BISHOPWISECARVER®

Linear Guide Systems for Low Contamination and Highly Corrosive Environments

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Linear guide systems have long been used to enable payloads to be moved smoothly and precisely in a diverse array of applications. The five most common types of linear guide systems are based on profile rail, drawer slides, linear bearings, guide wheels, and plain bearings. All five types have the same general layout and operation, with one or more mobile elements that can move over a stationary section with little friction. However, each type of linear guide system has different attributes that make each type well suited for some applications but ill suited for others.

Profile rail-based guide systems consist of solid rails that are primarily rectangular in profile have mating carriage blocks. Each carriage block contains rolling elements (ball or roller bearings) that are in contact with the running surfaces on its rail. When the carriage block moves linearly along the rail, the rolling elements roll between the carriage block and rail to reduce friction. The rolling elements are located in a loop inside the carriage block so that thev re-circulate continuously within the carriage block when it is moving.

Profile Rail-Based Guide System

Drawer slide-based guide systems generally consist of C-shaped slides and carriages formed from sheet metal. Each carriage moves along its slide via two intermediate sets of ball bearings, one between each side of the carriage and slide. Unlike profile rail-based linear guide system, the rolling elements typically do not re-circulate and are simply constrained to the carriage by a ball cage.

Drawer Slide-Based Guide System

Linear bearing-based guide systems consist of linear bearings and shafts. Each linear bearing fits over a shaft and contains rolling elements that roll on the shaft surface when the linear bearing moves. Linear bearing usually retain the rolling elements in cages but some have re-circulating paths like profile rail blocks. The shafts are usually round and the rolling elements are usually ball bearings, but linear bearings for square shafts and roller bearings are also available.

Linear Bearing-Based Guide System

Guide wheel-based guide systems consist of guide wheel-mounted carriages and mating slides. The guide wheels are essentially ball bearings with special running surface profiles that enable them to roll on slide surfaces with complementary profiles. Special features on the wheels or mounting hardware enable them to be easily fastened onto carriages. When the carriage moves relative to the tracks, the guide wheels rotate to reduce friction.

Guide Wheel-Based Guide System

Plain bearing-based guide systems consist of plain bearings and solid rails with matching running surface geometries. The plain bearingsô running surfaces are composed of inherently low friction material to enable the bearings to slide smoothly on their rails without the need for any rolling or moving internal components. Most plain bearings use various forms of plastic for their low friction material, but some use metal. The rails for plain bearings are typically round shafts, although rectangular shafts and channeled rails are also available.

Plain Bearing-Based Guide System

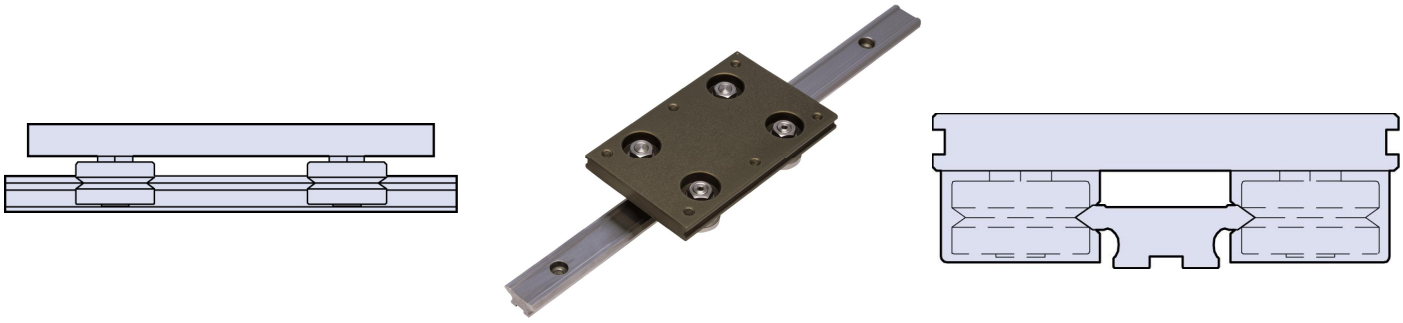
Highly corrosive environments, clean rooms, and food processing lines present different operational challenges, but all are among the toughest applications for linear guide systems. Equipment used in highly corrosive environments must be composed of corrosion-resistant materials. If the equipment contains any materials that can react with the harsh chemicals in the environment, the equipment may become damaged

and newly formed toxic or corrosive compounds may be introduced into the environment. At the other extreme, clean rooms and food processing lines have some of the most demanding low-contamination requirements. Contamination in these applications can present serious problems to the product and other sensitive equipment. Therefore, the equipment involved in these applications is usually required to be comprised of non-hazardous materials and release as little material (liquid, solid, or gaseous) as possible during the course of operation. There are also environments that may combine elements of the three, such as clean rooms with corrosive agents present. Equipment used in such an environment may react with the corrosives and cause more particulate matter to be created and released into the environment.

Rolling element-based linear guide systems can present problems in these applications since they typically require grease or oil lubrication on their running surfaces for optimal performance. When the running surfaces are dry, attributes such as service life and smoothness generally decrease while noise and friction typically increase. The exposed lubrication can present an issue in highly corrosive environments if the lubrication is reactive with the corrosive agents. The exposed lubrication can also be an issue in clean room and food processing applications since it can become a contaminant if it gets ejected from the rail during rail/carriage motion or if contaminating vapors outgas from it.

Many plain bearing-based linear guide systems also require grease or oil lubrication for optimal performance, but some have dry lubricant impregnated on the running surfaces of the plain bearing. The dry lubricant can be more problematic than the ñwetòlubricant in clean rooms since the dry lubricant can get dispersed more readily as airborne particulate. Also, plain bearing-based linear guide systems typically have lower load capacities and higher sliding friction than rolling element-based linear guide systems of similar size. Most plain bearing-based linear guide systems require the carriage to be mounted on multiple plain bearings and two parallel shafts. This is necessary to prevent the carriage from freely rotating on the shafts and to provide adequate moment load capacity. In these cases precise parallel alignment of the shafts to each other and the plain bearings to the carriage is necessary to prevent the plain bearings from binding at any point along their stroke.

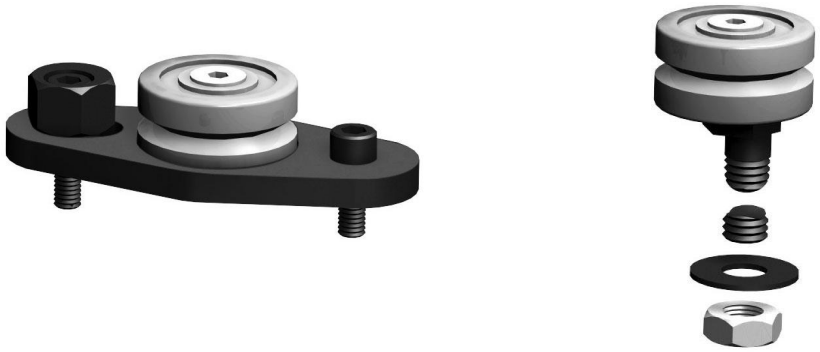
A unique solution for applications like this is the SL2 linear slide system from HepcoMotion. The SL2 is a guide wheel-based linear slide system that features 70° vee guide wheel-equipped carriages running on slides with dual 70° vee running surfaces. The SL2 system is distinctive in that it is designed to provide high load capacity and long operating life without slide lubrication, making it an excellent choice in clean room applications. This special attribute is due to the inherent low friction between the slide and guide wheel assemblies. Lubrication can be added to the slide to increase life and reduce friction, but due the low rolling friction between the slide and guide wheels, it is not necessary for satisfactory operation. The SL2 system is also suitable for highly corrosive environments since the slide and guide wheel assemblies are made from hardened stainless steel. The carriage is made from aluminum with a corrosion-resistant, USDA-approved surface treatment, but can also be made in stainless steel or other material by request.



SL2 Linear Slide System

The preload in SL2 linear guide systems can be adjusted by the end user to best fit the application. High preload is recommended when the carriage must be held rigidly and precisely on the slide, such as when the payload is a sensitive instrument. Low preload is recommended when extremely low running friction is

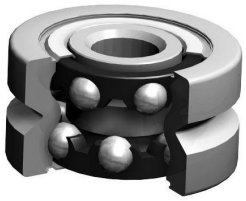
required or the carriage has to accommodate slight misalignments in operation, such as when an SL2 system is used in conjunction with other linear guide systems in a gantry assembly. The preload adjustment is made by simply adjusting the orientation of the eccentric wheel assembly studs to change the amount of engagement between the eccentric wheels and their contacting surfaces on the slide.



SL2 Eccentric Wheel Assembly

Achievement of the desired carriage running characteristics can be further aided by the selection of the appropriate type of guide wheels for the carriage. Two wheel options are available for the SL2 system ï twin bearing wheel assemblies and double row bearing wheel assemblies. The former is composed of two single row bearing guide wheels stacked together, while the latter is composed of one double row bearing guide wheel. The twin bearing wheel assembly provides more compliance, permitting more carriage misalignment while still providing low running friction. The double row bearing wheel assembly provides higher load capacity, operating speed, travel life, as well as reduced entrapment of foreign debris.

Twin Bearing Wheel Assembly

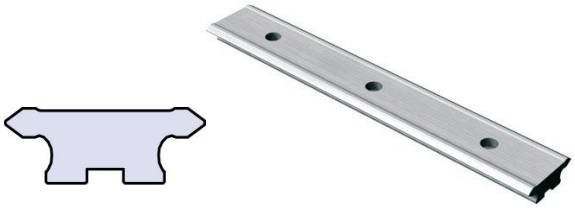


Double Row Bearing Wheel Assembly

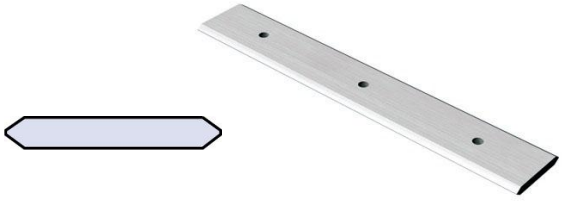
The ability to adjust the wheel preload in the field is unique among linear guide systems, since preload in other types of linear guide systems are factory-set and cannot be adjusted afterwards by the end user.

While the slide does not require lubrication, the guide wheels are internally lubricated with lithium grease to provide smooth motion and long wheel life. The guide wheels are lubricated for life and have nitrile rubber seals to minimize the cross-transmission of wheel lubricant and external contamination.

A wide variety of slides are available for SL2 linear slide systems. All are made from martensitic type 420 stainless steel and have dual precision-ground, zone-hardened 70° vee running surfaces and factory-drilled mounting. SL2 Flat Slides are recommended in applications requiring a linear slide with minimum height and mass. SL2 Spacer Slides are slightly taller, stiffer, and can accommodate optional wheel caps, lubricators, and slide end mounting clamps. Both types of SL2 slides are offered in multiple profile sizes. Slides lengths are user-customizable, and can be supplied up to 4020mm for a single piece slide, or virtually infinite with multiple butt-jointed slides.



SL2 Spacer Slide

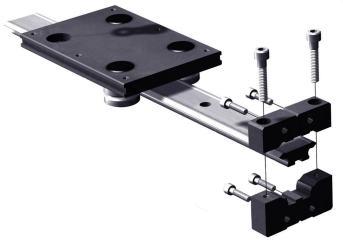


SL2 Flat Slide

All SL2 slides are double edged, so only one slide is needed for each carriage. The fact that the SL2 slides are double edged means that it is not necessary to align two separate running surfaces to ensure parallelism for consistently smooth travel. Double-edged slide systems also allow for the carriage to be mounted on the slide before the entire SL2 system is mounted in the application, thus reducing assembly time.

Removal of the carriage from the slide can be accomplished by loosening the eccentric wheels and tilting the carriage sideways until the wheels are clear of the slide. The slide does not require any mounting, dismounting, or adjustment during the carriage removal or reassembly processes. In contrast, removal and reassembly of the carriage on other types of linear guide systems is generally more complicated, and impossible in some cases such as some drawer slide-based guide systems. Removal or reassembly, if possible, would require each of the guide system's sliding elements (profile rail block, linear bearing block, plain bearing, etc.) to be linearly pushed off or onto one end of its rail/shaft. In all of these cases, significant time would also be required for realignment of the components before the slide system can be used.

Other options for the SL2 linear guide system include flange clamps, hole plugs, lubricators, and cap seals. The flange clamps permit spacer slide-equipped SL2 linear guide systems to be mounted just at the ends of the slide. In applications where debris-generation can occur, plastic hole plugs are available which fit in the counterbores for screw heads in the SL2 system, simplifying cleaning. In applications where track lubrication is permissible, plastic lubricators and cap seals are recommended. These carriage-mounted components contain lubricant-impregnated felt wipers that contact the slide running surfaces, continuously lubricating them and sweeping away debris as the carriage moves along the slide. The lubrication, while not necessary for operation, is recommended to enhance system life and smoothness. The cap seals fit over the wheel assemblies, providing added protection against debris entrapment and damage from contact with external objects.



SL2 with Flange Clamp

SL2 with Hole Plugs

Lubricator

Cap Seal

Selection of an appropriate type of linear guide system is essential in applications with critical operational environments. A correctly chosen linear guide system will minimize maintenance requirements, component replacement frequency, application problems, and overall operation cost. For applications with low contamination and/or highly corrosive environments, the SL2 linear slide system from HepcoMotion provides these benefits due to its dry slide operational capability, corrosion-resistant materials, and ease of installation and replacement.