BISHOP WISECARVER

INDUSTRIAL GRADE PERFORMANCE FOR HIGH SPEED AND HIGH CYCLE PACKAGING MACHINERY

DualVee® linear guide wheel components create motion inside packaging machinery and automated equipment

Packaging machinery designed to process products into containers, bundles, shrink wrap, and corrugated cardboard trays or cases, are essential to enabling the ever-increasing high speed productive throughput that market leading brands require. New machines and machine designs are necessary to expand production volumes for the introduction of new offerings and new product variants as brands adapt to consumer sentiment in their respective markets. Sometimes changes to the most well know food products only involve iterations to the packaging such as the introduction of pouching, single serve quantities, and cross-market introductions.

Automated continuous production packaging machinery often provides for end of line production activities after critical steps are complete. Packaging equipment at the end of primary production lines is designed to take the individual product units and bundle them together or package them into larger cases, containers, and boxes. Specialty equipment can shrink wrap bundles, apply adhesive tape, or glue seal box flaps, and even arrange finished cases onto pallets for distribution. Many packaging machines receive names based upon the work they complete including, cartoner, case erector, case packer, bundler, shrink wrapper, tray former, tray packer, palletizer, and many others.

Operation of packaging machinery often contributes to a dirty operating environment due to cardboard fibers and dust. The presence of debris contamination is not typically an issue for the products being packaged but could pose some unique challenges for equipment builders. Machine operators don't always perform the recommended maintenance on critical equipment to keep them free of wear, clean, and well lubricated so they operate at their best without unexpected downtime. Therefore, it is vital to build machines that are made to withstand abuse and are stronger than necessary to ensure reliability.

MACHINE BASE STRUCTURES

The base structures of most types of packaging machines are fabricated steel frames. Plate steel that is custom cut to size by laser or waterjet are combined with standard structural steel shapes such as tubular steel, angle iron, c-channel, and others are cut and welded together into the machine frame and then finished with high quality paint. Important features such as thread tapped holes and special cutouts are machined to accommodate the precision attachment of machine elements. Machinery that must operate in food processing, medical packaging, pharmaceutical and other sanitary environments are fabricated from stainless steel. Machine builders are adept at the necessary engineering and fabrication processes to produce accurate machine base structures that serve as the foundation for which additional components are to be installed.

LINEAR GUIDE WHEEL BEARINGS WITH 90-DEGREE VEE PROFILES

Guide wheels bearings with 90-degree vee outside diameter profiles are provided by Bishop-Wisecarver® under the DualVee® brand name. ***See figure 1***. Internally they are constructed as double row deep groove ball bearings and contain ball retainers to properly space the balls and various selections of grease that is specific to harsh environments. There are greases for low temperatures down to -94° F and high temperatures up to +500° F, as well as options for grease that is H1 rated for use on food processing machines where incidental food contact is likely. The materials of construction include AISI 52100 carbon steel for general purpose environments or AISI 440C stainless steel for enhanced corrosion resistance. On the outside the geometry features a double 90-degree vee angular shape for using the wheel on a pointed vee or on a concave vee track surface. Regardless of the surface used to roll on, the guide wheels are designed for use on matching linear tracks that also feature 90-degree vee surfaces. Tracks materials include AISI 1045 carbon steel or AISI 420 stainless steel and is either hardened on the vee surface of soft as drawn to shape. In either material choice additional finish options are available including electropolishing, passivation, electroless nickel plating, thin dense chrome plating, black oxide, and several other common coatings. ***See figure 2***.

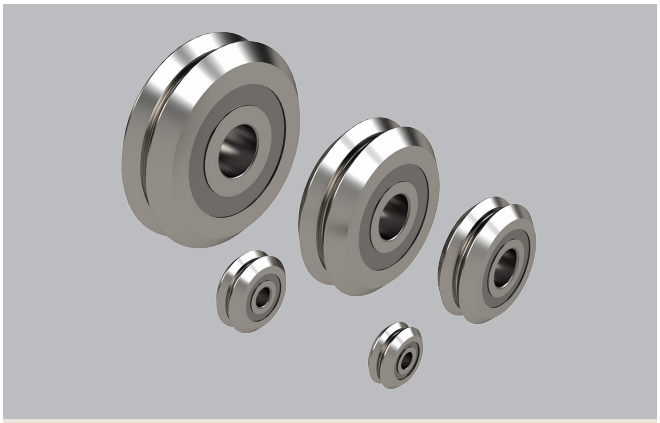

***FIGURE 1:** DualVee guide wheels available in AISI 52100 carbon steel and AISI 440C stainless steel in sizes 0 to 4XL.*

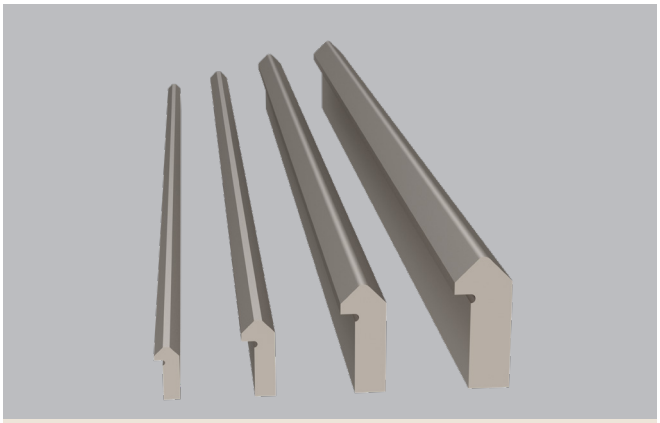

***FIGURE 2:** DualVee track available in AISI 1045 carbon steel and AISI 420 stainless steel with several finish options.*

A vee guide wheel rolling on a matching vee track provides unique characteristics that are inherent in the geometric design. The vee shaped surfaces generate a self-cleaning wiping action where particles and debris are ejected from the wheel-to-track interface during use to make this type of linear guide an ideal choice for use in dusty and dirty environments. The vee bearings provide very smooth and quiet operation combined with high load carrying capacity for industrial grade performance.

A wide range of bearing sizes are offered in DualVee® and a scheme for size is applied. Smaller size guide wheels have lower load rating capacities and larger guide wheels have much higher load rating capacities. The smallest size 0 guide wheels have a diameter of ø0.584" [ø14.83mm] with a radial load rating of 146 lbF [650N] whereas the largest size 4XL guide wheels have a diameter of ø2.968" [ø75.39mm] with a radial load rating of 3,215 lbF [14,300N]. Guide wheels can sustain high speed operation up to 5 m/s with an unlimited acceleration rate.

ATTACHING LINEAR GUIDE TRACKS TO MACHINE FRAMES

DualVee® linear guide tracks are short and wide with a 90-degree edge. The shape includes an undercut feature that is used to align the track quickly and accurately to a straight reference edge during assembly to machine frame structures. The wide area of the track is often referred to as the heel and is the area where mounting holes are located. Only the vee surfaces where the guide wheels roll are case hardened so the heel area can be easily machined.

Linear track is available without holes for anyone who wants to do their own machining or for applications where the steel track will be welded to a machine structure. Standard holes include either through holes or threaded holes. The through hole option is for mounting the track using threaded fasteners from the top, such as bolts or screws, that pass through the track into threaded holes on the mounting structure. The threaded hole option is for using bolts or screws

that pass through the mounting structure into the threaded holes on the track. With the correct plate thickness and fastener length the track can be mounted without fastener protrusion beyond the top surface making for a clean obstruction free installation. Custom machining is possible and includes counter bored holes or counter sunk holes to support the use of various fastener types.

Regardless of the hole type and fasteners used, it is important to mount a pair of linear guide tracks into a precise and parallel location so that the guided linear motion is consistently low friction without any tight or loose spots along the travel length that could cause binding. Standard cold rolled steel shapes offer enough precision to mount a DualVee® track against the reference edge on a 90-degree corner but hot rolled steel is often bulged and inaccurate at the corners and therefore inappropriate for direct track mounting. The track is somewhat flexible and will bend to conform to the mounting structure when fastened. Remember to press or clamp the linear track up against the undercut reference edge during fastening for best results. If enhanced precision is desired, machining is recommended for both the reference edge and the surface that the heel will contact. Additionally, machined parallel edges are ideal for obtaining the best result.

Finish coatings for structural steel machine frames often include durable paint or powder coating that cannot be applied with precise thickness control and will introduce inaccuracies onto machined reference edges. Therefore, it is recommended to mask important surfaces before applying the finish coating. If corrosion is a primary concern, it is possible to mount the linear guide tracks to the structure before applying the finish coating, but masking should be applied to the 90-degree vee contact surfaces where the guide wheels will make contact.

ATTACHING LINEAR GUIDE WHEELS TO MACHINE ELEMENTS

The original version of DualVee® guide wheel bearings feature a center through hole diameter used for mounting. Additional components called mounting bushings are made from AISI 303 stainless steel and designed for assembling the guide wheel on the center bore feature while supporting a short distance above the base on a flange. ***See figure 3***. There are options for standard mounting height with a taller flange and a lower profile mounting height with a thin flange.

All bushings have their own through hole that is sized at the clearance diameter for common threaded fasteners such as hex head bolts or cap screws. The fastener clamps down onto the wheel and bushing to rigidly attach the assembly into a threaded hole. There are two types of bushings including the concentric versions where the center clearance hole is centered, and an eccentric version where the center clearance hole is offset from the center. It takes two concentrically mounted guide wheels to create a precision plane or line of non-adjustable guide wheels used to act as the linear reference precision edge. It is recommended to hang heavy loads onto concentric wheel versions. The eccentric version with offset mounting hole is designed to allow adjustability in the position of the guide wheel because the bushing can be rotated with a cam action before

tightening the mounting fastener. This adjustability allows for field fit-up of the guide wheels to a pair of parallel linear guide tracks. Preload can be set to take out any free play and to ensure more accurate motion.

Another method for mounting guide wheel bearings is to use a journal assembly. ***See figure 4***. Journals are also made from AISI 303 stainless steel and includes washers and nuts made from 18-8 stainless steel. The journal does not need any additional fastener hardware to mount because it is a single-piece construction with a wheel mounting diameter, a middle support flange, and a mounting length with precision diameter. Journals mount into reamed through holes and locate on the pilot diameter closest to the flange with a longer threaded section that allows for attachment to a range of plate thicknesses. They are available in both concentric centerline for fixed location mounting and eccentric offset centerline versions for adjustability during mounting.

Studded guide wheel versions are pre-assembled with an AISI 303 stainless steel stud permanently attached to the center bore diameter. ***See figure 5***. The studded guide wheels raise the bearing up off the mounting surface with the integrated mounting flange. The flange section has an outside hex feature for using a thin wrench to assemble and adjust. The remaining length of the stud features either a threaded section on the concentric version, or a precision pilot diameter and a thread on the eccentric version. Concentric versions mount into threaded holes, and eccentric versions mount into reamed holes with back counter bores to accommodate flange nuts.

When mounting linear guide wheel bearings, it is important to follow the recommended assembly procedure and to observe the recommended fastener torque values. The technical data guide contains these important specifications.

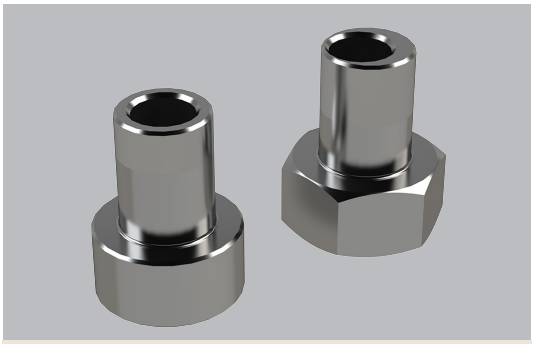

FIGURE 3: *DualVee bushings made from AISI 303 stainless steel.*

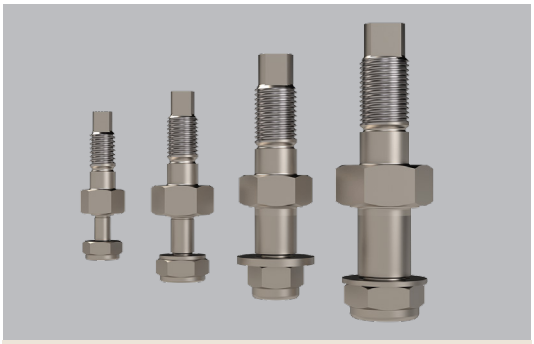

FIGURE 4: *DualVee journal assemblies made from AISI 303 stainless steel.*

FIGURE 5: *Studded DualVee guide wheel available in concentric and eccentric versions.*

LUBRICATION IS CRITICAL

The most critical factor associated with service life and product longevity is the presence and quality of lubrication on the wheel-to-track interface. As the vee guide wheel rolls along the vee track surfaces there is also the possibility of sliding or rubbing action when a single wheel slips on the smooth surface. If lubrication is not present to reduce the friction an accelerated wear rate will occur. A light motor oil is recommended and available for this purpose. More environmentally friendly options are under investigation and plant-based oil lubricants are promising but have much shorter shelf life compared to petroleum-based lubricants.

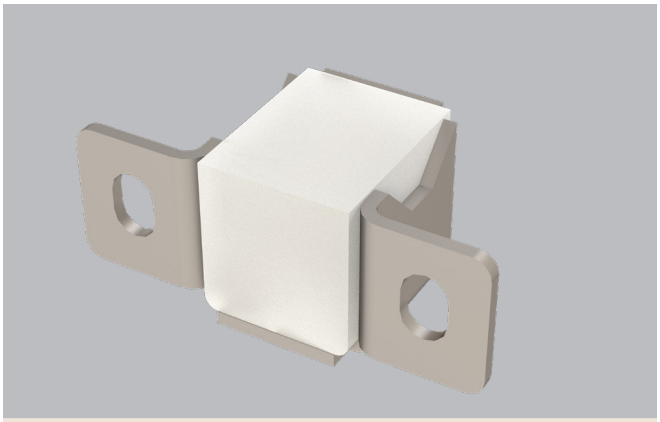

***FIGURE 6:** Track wiper with oil saturated felt.*

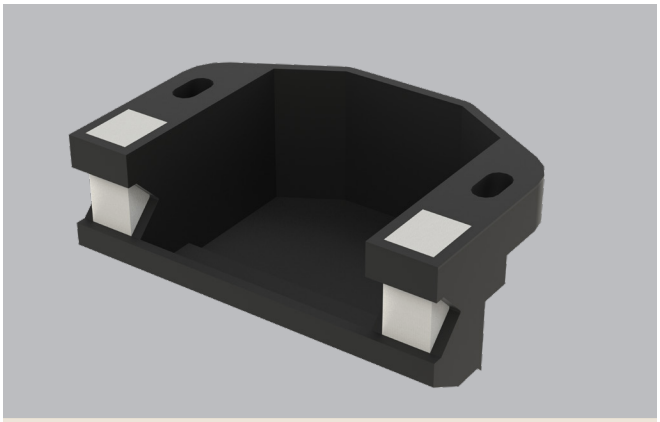

***FIGURE 7:** Wheel cover with wiper felts*

There are accessories designed to wipe away debris and apply lubricants. These include track wipers and wheel covers. The track wipers are stamped stainless steel sheet metal assemblies featuring oil saturated felt. Various designs ensure compatibility to the correct vee height relative to the wheel or track mounting surface to ensure proper wiping action. ***See figure 6***. The track wipers are often mounted between a pair of guide wheels and brush up against the linear guide track. Wheel covers are made from a polymer and contain a pair of wiper felts at the edges. ***See figure 7***. The wheel cover is designed to mount over a guide wheel bearing and offers additional protection for the guide wheel while providing the ability to wipe away debris and apply lubrication oil. Only one type of lubrication device is necessary for an installed motion axis.

It is important to periodically check for the presence of lubricant on the linear track surface where the guide wheel contacts. The lubricant should be clean and available in a light film on the surface. If lubricant is not present, or if the lubricant becomes excessively dirty, it should be removed and reapplied. To reapply lubricating oil the wiping felts can be removed and saturated with new oil before reassembly. If the felts are abraded or otherwise missing fibers, they should be replaced with new felts. Another simple method for reapplication of oil to the track surface is to spill some onto a shop towel or rag and then wipe the oil onto the track surface. This method does not require disassembly.

DRIVE MECHANISMS FOR MOTION AXES

A complete motion axis can be assembled from the vee guide wheels, linear guide tracks, and wheel covers or track lubrication and the addition of a drive mechanism. Electric motors are the most common type of drive component that can deliver the necessary forces to move a linear axis. The drive power is transmitted to the motion stage using linkages such as toothed belts, chain, lead screws or ball screws. In all cases additional support bearings are necessary on either the belt pulley, the chain sprocket, or to support lead screws and ball screws. When fully assembled, the electric motor transmits motive power through the drive mechanism to move the wheel plate assembly along the linear track surfaces.

IN CONCLUSION

Automated continuous production packaging machinery provides end-of-line handling and processing activities. Specialty equipment can shrink wrap bundles, apply adhesive tape, or glue seal box flaps, and even arrange finished cases onto pallets for distribution. Operation of packaging machinery often contributes to a dirty operating environment due to cardboard fibers and dust. It's vital to build machines that are made to withstand abuse and are stronger than necessary to ensure reliability. Many machines are assembled from structural steel materials that are welded into a machine base and finished with paint. These steel structures are an ideal platform for assembling industrial automation products such as motors, controls, sensors, and linear guides for motion axes. DualVee® Linear Guide Wheels and Components offer a variety of linear guide products that can be assembled into a complete motion axis. The vee guide wheel bearings roll on matching linear vee tracks and can be readily assembled to machine structures using common fasteners and simple hand tools. In addition to carbon steel and corrosion resistant stainless-steel versions, there are accessories such as track lubricators and wheel covers that can ensure the presence of lubrication to maximize service live. When combined together, DualVee® Linear Guide Components provide industrial grade performance for high speed and high cycle packaging machinery that market leading companies demand.

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.

(925) 439-8272 **sales@bwc.com** **2104 Martin Way**
Pittsburg, CA 94565