HaydonKerk Motion Solutions™ • www.haydonkerk.com • Phone: 800.243.2715 • International: 203.756.7441

HaydonKerk Motion Solutions™ products have been designed specifically for motion control applications. They are not compromised adaptations of general purpose screws or nuts. The screw thread form is designed for maximum life, quiet operation, and compatibility with HaydonKerk Motion Solutions anti-backlash nut designs.

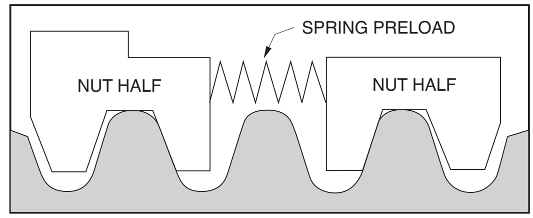
KERK® LEADSCREWS are available in standard diameters from 1/8-in (3.2mm) to 15/16-in (23mm), with standard leads from .012-in to almost 4-in (0.30mm to 92mm) including hard metric and left hand threads. Custom sizes and leads can be special ordered. Most stock screws are manufactured from 303 stainless steel and are produced with HaydonKerk Motion Solutions exclusive precision rolling process. Other materials are available on special order. Positional bi-directional repeatability (with Kerk anti-backlash nut) is within 50 micro-inches (1.25 micron) and standard lead accuracy is better than 0.0006-in./in. (mm/mm). Lead accuracies are available to .0001-in./in. (mm/mm). HaydonKerk Motion Solutions total in-house manufacturing and quality control assure uniform and consistent products.

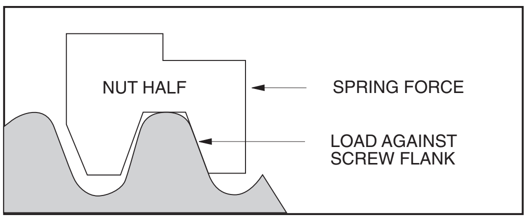
KERK® NUTS are available in 8 standard anti-backlash designs (CMP, ZBX, WDG, NTB, KHD, VHD, NTG, ZBA); general purpose BFW Series plus the Mini Series. (See Product Comparison Chart for size availability). Custom nut configurations and mountings are also readily available. The Kerk brand internationally patented anti-backlash designs provide assemblies which are wear compensating with low frictional drag and exceptional positional repeatability. Operation to more than 300 million inches of travel can be achieved. HaydonKerk Motion Solutions provides nuts in a wide range of wear resistant, self-lubricating thermoplastic materials.

Axial Take-up Mechanism

The standard method for taking up backlash is to bias two nut halves axially using some type of compliant spring. (Wavy washer, compression spring, rubber washer, etc.)

The unit is very stiff in the direction in which the nut half is loaded against the flank of the screw thread. However, in the direction away from the screw thread, the nut is only as axially stiff as the amount of preload which the spring exerts.



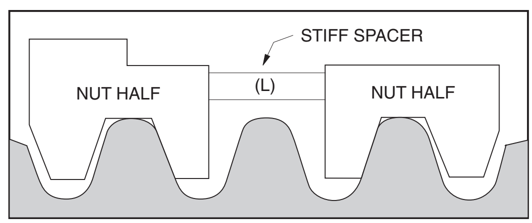


For example, if the maximum axial load to which the system is subjected is 50 lbs., the amount of spring preload must be equal to, or greater than, 50 lbs. in order to maintain intimate screw/nut contact. The problems arising from preloading in this manner are increased drag torque and nut wear.

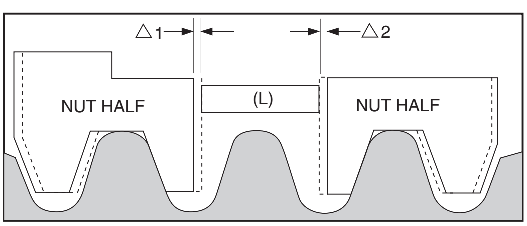
Obviously, the higher the load at the screw/nut interface, the higher the required torque to drive the nut on the screw and the more susceptible the unit is to nut wear.

An alternate method replaces the spring with a stiff spacer sized to fit exactly between the two nut halves.

There is no excessive preload force at the interface and the unit is capable of carrying high axial loads in either direction with no backlash.



This is fine initially. However, as use time increases, wear begins on the nut threads causing a gap to develop between the spacer (L) and the nut halves.



This gap (Δ1 + Δ2) is now the amount of backlash which has developed in the unit. This backlash can be removed by replacing the stiff spacer with a new spacer equal to (L + Δ1 +Δ2). This process, although effective, would be extremely costly and difficult to implement on a continuous basis.

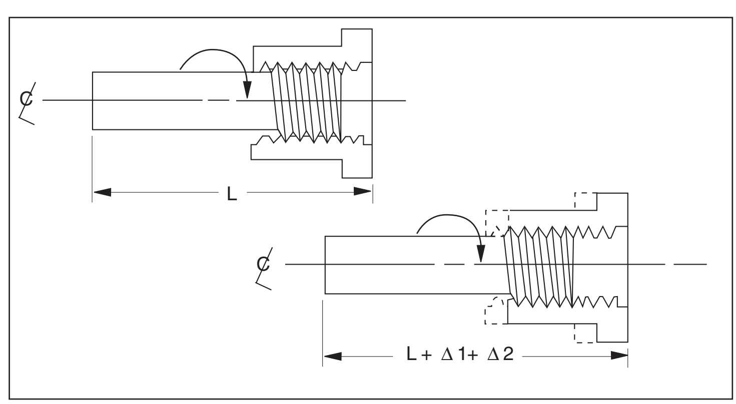
The Solution

What is needed, then, is a stiff spacer which will continually expand to accommodate the wear which occurs during use.

This is done by creating a spacer threaded at one end with a complimentary nut torsionally biased to advance when a gap develops.

The thread at the end of the spacer is a fine helix such that an axial load will not backdrive the nut once spacer growth has occurred.

The preload on the unit is only the amount necessary to turn the spacer nut on the spacer rod and is independent of the external system loadings. We thus have a self-wear compensating unit which has extremely low frictional drag torque yet high axial stiffness.



Kerkote® and Black Ice™ TFE Coatings

HaydonKerk Motion Solutions™ offers multiple options for lubrication. All Kerk® leadscrew nuts feature self-lubricating polymers. When maximum performance is required, Kerkote® and Black Ice™ TFE coatings provide unmatched results in the most demanding applications.

The purpose of TFE coating is to supply a more even distribution of lubricant than is normally found when using standard self-lubricating plastics on steel. The wear life, coefficient of friction and resulting torque to drive a lead screw assembly are highly governed by the ability of the engineered plastic to supply sufficient lubrication to the nut/screw interface. The inability of the internal lubricating agents in some plastics to consistently migrate to the surface may result in erratic drag torques and unpredictable wear.

Kerkote® TFE Coating

Kerkote TFE coating covering the entire screw surface results in an extremely even lubrication distribution. Test results indicate system torque requirements are consistently low with little or no change in required frictional driving torque, even with changes in motor R.P.M. HaydonKerk Motion Solutions has developed a custom composition Kerkote TFE specifically for our lead screw and nut materials. It is applied using an automated process and provides extended nut life and smooth operation with little additional cost.

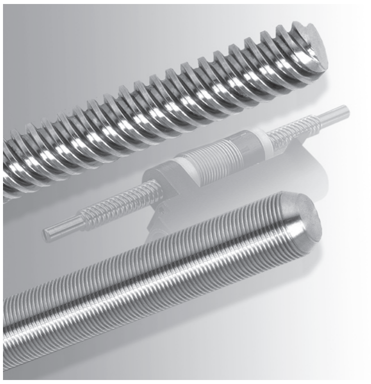
Kerkote TFE is a soft coating, a long-term dry lubricant that is optimized for softer plastics like acetals and nylons, with or without mechanical reinforcement. Lubrication to the nut/screw interface occurs by the nut picking up Kerkote TFE particles from the coating as well as from the migration of the internal lubricant within the plastic nut. Although care is taken to ensure that chips and voids do not occur in the coating, small voids have been shown to have no effect on system performance. The transfer of TFE to the nut continues throughout the operating life of the assembly as long as the nut periodically travels over areas with Kerkote TFE coating. The lubricant, although solid, also has some “spreading” ability as in fluid lubricants. Kerkote TFE coated screws provide the maximum level of self-lubrication and should not be additionally lubricated or used in environments where oils or other lubricant contamination is possible.

Black Ice™ TFE Coating

Black Ice TFE coating shares many of the benefits of Kerkote TFE but, in contrast, is a hard coating that offers exceptional durability in all types of environments, with virtually any type of polymer nut. Black Ice TFE coating remains on the screw, offering a low friction surface upon which the nut travels. Rather than acting as a dry lubricant, Black Ice TFE is an anti-friction coating whose surface properties displace the metal to which it is applied. Though it is not intended for use with metal or glass fiber reinforced nuts, Black Ice TFE is bonded securely to the screw’s surface and can withstand abrasion from contamination, rigid polymer systems, fluid impingement and wash down applications. Black Ice TFE can be used in the presence of more aggressive environment conditions, or anywhere reduced friction and a permanent coating is desired.

Both Kerkote and Black Ice TFE coatings offer the advantages of dry lubrication. These are maintenance-free coatings that are designed to last the life of the product. They are intended to be used without additional lubricants, thereby further increasing the value of Kerk leadscrew assemblies through elimination of the most common failure of screw driven drives, lubrication failure.

There are certain applications where external lubrication may be desired. These include the use of nut materials such as glass reinforced plastic or metal. Greases, when used properly can provide unique capabilities and HaydonKerk Motion Solutions does offer a selection of greases developed specifically for these applications. Please contact a sales engineer for assistance selecting the best lubricant for your requirements.

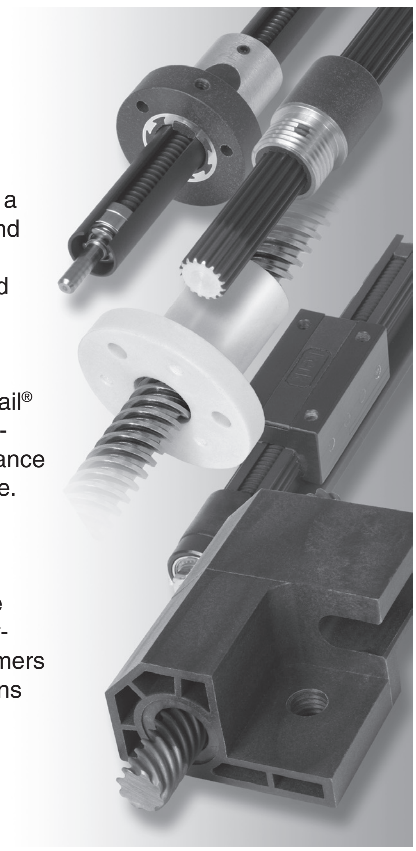


303 Stainless Steel

Kerk® brand leadscrews and linear rails start with premium grade 303 stainless steel. HaydonKerk Motion Solutions™ has identified the material properties most critical for producing the very high quality rolled steel screws in the world and controls these to levels unmatched in the industry. Because of our leadership position, we are able to utilize this exceptional quality steel without having to charge premium prices.

Kerk stainless steel leadscrews and guide rails are corrosion resistant, non-magnetic, and compatible with many demanding processes. The ideal starting point for a maintenance-free product, this premium quality stainless steel is being used in numerous applications including medical applications, clean rooms, food and human contact, salt spray, cryogenics and vacuum.

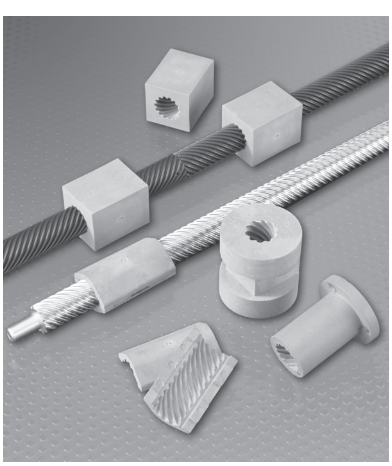
Kerkite® Composite Polymers



In addition to the Kerk® self-lubricating acetal nut material, HaydonKerk Motion Solutions offers a variety of custom compounded Kerkite composite polymers. Kerkite polymers are a family of high performance materials that offer exceptional wear properties with the cost and design advantages afforded through injection molding. Kerkite polymers offer a variety of mechanical, thermal and electrical properties and are compatible with many chemicals and environmental conditions.

Kerkite Composite Polymers are available options for most Kerk Leadscrew Nuts and are standard materials for Linear Rail and Spline Shaft bushings, RGS® Carriages and Screwrail® Bushings and End Supports. Each member of the Kerkite family is compounded with lubricants, reinforcements and thermoplastic polymers formulated to provide optimum performance in its target conditions and applications, resulting in superior performance and extended life.

A cornerstone of the HaydonKerk Motion Solutions advantage is design flexibility. Kerkite Composite Polymers, along with our injection molding and mold making capabilities, offer huge design advantages and cost savings compared with non-moldable materials. Kerkite high performance polymers outperform other plastics and outlast metal bushings and bearings. When combined with Kerkote® or Black Ice™ TFE coatings, Kerkite Composite Polymers have been shown to provide hundreds of millions of inches of travel in customer applications while continuing to maintain precise, accurate motion and positioning.



Special Materials

In addition to the Kerk standard material – 303 stainless steel, self lubricating acetal and Kerkite high performance composite polymers – we also work with a vast array of custom materials. HaydonKerk has rolled screws in many other materials, including 316 stainless, 400 series stainless, precipitate hardening materials, carbon steel, aluminum, and titanium. Kerk nuts had been produced in many alternative plastics including PEEK, polyester, Torlon®, Vespel®, PVDF, UHMW, Ertalyte® and customer-supplied specialty materials. We have also provided metal nuts made from bronze, brass, and stainless steel.

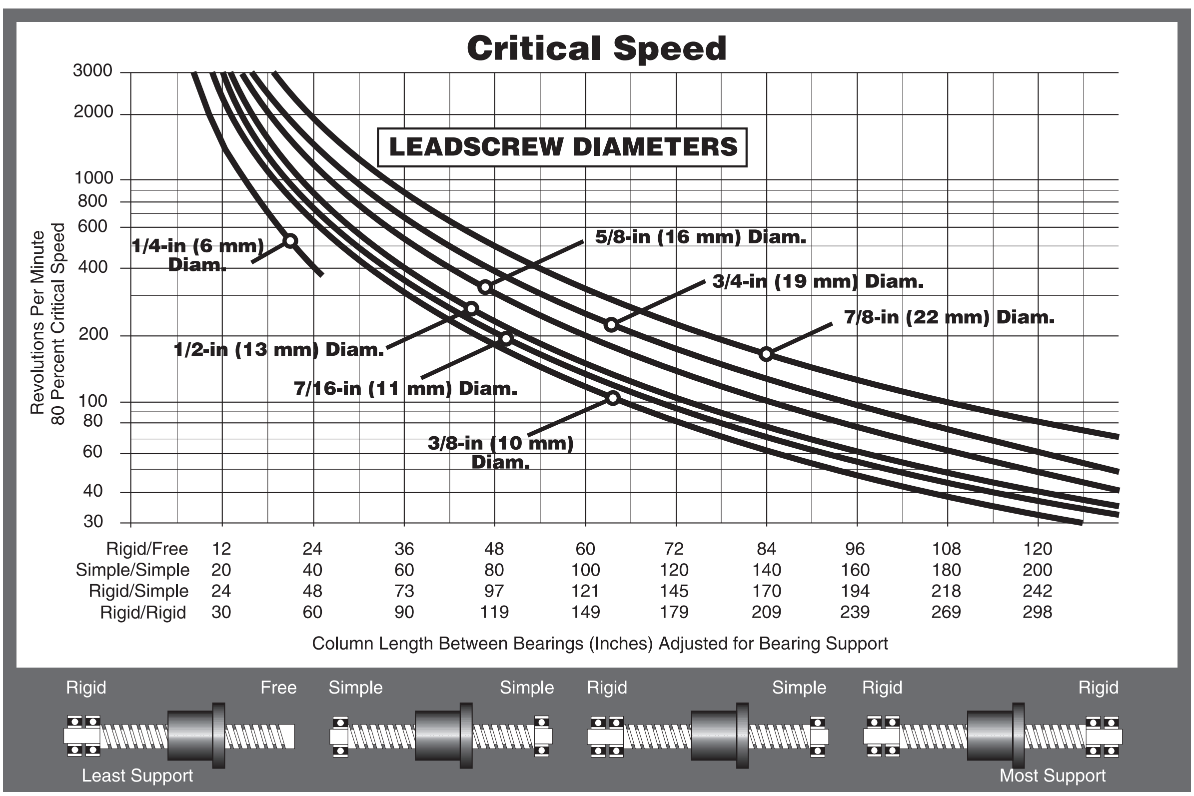
With so much flexibility in our manufacturing process, if the material can be molded, machined, ground, or rolled, HaydonKerk Motion Solutions can likely process it using state of the art machine tools, injection molding and mold making, grinding and thread rolling equipment. HaydonKerk Motion Solutions excels at supplying the best overall solution to meet our customers' requirements. Contact HaydonKerk Motion Solutions to find out how you can benefit from these choices.

Design and Engineering Data

Screw Accuracy
HaydonKerk Motion Solutions™ uses a unique precision rolling process for screw manufacturing. Standard lead accuracy for Kerk screws is .0006 in./in. (mm/mm). Lead accuracies are available up to .0001 in./in. (mm/mm). Please consult the factory for higher lead accuracies. Assemblies have an extremely high bi-directional repeatability of 50 micro-inches (1.25 micron).

End Machining
HaydonKerk Motion Solutions can custom machine screws to your specifications or provide cut-to-length screws for your own machining.

Critical Speed
This is the rotational speed at which a screw may experience vibration or other dynamic problems. See CRITICAL SPEED CHART to determine if application parameters result in speed approaching critical. To minimize critical speed problems: use a longer lead, choose a larger diameter or increase bearing mount support.



Lengths
Lengths can be specified up to 12 ft. (4M) from stock, (depending on diameter and lead). Cut to length screws are offered in 6-in increments (6-in, 12, 18,....) +1.0-in/-0-in.

Lead
Advancement per revolution. All screws are listed by lead, not pitch.
Lead = Pitch x Number of Starts

Pitch
Crest-to-crest distance or one divided by threads per inch. (On a multiple start thread, the pitch equals the lead divided by the number of starts.)

Traverse Speed

The nut materials we use provide long wear-life over a wide variety of conditions. However, very high loads and/or speeds will accelerate nut wear. Special materials may be required for these situations. We offer the following guidelines for continuous duty linear traversing speeds for optimum life:

Lead	Traverse Speed	Lead	Traverse Speed
1/10 - 1/2-in	4-in/sec.	1 - 12 mm	100 mm/sec.
1/2 - 1-in	10-in/sec.	12 - 25 mm	250 mm/sec.
1 - 2 1/2-in	30-in/sec.	25 - 60 mm	760 mm/sec.

Maximum Load

Although the Kerk® Anti-Backlash Assemblies are capable of withstanding relatively high loads without catastrophic failure, these units have been designed to operate under the loading shown in the size charts.

Efficiency

Efficiency is the relationship of work input to work output. It should not be confused with mechanical advantage. Listed efficiencies are theoretical values based on Kerkote® TFE coated screws.

Torque

The required motor torque to drive a lead screw assembly is the sum of three components: the **inertial torque**, **drag torque**, and **torque-to-move load**. It must be noted that this is the torque necessary to drive the lead screw assembly alone. Additional torque associated with driving frictional bearings and motor shafts, moving components, and drag due to general assembly misalignment must also be considered.

Inertial Torque:

$$T_j = I\alpha$$

Where I = screw inertia
α = angular acceleration

Drag Torque:

The Kerk Anti-Backlash Assemblies are typically supplied with drag torque of 1 to 7 oz.-in. The magnitude of the drag torque is dependent on the standard factory settings or settings specified by the customer. Generally, the higher the preset force, the better the Anti-Backlash characteristics.

Torque-to-Move:

$$T_L = \frac{\text{LOAD x LEAD}}{2\pi \text{ x EFFICIENCY}}$$

Back Driving

Sometimes referred to as reversibility, back driving is the ability of a screw to be turned by a thrust load applied to the nut. Generally, back driving will not occur when the screw lead is less than 1/3 the diameter for uncoated screws or 1/4 the diameter for Kerkote® TFE coated screws. For higher leads where back driving is likely, the torque required for holding a load is:

$$T_b = \frac{\text{LOAD x LEAD x BACKDRIVE EFFICIENCY}}{2\pi}$$

Screw Straightness

Screw straightness is measured as Total Indicator Runout(TIR). The standard straightness for lead screws is .003-in/ft. HaydonKerk Motion Solutions can provide tighter specifications on customer request.

All screws are hand straightened before shipping.

Mechanical Properties

Screw Intertia

Screw Size inch (mm)	Screw Inertia (oz-inch sec²/inch)
1/4 (6)	.3 x 10^{-5}
5/16 (8)	1.5 x 10^{-4}
3/8 (10)	1.5 x 10^{-5}
7/16 (11)	3.5 x 10^{-5}
1/2 (13)	5.2 x 10^{-5}
5/8 (16)	14.2 x 10^{-5}
3/4 (16)	30.5 x 10^{-5}
7/8 (16)	58.0 x 10^{-5}
15/16 (16)	73.0 x 10^{-5}

Anti-Backlash Life

Series	Without Kerkote® TFE Coating inch (cm)	With Kerkote® TFE Coating inch (cm)
CMP	40 to 60 million (100 to 150 million)	150 to 200 million (380 to 500 million)
ZBA	5 to 10 million (12 to 25 million)	15 to 40 million (38 to 100 million)
ZBX	40 to 60 million (100 to 150 million)	150 to 200 million (380 to 500 million)
KHD	80 to 100 million (200 to 250 million)	180 to 230 million (450 to 580 million)
WDG	100 to 125 million (250 to 315 million)	200 to 250 million (500 to 635 million)
NTB	100 to 125 million (250 to 315 million)	200 to 250 million (500 to 635 million)
VHD	200 to 225 million (500 to 570 million)	300 to 350 million (760 to 880 million)
BFW	N/A, Typical Backlash .003 to .010 (.076 to .25)	N/A, Typical Backlash .003 to .010 (.076 to .25)
NTG	5 to 10 million (12 to 25 million)	15 to 40 million (38 to 100 million)

Anti-backlash life is defined as the nut's ability to compensate for wear while maintaining its zero backlash properties. Above life data is based on 25% of the dynamic load rating. NTB style does not include mini series sizes. Life will vary with loading, operating environment, and duty cycle. The longer screw leads generally provide longer life.

Mechanical Properties

Leadscrew

Material	Surface Finish
303 Stainless Steel (options available)	Better than 16 micro inch

Nuts

Material	Tensile Strength	Coefficient of Expansion
Polyacetal with Lubricating Additive	9,700 psi	6.0 x 10^{-5} in/in/°F

Assembly

Standard Operating Temp. Range	Coefficent of Friction Nut to Screw
32 - 200° F* (0 - 93° C)*	Static = .08 .08 ** Dynamic = .15 .09 **

* Very high or low temperatures may cause significant changes in the nut fit or drag torque. Please call HaydonKerk Motion Solutions™ for optional temperature range materials.
** with Kerkote® TFE Coating

Dimensional Tolerances

Inch

.X	± .02
.XX	± .010
.XXX	± .005

Metric

< L 4	± 0.1
4 < L ≤ 16	± 0.15
16 < L ≤ 63	± 0.2
63 < L ≤ 250	± 0.3

Grease Compatibility Chart

Nut Type	Grease	Lubrication Coatings: Kerkote®	Lubrication Coatings: Black Ice™
CMP	Yes	Yes	Yes
ZBX	Yes	Yes	Yes
ZBA	Yes	Yes	Yes
KHD	No	Yes	Yes
VHD	No	Yes	Yes
WDG	No	Yes	Yes
BFW	Yes	Yes	Yes
NTB	No	Yes	Yes
NTG	Yes	Yes	Yes