BISHOP WISECARVER

PRELOADING GUIDE WHEELS IN LINEAR MOTION SYSTEMS

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PRELOADING

Preloading is a common and recommended practice when assembling structural components. Widely applied in static bolted joint assemblies, preloading is also beneficial in guide-wheel linear motion systems and in both cases, preloading enhances the life and increases the rigidity of the system. Whereas preloading in static bolted joint assemblies involves tightening the fasteners until a suitable level of joint tension is achieved, preloading in a guide wheel-based system involves adjusting the relative positions of the guide wheels so that all of them are in contact and suitably compressed against their mating tracks.

When properly preloaded, the operating life of the guide wheels is enhanced through reduced variations in resultant loading on the guide wheels. If the wheels were not properly preloaded, there would be a high probability that one or more of the wheels would not be in constant contact with the tracks, which may allow the carriage to freely tilt and shift relative to the tracks. Should that occur, applied loads on the carriage could cause higher resultant loads on the fewer wheels contacting the track, in addition to high shock loads whenever the loose wheels intermittently contact the tracks.

PRELOADING (CONT'D)

Proper preloading also provides other benefits. When the guide wheels are properly preloaded, vibration and noise are reduced since the carriage will not be able to tilt or shift relative to the tracks. Furthermore, when external loads are applied, a preloaded carriage will be subject to less displacement relative to the tracks. Likewise, the linear accuracy and repeatability of the carriage in a driven system will be enhanced. All of these attributes are beneficial in most applications and even critical in some, such as when high precision sensors are mounted on the carriage.

Adjustment of preload for guide wheel-based linear motion systems can be easily performed by end-users. Other systems, such as profile rail-based systems, cannot have their preload adjusted since it is a function of the machined dimensions of the components and, therefore, factory set. As a result, profile rail carriages (blocks) have to be carefully matched to their rails, as even the slightest dimensional mismatches can cause the carriages to jam on the rail if the fit is too tight or allow the carriage to freely tilt and shift if the fit is too loose. In contrast, guide wheel-based carriages can easily be swapped to other track assemblies, with any minor dimensional differences compensated for in the preload adjustment process.

GUIDE WHEELS

Guide wheels on a guide-wheel based carriage can be divided into two groups, concentric and eccentric. The wheel's axis on a concentric guide wheel is concentric with the axis of its mounting stud or bushing, whereas the wheel axis on an eccentric guide wheel is slightly offset in the radial direction from the axis of its mounting stud or bushing. Carriages have two rows of guide wheels, aligned in the direction of travel. The most common carriages have three or four wheels – typically with two concentric wheels on one side and one or two eccentric wheels on the other side. When properly preloaded, the running surfaces of the guide wheels shoulGd be parallel so that all of the wheels make simultaneous contact with their mating tracks and do not lose contact at any point over the linear motion system's stroke length.

Preloading is accomplished by rotating the eccentric guide wheel's mounting stud or bushing to "adjust the eccentricity" of the eccentric guide wheels. Since the axes of the wheels are offset from their mounting studs, rotating them causes them the wheel to move toward or away from its mating track.

PRELOADING THE DUALVEE GUIDE WHEELS

Preloading the DualVee guide wheels requires only a few simple tools. For DualVee guide wheels with integral studs, an open end wrench and a socket wrench are required. For DualVee guide wheels with separate bushings and fasteners, two open end wrenches are required. Despite the slightly different tools required for each type of DualVee guide wheel, the process is the same for all of them.

Begin by placing the carriage on the track assembly with the concentric wheels fully tightened and the eccentric wheels finger-tightened within their mounting holes. Using one hand, insert the open end wrench between the eccentric wheel and the mounting plate to engage the hex flats of the bushing or stud on the wheel. Use the other hand to hold the open end wrench or socket wrench on the wheel's fastener. *See Figures 1 and 2.*

Use the wrench to slowly turn the hex clockwise until resistance is felt - this indicates that the wheel is contacting the track. Then, with the wrench still held in position with one hand, tighten the eccentric wheel's fastener to lock the wheel in the adjusted position. The reason for turning the hex counterclockwise is so that the any radial load between the wheel and track will cause it to turn clockwise, creating a tightening torque on the wheel's fastener.

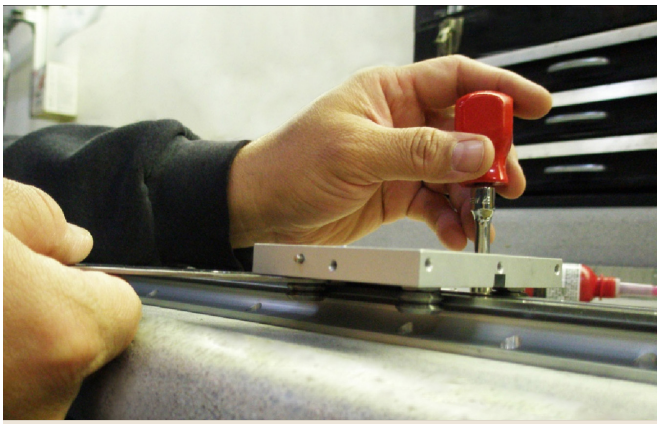

FIGURE 1

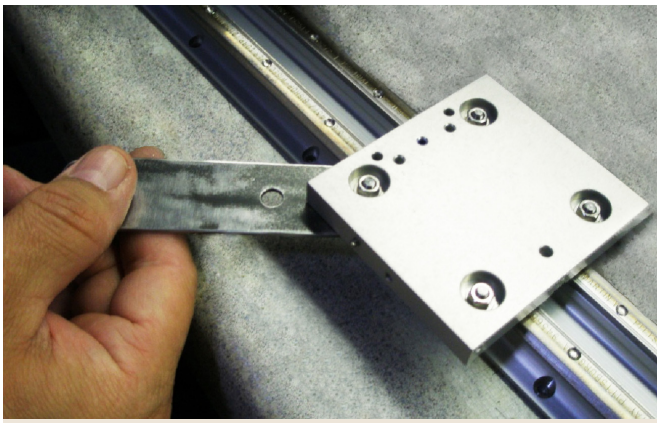

FIGURE 2

PRELOADING THE DUALVEE GUIDE WHEELS (CONT'D)

To check the level of preload, hold the carriage in place with one hand and rotate the wheel with the index finger and thumb of the other hand; the wheel's running surfaces should be able to be slide on the track when the wheel is rotated with moderate hand turning effort. *See Figure 3*. If the wheel cannot be rotated, adjust the wrench position to reduce the preload and try again.

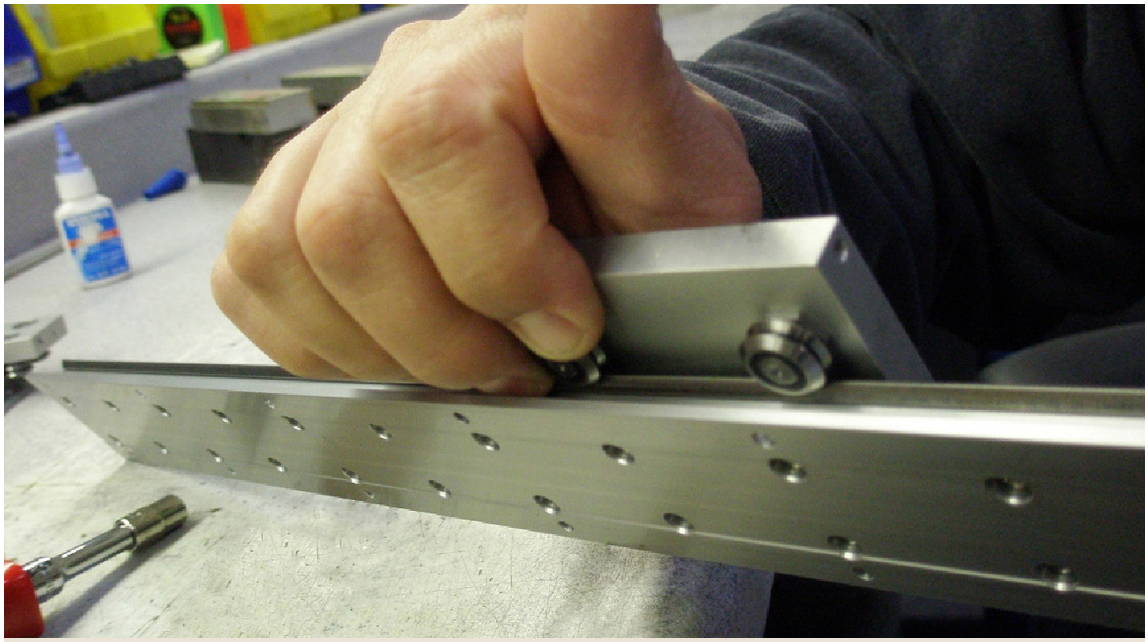

***FIGURE 3:** Manual Wheel Rotation for Checking Preload Level*

Manually slide the carriage along the entire length of the system to determine whether there is any noticeable variation in rolling resistance. If there is, readjust the eccentric wheel as necessary. If the variation is unacceptably large, the tracks are likely not parallel enough and will need to be realigned.

If there is more than one eccentric wheel on the carriage, repeat the process with all of the other eccentric wheels. Once all wheels are adjusted, recheck all wheels, concentric and eccentric, for preload using the stationary carriage-wheel rotation and sliding resistance methods described above, and readjust if necessary.

PRELOADING THE DUALVEE GUIDE WHEELS (CONT'D)

The moderate effort required to rotate stationary wheels on the track is the preload level generally recommended for most applications. However, the preload can be reduced or increased depending on the application. For example, a system with low rigidity requirements and low payload could have less preload if less breakaway and rolling resistance is required. Conversely, a system with high rigidity and accuracy requirements could have higher preload if increased breakaway and rolling resistance are acceptable. Preload is critical and should not be set excessively since the resultant load capacity and travel life of the wheels will be deleteriously affected. The preload in a wheel should never exceed the wheel's specified radial load capacity.Proper preloading is an easy process to perform and can significantly enhance the life and performance of a guide wheel-based linear motion system, decreasing its maintenance cost and increasing its functional value.

ABOUT

Bishop-Wisecarver develops innovative motion solutions that are expertly designed and delivered to perform from a company you can trust. Leveraging over 70 years of experience, we've earned the reputation of providing unmatched quality, reliable service and engineering support for every stage of a customer's design cycle. No matter your application, volume shipment requirements or extreme environmental conditions, Bishop- Wisecarver listens to your specific needs and delivers innovative solutions.

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