Recess		2
External Hexagon		3
100° Flat with Cruciform Recess		4
Button with Cruciform Recess		6
Captive Pan with Slotted Recess		71
Captive Pan with Cruciform Recess		72

Screw Size			
Coarse Threads		Fine Threads	
Size	Code	Size	Code
2-56	256	2-64	264
4-40	440	4-48	448
6-32	632	6-40	640
8-32	832	8-36	836
10-24	1024	10-32	1032
1/4-20	1420	1/4-28	1428
5/16-18	51618	5/16-24	51624

Call Long-Lok for larger diameters.

O-Ring Material		
Material	Specification	Code
Buna-N	General Purpose	B
Ethylene Propylene	ASTM D2000/SAE J200	EP
Buna-N	MIL-P-25732	H
Silicone	FDA Approved	I
Fluorosilicone	MIL-R-25988	K
Ag/Ni Silicone	MIL-G-83528	M
Buna-N	MIL-R-6855	N
Buna-N	MIL-R-7362	R
Silicone	AMS3304	S
Buna-N	FDA Approved	Y
Viton® (Fluorocarbon)	MIL-R-83248	V

Example 2:



Clearance Holes and Installation Torque

Nominal Screw Size	Maximum Clearance Hole (Inches)	Seating Torque (In-Lbs.)	
#4	.112-40UNC-2A	.128	5
#6	.138-32UNC-2A	.149	9
#8	.164-32UNC-2A	.177	20
#10	.190-32UNF-2A	.201	23
1/4	.250-20UNC-2A	.266	75

Notes: 1. Do not chamfer holes. Break sharp edges 0.010 inches maximum.
2. Please contact Long-Lok Fasteners for details on other sizes.

SS 3 1032 V A Z 11 P

Screw Material	
Description	Code
Stainless Steel 300 series	C
Alloy Steel	A
400 Series CRES*	L
Low Carbon Steel	S
SAE Grade 5	G5
SAE Grade 8	G8
316 Stainless Steel	9

Screw Finish	
Description	Code
Zinc Plate per QQ-Z-325, Type 1 (clear)	Z
Zinc Plate per QQ-Z-325, Type 2 (gold)	ZZ
Cadmium Plate per QQ-P-416, Type 1, Class 3 (silver)	C
Cadmium Plate per QQ-P-416, Type 2, Class 3 (gold)	CC
Black Oxide per MIL-C-13924	O
Passivated	P
No Plate*	N

Length	
Description	Code
Lengths in increments of 1/16"; tolerances per applicable specifications. Consult factory for minimum thread length requirements.	
Examples:	
1/8"	2
1/4"	4
5/16"	5
3/8"	6
Etc.	Etc.

Optional Processes		
Description	Added Material	Code
Poly-Lok® Patch Type Self-Locking Element	Polyester	PL
	Nylon	LP
Long-Lok® Strip Type Self-Locking Element	Kel-F®	LL
	Vespel®	LV
	Stainless Steel	LH
Tek-Lok® Pellet Type Self-Locking Element	Nylon	TA
	Kel-F®	TL
	Vespel®	TV
Dyna-Thred® All-Metal Self-Locking Process	—	D
Head Drill	—	H
Add Teflon® Washer	—	W
Add O-Groove to 100° Flathead	—	G

*All CRES will be passivated.

See for Yourself

Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

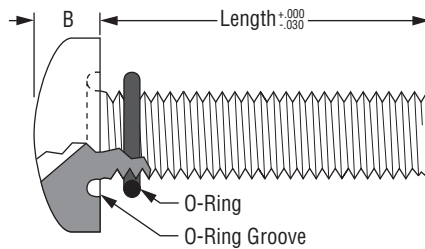
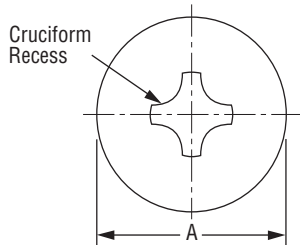
Head Sealing Types

Dimensional Data

To accommodate the O-ring groove, Self-Seal fasteners incorporate heads slightly larger than common bolts and screws. Tabulated here are dimensions for six of the most commonly specified Self-Seal fasteners. For dimensional data on styles or sizes not shown here, please contact Long-Lok.

Reminder: Length is specified in 1/16" increments. Contact Long-Lok for minimum thread lengths and special grip requirements. Unless otherwise specified, Self-Seal fasteners are provided with a full-length thread.

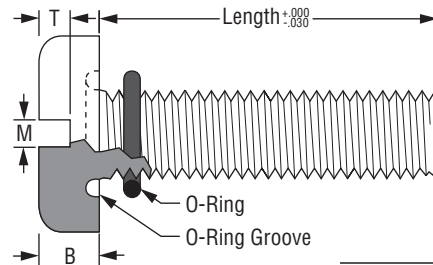
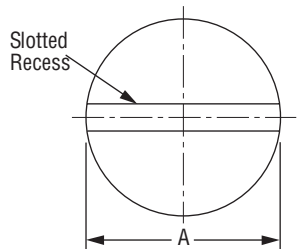
Pan Head – SS1



Note: Pan head Self-Seal® fasteners with cruciform recess are also available under MS3212/MS3213.

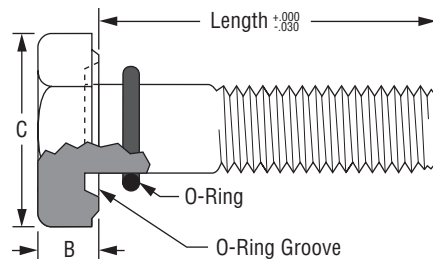
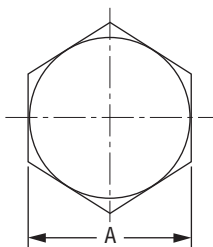
Size	4	6	8	10	1/4
A	.238-.228	.294-.282	.347-.335	.403-.391	.517-.497
B	.080-.075	.097-.092	.115-.109	.133-.126	.175-.170

Pan Head – SS2



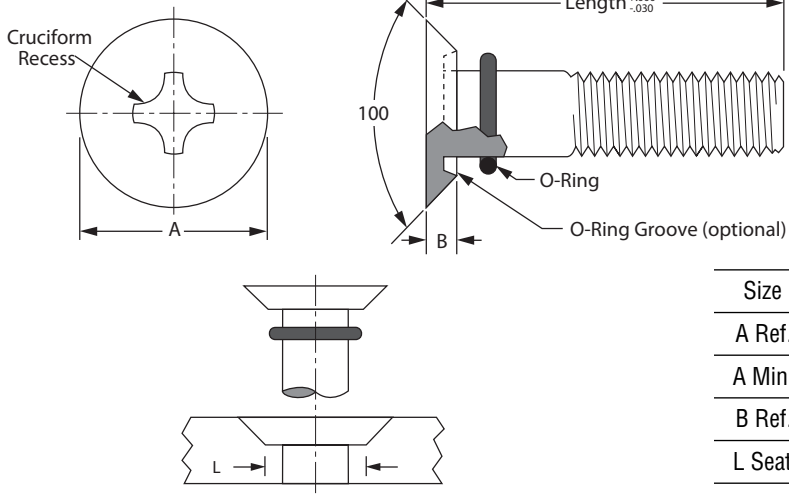
Size	4	6	8	10	1/4
A	.220-.210	.271-.256	.323-.306	.374-.357	.493-.473
B	.070-.065	.083-.076	.097-.090	.113-.100	.148-.133
M	.030-.023	.039-.031	.048-.039	.054-.045	.060-.050
T	.030-.023	.037-.030	.045-.038	.050-.043	.067-.050

Hex Head – SS3



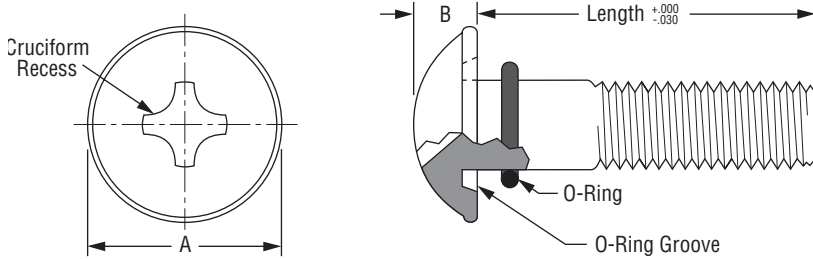
Size	8	10	1/4	5/16	3/8
A	.312-.305	.440-.428	.502-.490	.565-.553	.627-.615
B Ref.	.120	.155	.180	.212	.248
C Ref.	.340	.510	.580	.650	.720

100° Flat Head – SS4



Size	4	6	8	10	1/4
A Ref.	.279-.267	.334-.323	.410-.400	.510-.496	.666-.648
A Min.	.231	.287	.362	.452	.600
B Ref.	.041	.042	.045	.073	.097
L Seat	.164-.162	.226-.222	.274-.268	.286-.278	.388-.380

Button Head – SS6



Size	4	6	8	10	1/4
A	.285-.270	.370-.350	.385-.365	.440-.420	.580-.555
B	.080-.070	.100-.090	.115-.105	.135-.125	.160-.145

Vibra-Seal® Pre-Applied Thread Seal

- -65°F to +300°F
- Non-Curing — Stays Flexible
- **Reusable Up to 5 Times**
- **Inhibits Corrosion — Excellent Solvent Resistance**
- **503, 516, 517, 503HV**



Vibra Seal® Preapplied Thread Sealant is a tough, non-hardening sealant engineered to be preapplied to parts. Vibra-Seal is designed to provide an instant seal on tapered pipe threads against most fluids, fuels and lubricants but can also be used on straight threads. Vibra-Seal performs to the demanding requirements of the automotive, truck and agricultural equipment manufacturers. It provides lubricity superior to Teflon® — at a lower cost!

Available in white or burnt orange colors, Vibra-Seal coatings are highly filled water based liquids that are non-toxic and non-sagging. When dried, they become a resilient, tight clinging and non-curing sealant. Vibra-Seal coated parts also resist loosening because of the prevailing torque created by the coating. Long-Lok can coat entire parts (frequently done on smaller fasteners) or can apply Vibra-Seal sealant to a limited

band of threads, which is typical of larger fasteners and fluid fittings.

Typical Applications

- Rear Axle Filler Plugs
- Bearing Adjuster Nuts
- Overhead Fire Sprinklers
- Pressure Gauges/Sensors
- Cable Connectors
- Door Closure Hardware
- Brake Fittings
- Compressor Pipe Plugs
- Shower Heads
- Pipe Fittings of all Kinds
- Adjustment Screws
- Screws for Plastic Assembly

Specifications

Resin Coating	Acrylic
Colors	White or Burnt Orange
On-Part Life	4 Years, Minimum
Toxicity	None

Torque Tension

The tension in the fastener can be reasonably controlled by controlling the torque. For any given fastener the torque tension relationship can be stated as follows:

$$T = KDF$$

where T = Torque, lb.-in. (N • m)

D = Nominal bolt diameter, in. (m)

F = Tension or clamping force, lbs. (N)

K is a universal constant for all sizes which can be established empirically.

(You can find safe stresses for bolts in manufacturers' fasteners specifications or tool engineers handbooks).

K Values for Vibra-Seal® Sealants*

	K Value
Dry Zinc Phosphate	0.13
Zinc Phosphate/Oil	0.11
Vibra-Seal on dry Zinc Phosphate	0.11
Vibra-Seal on Zinc Phosphate/Oil	0.09

*3/8"-16 Grade 5 bolts with Grade 2 as received nuts.

(Example: Vibra-Seal on 3/8"-16, Grade 5, zinc phosphate bolt:

$$T = .11 \times 375 \times 5000 = 206 \text{ lb.-in.})$$

Performance

Pressure Resistance

1. Pipe Threads

Pipe Size	Burst Rating	Test Pressure	Test Results (Test Fluid -10 wt. Motor Oil)
1/2" NPT	10,400 psi (72 MPa)	10,000 psi (69 MPa)	Test discontinued with no sign of leakage
2" NPT	5,200 psi (36 MPa)	4,000 psi (28 MPa)	Test discontinued with no sign of leakage
3" NPT	5,000 psi (35 MPa)	3,000 psi (21 MPa)	Test discontinued with no sign of leakage

2. Straight Threads

In addition to NPT joints, Vibra-Seal products can also be used to seal straight threads. Test performed on 3/8-16 straight threads, torqued up snug, exhibited excellent sealing characteristics at oil pressures up to 600 PSIG (4.14 MPa).

Steam Pressure Resistance

Tests performed on 1/2" cast iron National Pipe Threads (NPT) assembled with 24 lb.-in. (2.7 N • m) seating torque yielded the following results.

Steam Pressure	Steam Temperature	Test Results
12 psi (.014 MPa)	200°F (93°C)	Test discontinued after 1,000 hours with no sign of leakage
30 psi (.207 MPa)	250°F (121°C)	Test discontinued after 1,000 hours with no sign of leakage

Solvent Resistance

Tests performed on 1/2" cast iron National Pipe Threads (NPT) at 100 PSIG (.69 MPa) hydrostatic pressure after 30 days immersion in solvents indicated.

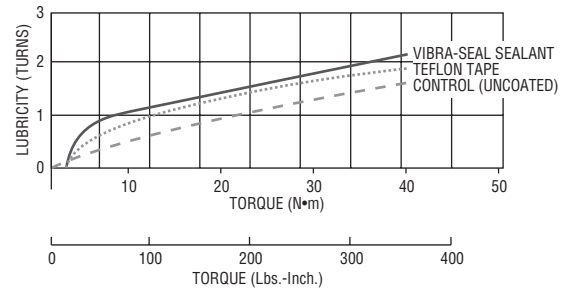
Solvent	Solvent Temperature	Test Result
10 Weight Motor Oil	300°F (149°C)	No Leakage
Water	200°F (93°C)	No Leakage
Gasoline	77°F (25°C)	No Leakage
Air @ 98% Relative Humidity	100°F (38°C)	No Leakage
50% Glycol and Water	188°F (87°C)	No Leakage

Design Notes:

- Vibra-Seal coatings are slightly basic and may stain or discolor some metals, especially those containing copper. However, the effect on performance of the sealant and staining of the metals is inconsequential.

Lubricity

NPT joint assembly is made quicker and easier because of the lubricating ingredients in Vibra-Seal products which resist thread galling. Line-up adjustments can be made several hours after assembly without loss of sealing quality. Joints can be easily disassembled with regular tools even after years of service.



Reuse

Vibra-Seal products have exhibited the ability to be reused five times on 1/2" NPT fittings which are torqued up snugly. After five uses, these fittings still maintain 300 psi (2.0 MPa) hydraulic pressure without recoating.

Breakloose and Prevailing Torque Characteristics

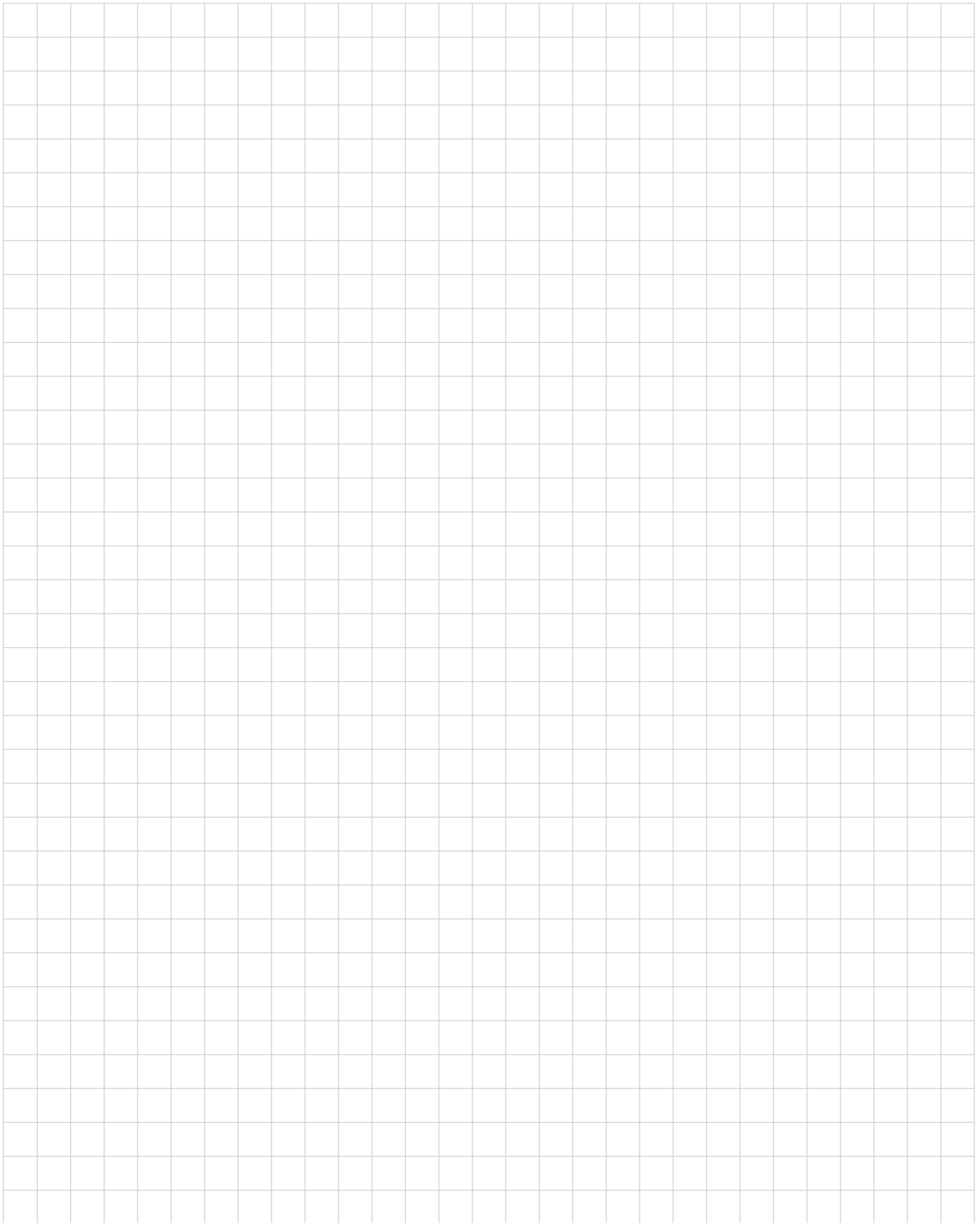
Vibra-Seal coated parts will resist loosening because of the prevailing torque characteristics shown below:

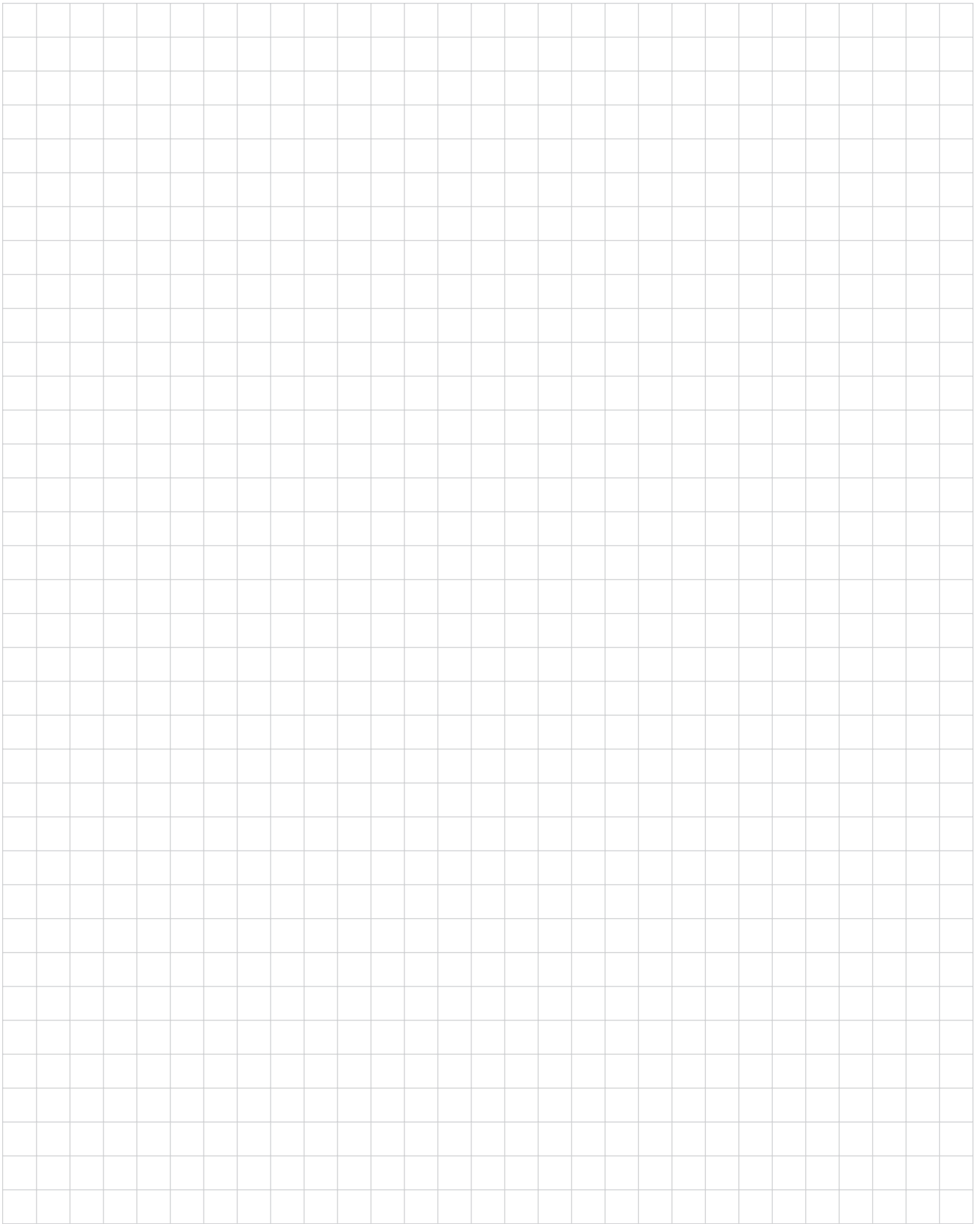
Specimens: BOLTS - Grade 5, 3/8" - 16 x 1-1/2" zinc phosphate and oil finish. NUTS - Grade 2, 3/8" - 16 zinc phosphate and oil finish.

Typical Strength Values @ Room Temperature Test Specimen	Seating Torque	Breakloose Torque	Prevailing Torque - 180°
Control (No Coating)	360 lb-ins (40.7 N•m)	243 lb-ins (27.5 N•m)	0 lb-ins (0 N•m)
Vibra-Seal Products Coating	360 lb-ins (40.7 N•m)	175 lb-ins (19.8 N•m)	21 lb-ins (2.4 N•m)

How to Specify

Vibra-Seal coated fasteners and components are produced to order by Long-Lok Fasteners Corp. Long-Lok processes your supplied parts, or we can supply complete products, including the basic fasteners or fluid fittings. To order Vibra-Seal coated fasteners or components, or to request a quote, please call Long-Lok and speak directly with one of our Sales Engineers.





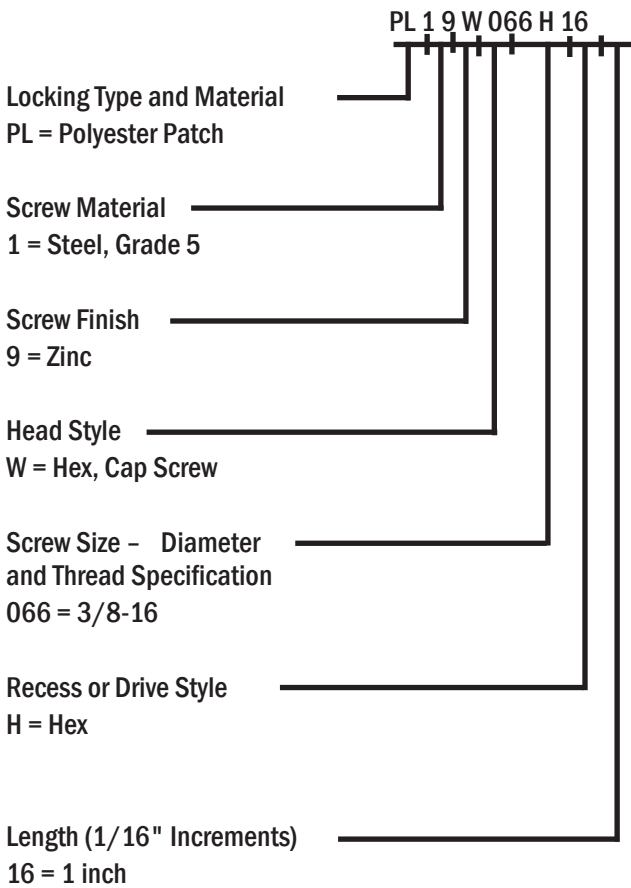
Standard Product Ordering

Part Number Selection for...

- Long-Lok® Strip Type
- Poly-Lok® Patch Type
- Tek-Lok® Pellet Type

Use the tabulated material, at right, to build complete Part Numbers per the example shown here. Please do not use spaces or dashes.

Example:



Note: Unless otherwise specified, thread fit classes and configuration envelope dimensions are per the applicable head style ANSI/ASME commercial standard.

Metric Sizes

Though not cataloged here, metric size equivalents for most of our self-threaded fasteners are available. Please call Long-Lok if your application calls for metric dimensioned parts. We are prepared to handle your requirements!

Options:

Long-Lok offers the following standard options at nominal additional cost. Add one or more of the option codes to the end of the basic part number. Please contact us for special requirements not listed.

- M = Head Marking. Six or more dots raised or recessed 0.010" maximum in a circular pattern.
- X2 = Provide 2 threads minimum lead before engagement with locking material.
- HQ = Burr-Free (See "Glossary of Terms", Page 9).
- E = End Burr Removed.
- Z = MIL-DTL-18240 compliant

For Military Applications:

1. Part number code to be used when a Military or National Aerospace Standard basic screw is desired.
2. Replace "AN", "MS" or "NAS" with the desired Long-Lok® insert materials code tabulated here; LP, LL, LH, LV, PL, TA, TL, TV or SP.

For More Information

Descriptions of the self-locking fasteners tabulated to the

Poly-Lok® Patch Type.....	16
Long-Lok® Strip Type	18
Tek-Lok® Pellet Type	20

It is recommended that product details described on these pages be reviewed before ordering.

Part number selection for other Long-Lok products may be

Dyna-Thred®	24
Dri-Loc®	28
Self-Seal®	34
Vibra-Seal®	42

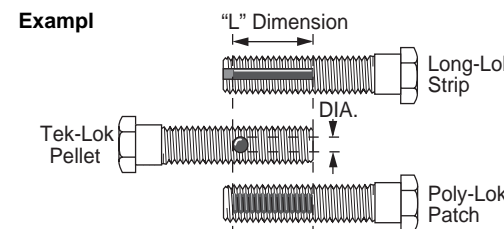
PL 19 W 066H 16

Locking Type and Material			Screw Material*		Screw Finish*		Head Style		Screw Size and "L" Dimension (See definition below)										Recess or Drive Style		Length										
Type	Material	Code	Description	Code	Description	Code	Description	Code	Coarse Threads					Fine Threads					Description (Applicable Head Style Codes)	Code	Description	Code									
									Size	Code	"L" Dimension* (Ref. only)			Size	Code	"L" Dimension* (Ref. only)															
									Long-Lok Strip ±.040	Poly-Lok Patch	Tek-Lok Pellet		Long-Lok Strip ±.040	Poly-Lok Patch	Tek-Lok Pellet																
									"L" Dim.	Di.	"L" Dim.	Di.	"L" Dim.	Di.	"L" Dim.	Di.															
Long-Lok Strip	Green Polycap Nylon	LP	Steel, Grade 5	1	Cadmium	2	Round	A	00-90	09	.095	—	—	0-80	00	.125	1/8 ±1/32	.06	.02	Cruciform Recess (A, D, F, G, J, M, N, T)	+	P	Lengths in increments of 1/16"; tolerances per applicable specifications. Consult factory for minimum thread length requirements.								
			Steel, Mild Carbon	2			Button	B	1-64	14	.125	.07	.03	1-72	12			.07	.03												
			Blue Kel-F®	LL			Aluminum	3	Anodized	3	Pan	D	2-56	26	.185			1/8 ±1/32	.08					.03	2-64	24	.08	.03			
							Brass	4			Plain	4	Oval	F					3-48					38	.185	.09	.04	3-56	36	.09	.04
							300 CRES	5					100° Flat	G					4-40					40	.240	.14	.06	4-48	48	.240	.14
	Hot-Lok™	LH	Steel, Grade 8	6	Cadmium, Gold Iridite	5	82° Flat	J	6-32	62	.285	3/16 ±1/32	.16	.08	6-40	60	.285	.16	.08												
			A286 CRES	7			Black Oxide	6	Binder	M	8-32		82	.320	1/4 ±1/16	.17	.09	8-36	86					.320	.17	.09					
	Poly-Lok Patch	Polyester	PL	Monel™	8	Passivate			7	Fillister	N	10-24	04			.320	5/16 ±1/16	.19	.09					10-32	02	.320	.19	.09	Slotted Recess (A, D, F, G, J, M, N, T, V, W, X)	/	S
				316 CRES	9		Phosphate and Oil	8		Truss	T	5/16-18	058	.420	3/8 ±1/16	.27		.14	5/16-24					054	.420	.27	.14				
				400 CRES	A					Zinc	9	Socket Cap	U	3/8-16		066		.480	1/2 ±3/32					.30	.16	3/8-24	064	.480			
Titanium				B	Zinc, Gold Iridite		0	Hex Tap Bolt				V	7/16-14	074	.530	3/8 ±3/32		.31		.16	7/16-20	070	.530	.31	.16						
Silicone Bronze				C				Internal Hex Socket (B, G, J, U, X)		J	1/2-13	083	.562	5/8 ±3/32	.33			.16	1/2-20	080	.562	3/8 ±3/32	.33	.16							
Tek-Lok Pellet	Kel-F®	TL	K-Monel™	D	Hex Cap Screw	W	9/16-12	092	.625	5/8 ±3/32	.38	.19			9/16-18	098	.625	3/8 ±3/32	.38	.19			Off-Set Cruciform Recess (A, D, F, G, J, M, N, T)	+	T	Etc. Etc.					
			Vespe®	TV	Headless Set	X [X]	Hex Tap Bolt	V			5/8-11	101	.625	5/8 ±3/32	.41	.19			5/8-18	108	.625	.41					.19				
									3/4-10	120	.750	5/8 ±1/8	.47		.22	3/4-16	126	.750	1/2 ±3/32	.47	.22										
7/8-9	149	3/4 ±1/8	5/8 ±1/8	.52	.22	7/8-14	144	.750	1/2 ±3/32	.52			.22																		
1-8	168			1-12	162	.750	1/2 ±3/32			.52	.22																				
1-14	164																														

Select point style for use on set screws. Code letter for point follows the "X" in the completed part number.

A-Flat	B-Cone	C-Full Dog	D-Cup	E-Oval	F-Half Dog

"L" Dimension
 "L" Dimension refers to the length of the locking element in both Long-Lok and Poly-Lok versions, or to the distance from screw tip to the "head" side of the pellet in Tek-Lok versions. In the case of set screws the "L" measurement is made from the start of the thread region, not the end of the part.



*Notes:
 1. Not all Material/Finish combinations are available for every head style.
 2. Additional finishes are available upon request.
 3. Consult factory for detailed information.

Long-Lok Fasteners

National Sales: 1-800-Long-Lok (1-800-566-4565)

www.longlok.com

email: custserv@longlok.com

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Send us a sample of your part or fastener, along with a brief description of its application and performance requirements, and we'll process it using the most appropriate Long-Lok thread locking or sealing method. Or, to sample a standard Long-Lok fastener, simply supply us with a Part Number. Samples are provided free of charge. Call your nearest Long-Lok facility for assistance.

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