Shuttleworth
INTEGRATED PRODUCT HANDLING SOLUTIONS
powered by Pro Mach

OWNER'S MANUAL

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Shuttleworth
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OWNER'S MANUAL – BELT CONVEYOR

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1.0 SLIP-TORQUE® TERMINOLOGY

The following provides common terminology in relation to our Slip-Torque product.

BACKUP TUBE OR CHANNEL

The backup tube or channel is a part of the conveyor frame. It runs the length of the frame and provides additional stiffness to the frame assembly. In conveyor sizes 450 and wider, the backup tube/channel provides a support surface for the T-bar.

Depending on the type of frame structure being used, this may be a square tube, or a C- shaped channel.

BEARING MOUNT

The Bearing Mount is a bulkhead between the two side rails of the conveyor. There are typically at least two per meter of length. They determine the frame width (size), provide stiffness, and provide a mounting location for bearings in a line shaft system. They also support and locate the backup tube or channel. Construction is typically sheet steel, formed and welded, although some systems will use extruded aluminum cross members in place of the bulkheads.

BEARING

Shuttleworth uses both ball and plain bearings. Plain bearings will always carry the term "bushing" in the descriptions. "Bearings" will always refer to ball or roller bearings.

BELT DRIVE

Refers to Shuttleworth conveyor utilizing a line shaft along the length of the conveyor to power the transverse roller shafts on the surface of the conveyor. The Drive Belts link the line shaft to the roller shaft.

BELTS

DRIVE BELTS

Drive belts transmit power from a line shaft to a pulley on each roller shaft. Drive Belts are considered a wear item and should be on a spares list. Only applies to Shuttleworth "Belt Drive" systems.

JUMP BELTS

Jump belts transmit power horizontally from roller shaft-to-roller shaft when it is impractical to obtain power directly from the drive shaft with a drive belt. Jump belts are normally used to power roller shafts at bearing and drive sprocket locations on Shuttleworth "Belt Drive" systems

TIMING BELTS

Timing belts are used in primary power transmission and in Lift and Transfer assemblies.

BI-DIRECTIONAL CONVEYOR

The bi-directional conveyor surface is unique to Slip-Torque® conveyor. Instead of requiring individual conveyors to travel in and out of a work cell, Shuttleworth conveyors can be configured with multiple parallel lanes, each travelling one direction or the other, all within one frame.

Below please find our common terminology in relation to our Slip-Torque® product.

BUSHING

Bushing refers to a plain bearing. Most references to Bushing will involve the roller shaft supports. Roller shaft Bushings come in a variety of materials that have been matched to the application.

BUSHING COVER

Bushing cover is a generic term used to describe the upper covers that protect the ends of the roller shafts and the power transmission (line shaft or chain drive) components at the surface. They can be extruded plastic or aluminum, or formed stainless steel. Plastic bushing covers snap onto nibs molded on the bushing holder. Both stainless steel and extruded aluminum bushing covers bolt in place. Another primary function of bushing holder is to keep the bushings locked into the bushing holder.

BUSHING HOLDER

The bushing holder is a molded plastic or stainless steel part that retains the roller shaft bushings along the side rail.

BUSING RETAINER CLIP

This nickel plated steel clip snaps onto the standard pitch plastic bushing holder over the bushing and is used to hold the bushing in place when a bushing cover cannot be used.

CHAIN DRIVE

Refers to Shuttleworth conveyor powered by a chain (ANSI #25-2) that runs the length of the conveyor. Power is transmitted directly to the roller shafts on the surface by coupling the shaft to the chain via a sprocket. No intermediate power transmission is used. This type of system typically requires less maintenance, but is noisier than a comparable Belt Drive system. Chain Drive systems can also run faster and carry heavier loads, and are better suited to harsh or wet environments.

CLEAN GLIDE

Slip-Trak conveyor designed and tested for Class 1 (Fed 209E) cleanroom environments.

CLEAN PASSAGE

A clean room compatible mini-environment compatible to Fed 209E Class 1 (ISO 3).

COARSE PITCH

Refers to roller center spacing of 37mm (1.458") or 28 shafts per meter. A coarse pitch roller 32mm (1.26" dia.) is implied, but other roller diameters can be used on coarse pitch spacing.

CONTROLS

Controls" is a term used by Shuttleworth to indicate the presence of electronic control systems, typically driven by a PLC. Control systems will vary in complexity depending on the customer's requirements.

CORNER GEARBOX

Transmits power 90° between primary drive train (line shaft or chain). Located in Shuttleworth Slip Torque corner modules when drive power cannot be taken from upstream or downstream conveyor modules.

DOUBLE BELTING

This involves the addition of an extra drive belt on each roller shaft pulley. It is required when the average weight of product on the conveyor surface is more than 2 kg per shaft. Weights in excess of 2 kg/shaft cause slippage between the belt and the pulley and a greatly reduced belt life.

DOUBLE DRIVE

This involves the addition of an extra pulley on the normally idle end of each roller shaft. It is required on a very wide conveyor using Belt Drive.

DRIVE MOUNT

The drive mount houses the motor and primary power transmission components. For Belt Drive systems, this would consist of the timing belt and sprockets to connect the motor & gearbox to the line shaft.

For Chain Drive systems, the chain is part of the primary power transmission system and is directly driven from a sprocket on the gearbox output shaft.

Some drive mount assemblies are configured to power multiple shafts or chains from one motor. Most drive mounts are centered on the frame (laterally), but occasions where the area under the conveyor must be used, a SIDE MOUNT can be engineered.

DRIVE SHAFT BEARING

This special sealed 25mm ball bearing seats in the bearing mount and supports the line shaft.

DRIVE SHAFT

The Drive Shaft is made of 25mm diameter stainless steel shafting and runs parallel to the side rails and through the bearing mounts. It is held in position by the drive shaft bearings. The drive shaft transmits power from the primary power transmission to the individual roller shafts via drive belts.

END TRANSFER

This is a cantilevered extension of the Slip-Torque® conveyor past the end of the side rails. It is frequently used when interfacing with belt type of conveyors to minimize the dead zone between the two conveyors. It consists of special bushing holders, roller shafts, and jump belts. Most if not all the interfaces consist of powered rollers, thus eliminating stalled products. Dead plates are also available and may be warranted if the product is large enough compared to the gap.

FINE PITCH

Refers to a roller center spacing of 18.5mm (.729"), or (54 shafts per meter) which requires fine pitch rollers 17mm (.670" dia.).

FRAME

Conveyor frames consist of side rails, bearing mounts, and back-up tubes or channels

EASY CLEAN FRAME STYLE
Easy Clean frames are bolted together with spacers for ease of cleaning. Cross supports are welded tube & plate assemblies, and backup channels are stainless steel C channels. Bushing holders are stainless steel structures and bushing covers are formed stainless steel. The bushing retainers are integral with the bushing holders and not the covers. Covers are designed to be retained, but lifted clear of the drive chain for thorough cleaning.

STAINLESS STEEL FRAME STYLE
Stainless steel frames are welded together. Bearing mounts are welded to the side rails, and the backup tube is a square tube welded to the bearing mounts. Bushing holders can be plastic or stainless steel as is warranted by the application. Bushing Covers are formed stainless and bolt in place.

EXTRUDED ALUMINUM FRAME STYLE
Extruded aluminum frames are bolt construction. Bearing mounts are bolted to slots on the inside surface of the extrusion, and the backup channel is a C shaped aluminum extrusion. Bearing mounts are typically painted steel but could be stainless steel. Bushing holders are typically plastic, but could be stainless steel for special applications. Belt drive aluminum frame can use plastic bushing covers (least cost), while chain drive will require formed steel (painted) or formed stainless steel bushing covers.

GUIDE RAIL

Guide rails fit between the bushing covers and provide additional guiding to products if needed. Construction could be UHMW rail or stainless steel formed sheet. Guides can be mounted with threaded rods for maximum rigidity or can be mounted with quick release knobs for maximum flexibility.

GUIDE RAIL BRACKETS

These support brackets are for attaching and adjusting the guide rail in relation to the conveyor. Brackets could be fixed or adjustable.

INDEXER

An indexer is a special conveyor that singulates products to match them to another type of conveyance. A typical example is releasing single products into a lug chain which in turn feeds a packaging machine. The Shuttleworth Indexer can be configured with a center cut-out at the end to allow conveyor lugs to pass up into the surface to simplify the product transfer. Multiple products or patterns can also be released with an indexer. The Shuttleworth Multi-Packer is an example of this application.

INDEXING

The process of separating a single product or a specific number of products from a group of products. A speed change and a product stop are often used to accomplish this.

INTERFACE

Applies to the transfer between the conveyor and the adjoining equipment. Usually implemented as an end transfer, but could also be a side transfer.

JOINT KEY

Joint keys are aluminum bars that are used to connect extruded aluminum frames together. They fit in the T-slots of the extruded side rail.

JOINT PLATE

Steel plates used to connect frames together. Most often refers to Stainless Steel frames or Easy Clean frames, but can be used when joining aluminum frames, especially if they are not the same size or not in line with each other.

LEG ASSEMBLY

Leg assemblies can be tubular steel or extruded aluminum, and support the conveyor sections. They normally consist of legs, adjustable feet, and cross-members. They sometimes are fitted with lateral knee braces for extra rigidity on some systems.

LIFT AND ROTATE

These devices are used to rotate the product on the conveyor centerline. They are available with pneumatic drives or servo motor drives. Possible rotations are 90° or 180°.

LIFT AND TRANSFER

A device that provides smooth, accurate lateral product transfers from one lane to multiple lanes or from one conveyor elevation to another.

LIFT GATE

Lift gates are hinged sections of Slip-Torque® conveyor that easily lift to access work areas. Shuttleworth Lift Gates are counterbalanced and do not require springs for lifting. This increases the safety of the device.

LINE PRESSURE

Line pressure refers to the amount of forward drive the conveyor imparts to the product being conveyed. It is expressed as a percentage. For instance, a product weighing 10 kg (100 lbs.) that is conveyed forward with a force of 600g (6 lbs.) is said to have a line pressure of 6%.

LOW PROFILE

Ergonomic low profile conveyor designed to minimize overall dimensions. The enclosed drive mechanism, reduced vertical profile, and rounded covers allows operators to work directly on the conveyor.

MULTI PACKER

See INDEXER.

PRODUCT STOP

This device is used to temporarily stop the product for placement on another device or as an escapement. They are almost always mounted below the roller surface. Available with a stainless steel blade or pins mounted on a linear thruster that is raised and lowered pneumatically.

POSITIONER

These pneumatic devices are used to precisely locate product. They are available in increasing degrees of accuracy and can be conveyor or floor mounted. Examples of positioners can be as simple as guide rail, or as complex as a clamp and shot-pin arrangement. In many cases, a clamp to a fixed reference is sufficient for the location.

PRODUCT BRAKE

Brakes are used to slow down moving products by stalling the roller surface in a specific location. The end result is a gap between products or train of products. Brakes will not always stop products, especially in a train, but can aid in generating gaps for timing devices.

PRODUCT PUSHER

Usually powered by a rodless pneumatic cylinder, the pusher is designed to move products laterally from one conveyor lane to another or even off of the conveyor via a Side Transfer.

PULLEY

Pulleys are used to couple the Drive Belt from the Line Shaft to the Roller Shaft. Pulleys are plastic and pressed on to the roller shaft. No pulleys are used on the line shaft.

Does not apply to Chain Drive conveyors.

PULLEY COVER

See Bushing Cover.

REVERSING CONVEYOR

Reversing conveyor can convey product in either direction, but not both at the same time (See BI-DIRECTIONAL CONVEYOR).

ROLLERS

Rollers are the plastic wheels that actually carry the product on the conveyor surface. They are available in a variety of different materials and in three diameters. We also offer solid or cored rollers for different applications.

Coarse pitch:	32mm (1.260") dia.
Standard Pitch:	21mm (0.835") dia.
Fine Pitch:	17mm (0.670") dia.

ROLLER SHAFT

Roller shafts are made of 8mm diameter stainless steel shafting. Bushings and bushing holders support the shafts on each side of the conveyor. Rollers slip or are pressed onto the roller shaft to make up the roller surface.

ROLLER SHAFT BEARINGS

The Bushing is replaced with a sealed ball bearing on one or both sides of the roller shaft. Roller shaft bearings may be used in high-speed applications, heavy product applications or in hostile environments.

ROTATOR

A conveyor section with the ability to rotate. Two types are available. The pneumatic driven rotation which can rotate 90º, +/- 90°, or 180º. Servo driven rotation has unlimited angular capabilities.

SENSOR

Sensors are used to determine where the product is on the system. 12mm barrel type sensors can be installed in the surface in many applications improving or eliminating overhead clutter. Sensors may be optical, inductive, capacitive, or magnetic (hall & reed type). Sensors are optional and can be provided and mounted by Shuttleworth as a value added service for customers who wish to provide their own automation and control.

SET COLLAR

Set collars are used in various applications on Shuttleworth conveyors. The two main applications are to identify set points on adjustable guide rail, and to retain rollers when spring loading.

SIDE RAILS

Side rails are the side members of the conveyor frame. They are available in stainless steel or extruded aluminum. See “FRAMES” for a discussion of types.

SIDE TRANSFER

This is a special arrangement of rollers and bushing covers to allow product to be transferred onto or off of the side of the Slip-Torque conveyor. The bushing cover is removed in the side transfer area and other components will be added to meet the customer’s requirement. Side transfers are done on the idle (non-driven) side of the conveyor and may use guides or pushers to move products off of the system. Other devices may be required to aid product transfers on to the conveyor.

SKEWED ROLLER SHAFTS

By moving one end of the roller shaft along the conveyor by one pitch, the product can be made to skew over to one side of the conveyor. Infrequently used, these shafts help a product to travel along a guide rail or move over towards a guide rail from the center of the conveyor. This technique requires a Belt Drive type system.

SLIP-TORQUE PRINCIPLE

The Slip-Torque principle refers to the friction between the roller and the roller shaft. As the roller shaft turns, the friction between the roller shaft and the I.D. of the roller provides forward "push" to the product being transported. If the product is stopped, the roller shaft continues to turn but not the roller. The outside surface of the roller does not slip against the product because the friction force between the product and the roller is typically higher than the friction force between the shaft and the roller. Forward push or "line pressure" is determined by the coefficient of friction between the roller material and the roller shaft.

SLIP-TRAK

Slip-Trak has all the characteristics of the Slip-Torque but is designed to be compatible with Federal Standard 209E Class 10 and Class 1 (ISO Class 4 and ISO Class 3) clean rooms. The through shaft or open center construction maximizes process adaptability.

SPACER ROLLER

Spacer rollers are simply narrow rollers. They are typically 1/3 as wide as their full-sized counterparts. They are available for all roller diameters. Spacer rollers are needed in applications where the product may need the surface rollers close together.

SPACER SLEEVES

Spacer sleeves are lengths of conductive plastic tubing that are slipped onto the roller shaft to separate rollers. They are used to create gaps in the roller surface for product stops, special sensors, and to fill in large areas of roller shaft where rollers may not be required, as in a frame width transition application.

SPEED CHANGE

A unique characteristic of Slip-Torque, speed changes can be achieved at nearly any point on a conveyor surface. These are useful in creating gaps in a line of products on the conveyor surface, or in closing gaps for accumulation. The system must be engineered with the proper drive components; however, the speed change can happen at any point in the speed change region.

SPLIT ROLLER SURFACE

A split roller surface places a special bushing holder in the conveyor surface, essentially providing two separate surfaces, yet in the confines of one frame assembly. There are a myriad of reasons to split a surface including needing bi-directional conveyance with a small product footprint.

SPRING LOADING

Spring loading refers to a method of incorporating springs between a pair of rollers on a roller shaft. This creates extra friction in the roller surface, and increases line pressure. This provides for a more positive product control during acceleration or deceleration.

STANDARD PITCH

Refers to a roller center spacing of 22.7mm (.895") or (44 shafts per meter). Also, implies standard pitch rollers 21mm (.835" dia.), but fine pitch rollers 17mm (.670" dia.) can be used.

SWINGER

A standalone pattern forming subsystem that divides one lane of product into multiple lanes. A simple 2 position system might be pneumatic powered, while higher lane counts are servo powered. The Swinger Pattern Former can also be engineered with two parallel infeed lanes.

T-BAR

The T-Bar is used to support and stabilize the center of the roller shafts in conveyor sizes over 310. The T-Bar has load-carrying capacity and prevents bending of the roller shafts under heavy loading.

TURNS

45° TURN

A special end configuration of Slip Torque® conveyors that can be engineered into most frame sizes and styles. Guides are added to maintain product orientation (non-round product) through the turn.

90° TURN

A special conveyor module in a limited number of sizes. Power transmission is usually taken from neighboring modules, but the module can be self-powered. Product orientation can be maintained with guides through the corner. Uses the Slip Torque® technology to maintain low line pressure and gentle handling

TAPERED ROLLER TURN

Another 90° turn, but with tapered rollers across the width of the conveyor. The tapered rollers maintain the product orientation throughout the turn. Designed for heavy duty industrial applications, the tapered roller turn would not be suitable handling small or delicate products.

30° TWIST CONVEYOR

A pair of conveyors at 90° that is twisted to allow the products to tilt. Gravity forces the products into the V of the two powered conveyors. More effective than guide rail for alignment of heavy stacks of paper or books.

VERTICAL CONVEYOR

A stand-alone module that transports product vertically between two different elevations. Available with pneumatic or electric drives in non-cleanroom and in cleanroom versions.

ZONE CONTROL CONVEYOR

A non-contact queuing and accumulation conveyor that is ultra-clean and compatible with Federal Standard 209E Class 1 (ISO Class 3) clean rooms.

2.0 GENERAL DATA

2.1 The Slip-Torque Principal

Figure 1 below shows a package resting on a Slip-Torque® roller surface. The segmented rollers form a string that is mounted on a roller shaft, powered by a flexible belt by mean of a pulley. The flexible belt itself is powered by a drive shaft. When the drive shaft is powered, the rollers on the roller shafts rotate and tend to transport the package.

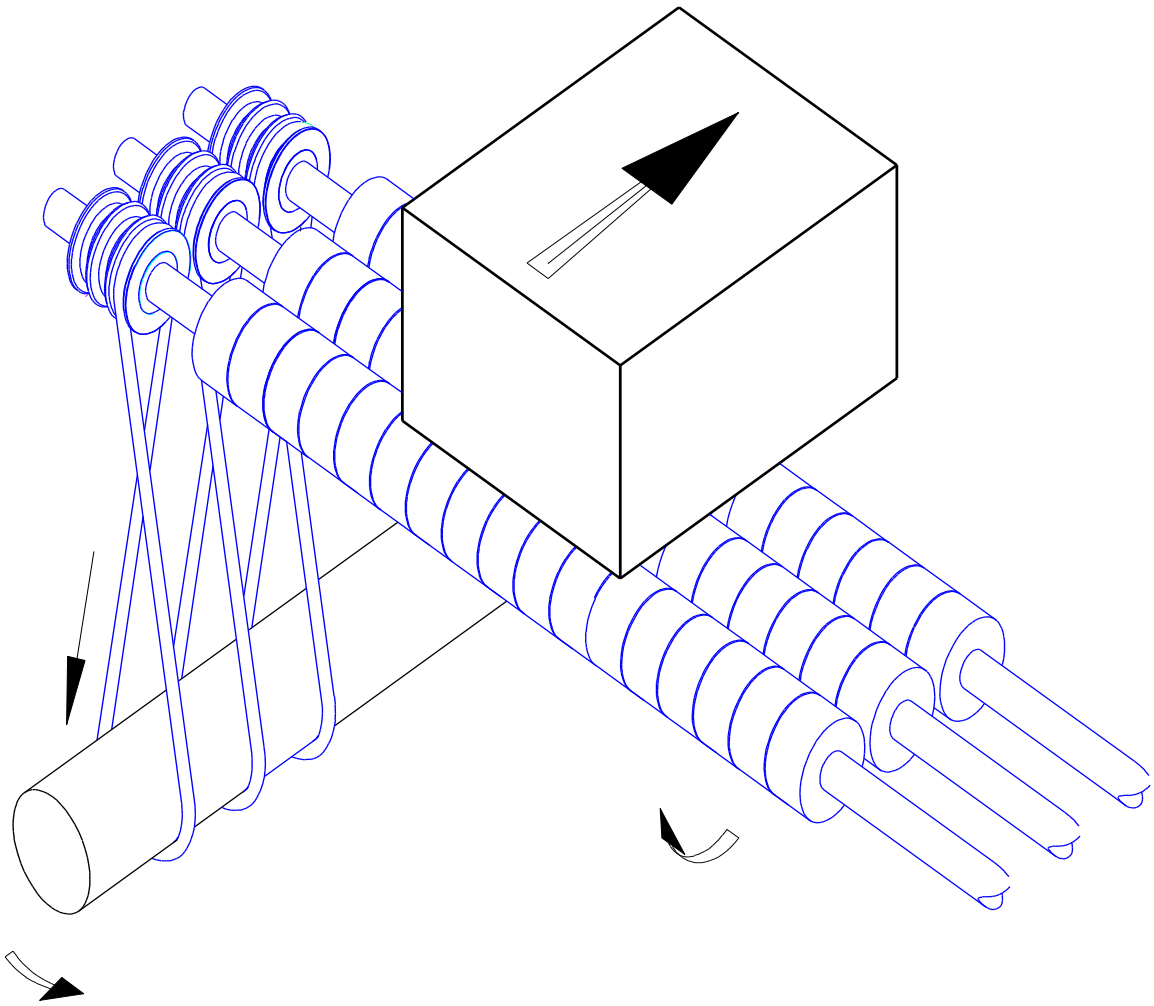


Figure 1

Let's consider these elements one at a time:

- The **drive shaft**, made of ∅ 25mm stainless steel ground to a smooth finish (Ra 0.4) rotates at speeds from 30 to 300 RPM.

- The **drive belt** is an endless loop made of a special polyurethane formulation approximately ∅ 3 mm. These belts seldom, if ever, break. They can, however, be accidentally stretched or cut. In this event, one of the spare belts should be moved into place.

- The belt engages a **pulley**, which is pressed on the roller shaft. The grooves in this moulded pulley are of a special shape, which was achieved after extensive research.

- The **roller shaft**, made of ∅ 8 mm 304 stainless steel, is centreless ground to a finish of Ra 0.2 to 0.4. This precision finish is important.

- The plastic **rollers** themselves are a loose fit on the roller shaft. The plastics of which they are moulded are proprietary compounds. We will however, guide any customer in selecting a formulation, which is compatible with his product. There is a wide selection of roller materials available, each of which has a slightly different coefficient of friction.

- The package resting on the conveyor has an unknown weight.

The heavier the weight, the more driving force will be imparted to the package. This is the ***first*** important point, which makes Slip-Torque® utterly different from any other conveyor. It automatically adjusts the driving force in proportion to the weight of the packages being conveyed. There are many ways in which the driving force (line pressure) can be adjusted or fine-tuned after the conveyor is installed. Refer to section 6.

The ***second*** significant fact is that the driving force is controlled by the coefficient of friction between the roller and the roller shaft. It is obvious that the driving force is under our control, and is not controlled by the customer or by accident. The roller is, in effect, a plastic bearing. All plastic bearings require a polished surface of the shaft to Ra 0.4 or smoother. It is made of 304 stainless steel so as to prevent corrosion and preserve the fine finish throughout the conveyor's life.

The ***third*** important point is that the drive belt does not slip. When slippage occurs, it always occurs between the rollers and the shafts, not at the belt or under the package.

Let us examine further the mechanism, which generates the line pressure in Slip-Torque® conveyors. *Figure 2* below shows a package resting on a single plastic roller on a roller shaft.

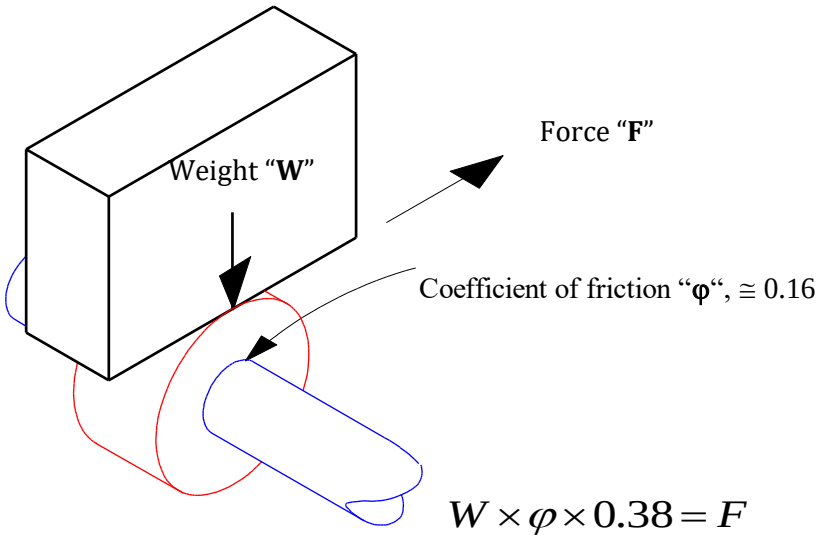


Figure 2

The radius of the roller shaft is 38% of the roller itself. The package weight (W) is unknown. As the shaft rotates, the package is driven forward by some force (F). That force depends upon the coefficient of friction (φ) between the plastic rollers and the polished shaft, but is also limited by the 38% relationship between the two radii. The formula W x φ x 0.38 = F shows the relationship between the weight of the package, the roller material, coefficient of friction and the line pressure F.

This is part of the magic of Slip-Torque® the line pressure is carefully limited by the ratio of these diameters. This is unique to Slip-Torque®. In theory, the line pressure is the same regardless of the conveyor speed. In actual practice, line pressure drops slightly for very low speeds and impact increases for very high speeds. So, in practice, conveying speeds do influence line pressures slightly. The flatness and hardness of the package bottom also influence line pressure.

Figure 3 below shows what happens when one tries to slide a package sideways on Slip- Torque®. The resistance to sliding now takes place between the bottom of the package and the surface of the rollers.

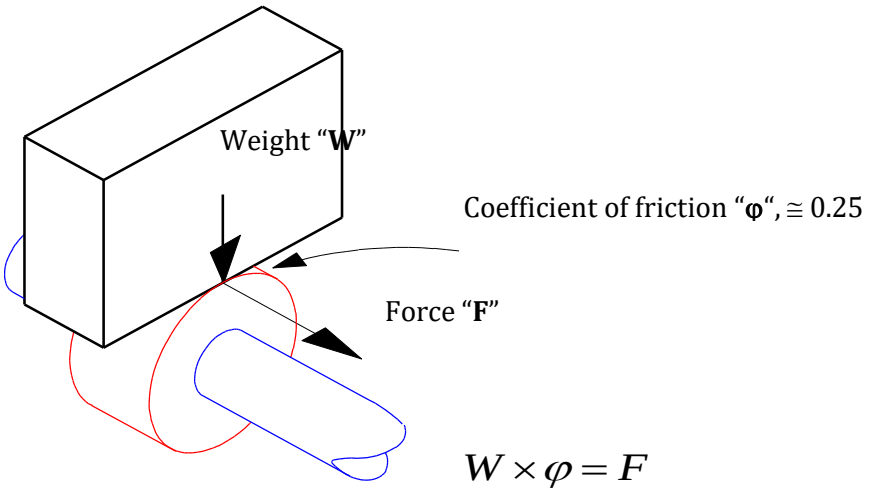


Figure 3

The resisting force is much higher because motion does not take place on polished bearing surfaces. Instead we have an unknown coefficient of friction between an unknown package and a plastic roller. Each package will have a different coefficient of friction, but it will always be higher than before (about 25% for corrugated carton). In addition, the 38% relationship is missing. This explains why objects on Slip-Torque® can easily be conveyed ahead, but they resist being pushed sideways. This is the ***fourth*** important point about Slip-Torque®

2.2 Slip-Torque Technology

Figure 1 below shows a package resting on a Slip-Torque® roller surface. The segmented rollers form a string that is mounted on a roller shaft, powered by a flexible belt by mean of a pulley. The flexible belt itself is powered by a drive shaft. When the drive shaft is powered, the rollers on the roller shafts rotate and tend to transport the package.

2.2.1 SAFETY

Unlike most other types of conveyors, Slip-Torque's dispersal of power means that no large amount of power is concentrated anywhere on the conveyor surface. There is simply not enough force in any one place on the conveyor surface to cause injury. Personal can work safely directly on the conveyor surface. This lack of concentrated source of power eliminates most potential damage to the conveyor. Should foreign objects such as broken glass or metal shavings becomes lodged in the conveyor, the adjacent rollers will stop turning until the object is removed. The rest of the system will continue to function normally. Potentially harmful devices and areas are guarded accordingly. Shuttleworth conveyors comply with European Safety Standards and bear the CE mark. A safety declaration can be found in section 4 of this manual.

2.2.2 MAINTANENCE

Shuttleworth uses sealed for life drive shaft bearings and gearboxes and engineered plastic components that require no lubrication. Under normal operating conditions with preventive maintenance, Slip-Torque® conveyor will give many years of operation with minimal maintenance.

2.2.3 FOOD-GRADE CONVEYOR

Shuttleworth conveyors are USDA approved.

2.2.4 EASY TO CLEAN

Slip-Torque® conveyors can be easily cleaned with usual washing procedures. The open spaces between rollers allow spills and small particles to fall through the conveyor surface to the floor. There is no return conveyor to catch and distribute spills.

2.2.5 ELECTROSTATIC CHARGE DISSIPATION

Slip-Torque® conveyors can be designed to control electrostatic build-up on products to a maximum of 20 volts. Resistance to ground is approximately 6.10^6 Ohms at 10 VDC.

2.2.6 ELECTROMAGNETIC COMPATIBILITY

Slip-Torque® conveyors are designed to comply with the current relevant European regulations.

2.2.7 CLEANROOM CONVEYOR

Slip-Torque® conveyors have been used for more than 10 years in cleanrooms ranging from class 10,000 to class 10 in over 200 installations worldwide. “Slip Trak” (a specifically designed version of Slip-Torque®) can operate in class 1 cleanrooms.

2.2.8 NOISE LEVEL

Under normal operating conditions, noise produced by Slip-Torque® conveyors is under 70 dBA. When noise produced by a Slip-Torque® system is over 70 dBA, this value will be stated in section 4 of this manual.

2.2.9 COMPATIBILITY

Slip-Torque® is the perfect tool to interface with a transportation belt, chain or roller conveyor to use to accumulate products, or to perform other ancillary processes that require the use of a more flexible conveying system.

2.2.10 RELIABILITY

Power is transmitted to individual roller shafts via a flexible belt and product is conveyed on multiple roller shafts. Should one drive belt break, the conveyor surface will function with little effect on the conveyed product. This is because the rollers on the dead shaft become freewheeling. This characteristic allows the conveyor to operate with a high reliability without being subject to a sudden failure. Maintenance time can be scheduled when convenient.

2.2.11 MODULARITY

Shuttleworth offers modular product design consisting of either welded stainless steel or extruded aluminum and bolted stainless steel frame styles. They are available in standard sizes ranging from 110 to 1500 and in 0.5 m up to 3 meters lengths. The bolted construction of the extruded aluminum

frame along with the continuous slots in the extruded aluminum side rails and back-up channels allows Slip-Torque® conveyor to be easily reconfigured with respect to layout as well as location of devices. This becomes important during installation if a change becomes necessary or when a product change requires reconfiguration of the material transport system.

2.3 Operating Environment

Slip-Torque® operates best in a dry environment. Operation in wet and dirty environments is possible with standard drive system protections. When making exceptions consider the following:

- Applications where large amounts of dirt will build-up on the roller surface should be avoided. If periodic cleaning can be exercised then Slip-Torque® can be used in this type of applications.
- Slip-Torque® uses a friction drive system. For this reason, standard pulley protections should be used in applications where large amounts of oil, soap or other friction reducing liquids are present.
- If sugary solutions are present the conveyor should be washed down daily as part of routine maintenance.

2.3.1 ROLLER SURFACE: ROLLERS AND PITCH

Slip-Torque® is available in three distinct roller diameters - "standard" pitch (∅21 mm) - "fine" pitch (∅ 17 mm) - "coarse" pitch (∅ 32 mm) and are usable on two pre-set pitches (18.5 mm and 22.7 mm). Pitch is the centreline to centreline distance between roller shafts. It can be increased by using multiple of those two pitches. Most components are designed to be interchangeable between the three roller types. As a rule, an individual product should rest on at least three rollers for those products whose centre of gravity elevation is greater than their length in the direction of travel. Products whose length is greater than the centre of gravity elevation must rest on at least two rollers. When making exceptions, consider the following:

1. The higher the surface speed, the more unstable the product.
2. Top-heavy products can lead to instability.
3. Products are easier to handle when in a straight line.
4. Products are easier to handle when supported by guides rather than grouped in accumulation or when going around corners.

The majority of products can be accumulated and conveyed on standard pitch. Fine pitch is used to handle smaller less stable products. Coarse pitch is used to handle larger more stable products at higher speeds. Normally the rollers used on Slip-Torque® are free to rotate.

2.3.2 DRIVE BELTS AND JUMP BELTS

As mentioned before, belt driven Slip-Torque® conveyors use polyurethane drive and jump belts to power the roller shafts. Various configurations imply specific belting arrangements. Jump belts are used whenever drive belts cannot be fitted. In other words, when an obstacle like a bearing mount or a drive sprocket/pulley on the drive shaft doesn't allow for the necessary space required. In that case, the driven roller shaft is powered by the neighboring roller shafts through 1 or 2 jump belts.

Load and Speed Limitations (under normal conditions)			
	roller ∅ 17 mm	**roller ∅ 21 mm**	**roller ∅ 32 mm**
Maximum speed	27 m/min.	36 m/min.	55 m/min.
Maximum load/belt	0.9 Kg	1.8 Kg	1.8 Kg

General Rules for Belting

Tight and slack sides are created on a drive belt when the torque requirement of a product load on the roller shaft causes one side of the drive belt to have a greater tension than the other. As the product load increases and the belt tension on the slack side decreases, drive belts have a tendency to jump out of their grooves if the slack side angle opens. With single drive shaft bi-directional belting, alternate pulleys are spaced inboard to avoid directly adjacent slack sides and to create fairly equal slack side angles. If this spacing is not done, adjacent slack sides can sometimes touch each other resulting in belt wear and/or jumping.

BELT WEAR

As the slack side angle is decreased, the tight side angle naturally increases. Excessive tight side angles result in excessive belt wear as the belt rubs against the pulley flange.

ROLLER SHAFT THRUST

In keeping proper belt geometry, a roller shaft thrust load will always be generated. Depending on drive shaft rotation and belt geometry, this thrust load may be toward the pulley end of the shaft or away from it. If the thrust load tends to pull the pulley away from the bushing, a set collar or press fit roller must be added on the non-pulley end to retain the roller shaft. If the thrust load is great enough, a thrust bushing is used in place of a standard bushing.

DRIVE SHAFT ROTATION

The direction of drive shaft rotation affects the belt geometry. Drive shaft rotation is considered to be “standard” when the TOP of the shaft rotates TOWARDS the nearest side rail. Because reversing conveyor has both standard and non-standard drive shaft rotations (depending on the direction of the surface), there are special belting practices to be followed.

2.3.3 PRODUCT WEIGHT

The maximum available weight per roller shaft is 1.8 Kg at speeds of up to 30 m/min. (with standard drive configuration at normal room temperature) without affecting the drive belts performances. It is possible, however, to significantly increase this limit by changing in one or both of the following ways:

1. Increase the number of belts per pulley.
2. Increase the number of pulleys per roller shaft.

The second option is most common as it gives a better belt configuration and hence longer belt life.

2.3.4 TEMPERATURE

Temperature in °C		
	Product	**Ambient**
Minimum	- 40	- 5
Maximum	(*) + 80	+ 46

(*) High temperature rollers will allow a product temperature up to +150°C.

2.3.5 LINE PRESSURE

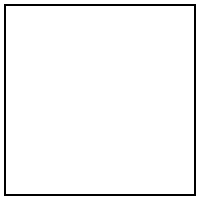
Line pressure is the pressure exerted on a product by products behind it in accumulation. Low pressure dynamic accumulation, defined in the Shuttleworth sense, means moving and accumulating products at very low pressure with greater versatility.

Shuttleworth Slip-Torque® is generally used as a low line pressure, self-regulating conveyor system. Products can be mass accumulated on this conveyor with lower resulting line pressure than on any other type of conveyor known.

Line pressure may be changed to meet your needs by using rollers of different composition and friction characteristics. Different line pressures can be affected even within the same selection of conveyor. To help you better understand why Slip-Torque® can offer you new opportunities; the following chart has been prepared.

***Slip-Torque*® Conveyor**		
Conveyor type	**Pressure in DaN**	**Line pressure percentage**
Slip-Torque® coarse pitch	0.3	3
Slip-Torque® standard pitch	0.6	6
Slip-Torque® fine pitch	1.0	11
Roller belt	2.0	21
Plastic low friction tabletop chain	2.4	25
Lubricated stainless steel tabletop chain	2.6	27
Wire mesh	2.9	30
Plastic tabletop chain	3.6	37
Unlubricated stainless steel tabletop chain	4.0	41
Rubber belt	6.4	66

Three, six pack of bottles (**9.6 Kg**) were used on each type of conveyor and average resulting pressures were recorded. It has been found that individual tests vary somewhat depending on product density, area of contact and speed of operation. A large corporation that uses Slip-Torque® in the production process supplied the chart shown below to Shuttleworth. All data was arrived at by the source without assistance or counsel by Shuttleworth. The line pressure is measured for a single row of toilet paper.



Please note that the table top chain basically produces a straight line meaning that one unit increase in length equals a one unit increase in line pressure. Using Slip-Torque®, a one unit in length increase does not increase the line pressure in a one to one ratio.

2.4 Components Life

Slip-Torque® is a revolutionary conveying system comprising of many different types of components. Each Slip-Torque installation is unique and no exact data for each individual installation can be given. However, we are confident you will be extremely satisfied with the life of Slip-Torque. The estimated life of components listed below is NOT guaranteed for any one application, but is given only as a guideline as to what may be expected under the following conditions:

1. A load of 0.5 Kg per roller shaft;
2. A temperature of 20° C with a relative humidity of 60%;
3. A clean dry environment with good preventive maintenance;
4. A well-engineered and installed system

Estimated Components Life – Standard Pitch (in hours)		
	At 10 m/min.	***At 30 m/min.***
Stainless steel frame	80.000	60.000
Drive shaft	40.000	30.000
Roller shaft	40.000	50.000
Plastic roller	100.000	70.000
Drive shaft bearing	20.000	15.000
Bushing	15.000	7500
Drive belt	20.000	10.000
No. 40 sprocket	15.000	10.000
No. 40 chain	15.000	10.000
Gear motor	10.000	8.000
Plastic pulley	80.000	60.000

*Lighter loads will increase life (the converse is true for heavier loads)

3.0 SAFETY ISSUES

3.1 General Recommendations

It is the responsibility of the Owner/Employer to provide for the development and implementation of a system Lockout or Tag out procedure. An example of a sample lockout procedure can be found in Paragraph C of this section.

The owner must establish procedures to verify that equipment purchased from Shuttleworth will not be a hazard to his employees. An owner of Slip-Torque® equipment can expect co-operation and assistance in solving safety problems, which are brought to our attention and relate to his Shuttleworth Equipment. The following list of safety precautions should be thoroughly read and reviewed with all personnel prior to working with or on the equipment and systems. Failure to heed these warnings can result in an accident causing personal injury or property damage.

A competent person (or persons) should be allocated with the responsibility of implementing and maintaining safety standards of personnel and equipment. Persons responsible for the equipment covered by this manual must ensure that it is properly and safely installed, operated and maintained. Only appropriate qualified staff, applying acceptable standards of engineering practice and the recommendations contained within this manual, must be employed in these activities.

Statutory and local requirements concerning work practices, safety and/or health procedures must be observed.

Site management should ensure that notices warning of potential hazards and prohibited actions are prominently displayed, and that all personnel with access to the installation area can understand them or are made aware of the instructions.

Refer also to the supplementary warnings and safety precautions in this section. In addition, refer also to specific safety signs contained within sub-vendors literature. A log should be kept of maintenance work performed, blinds installed, and relays locked-out, etc. so that this equipment is not inadvertently left nonfunctional when restarting the unit. Motors may start without warning when commanded to operate by the control system, so these must be locked and de-energized before commencing work on them or their driven equipment.

Do not operate this equipment in excess of its rated capacity, speed, temperature, nor otherwise than in accordance with the instructions contained in this manual. Operation of the equipment in excess of the conditions set forth in the sales contract will subject it to stresses and strains which it was not designed to withstand. If you need to increase product weight or conveyor speed, consult Shuttleworth, as a higher power gear motor may be required.

It is vital that any physical injury is examined as soon as possible by a qualified medical attendant.

A suitable authority shall certify lifting equipment with documentary evidence maintained by the competent person. Such equipment must not be used to move components having a greater weight than the rated capacity.

All electrical work shall be undertaken in accordance with any applicable electrical code or health and safety legislation in force at the site. These codes may be local, state, province, national or governmental and copies of those applicable should be obtained and updated by the competent person. It will be the responsibility of the competent person to ensure operating and maintenance personnel are aware of and comply with governing codes. Electrical schematics will be provided by Shuttleworth (section 10 of this manual) if machine controls were supplied by Shuttleworth.

Maintenance of the equipment will be assisted if good housekeeping is employed in the following areas:

- Spillage of any kind quickly dealt with.
- Avoid build-up of dirt by regular cleaning.
- Coil and fasten loose cable securely, particularly those at floor level.
- Used cleaning fluids and rags should be disposed of after use.

!!! WARNING!!!

DO NOT START THE CONVEYOR UNTIL ALL GUARDS AND COVERS ARE IN PLACE. REFER TO THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

DO NOT ATTEMPT TO DO ANY MAINTENANCE, CLEANING OR REPAIR WORK ON THE CONVEYOR AND ASSOCIATED DEVICES WHILE IN OPERATION. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

DO NOT BY-PASS OR ALTER SAFETY FEATURES. THEY GUARANTEE YOUR SAFETY. NON ADHERENCE WILL LEAVE YOU LIABLE IN THE EVENT OF AN ACCIDENT.

DO NOT LEAVE LOOSE BELTS HANGING ON THE DRIVE SHAFT. DAMAGE TO THE CONVEYOR OR PERSONAL INJURY MAY RESULT. USE SPARE BELT RETAINERS TO HOLD ADDITIONAL BELTS.

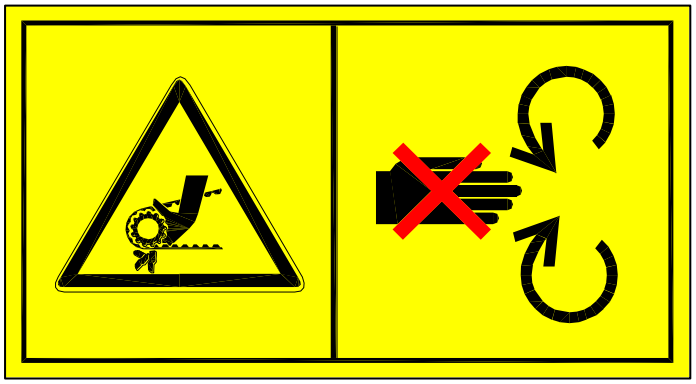
DO NOT WALK OR CRAWL UNDER THE CONVEYOR WHILE IN OPERATION. DAMAGE TO THE CONVEYOR OR PERSONAL INJURY MAY RESULT. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

DO NOT SIT, STAND OR WALK ON THE CONVEYOR AT ANY TIME.

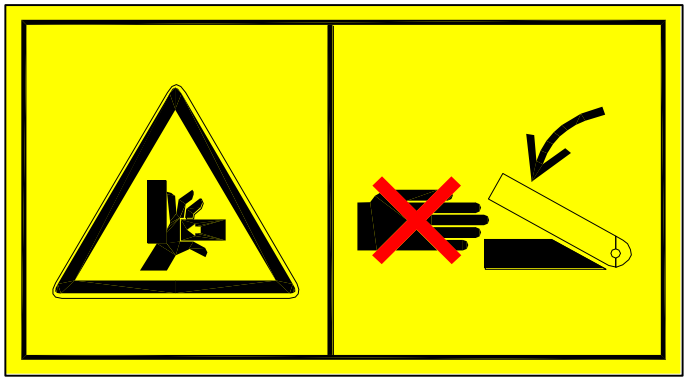
CONTACT SHUTTLEWORTH ENGINEERING DEPARTMENT IF A CHANGE IN OPERATING PARAMETERS IS REQUIRED AS THE CONVEYOR PERFORMANCE MAY BE ALTERED.

3.2 Safety Labels

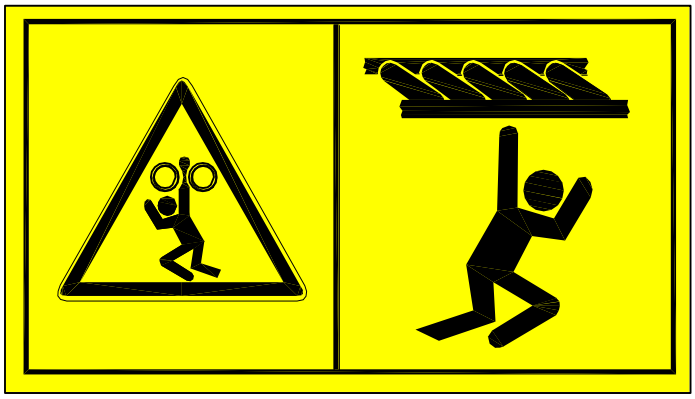
Warning labels are attached to conveyor frames or devices that are used in a Slip-Torque® system. They should not be removed or covered. Maintenance information may also be present with the warning message. Refer to section IV for additional labels specific to your application. Warning labels are subject to revision. Location on individual systems may vary according to circumstances.



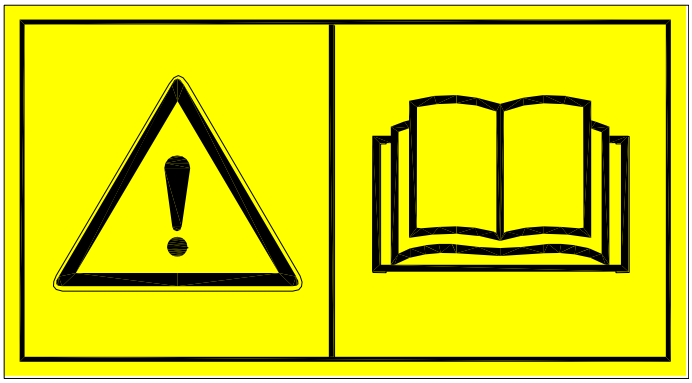
DO NOT OPERATE EQUIPMENT WITHOUT GUARDS SECURELY IN PLACE.



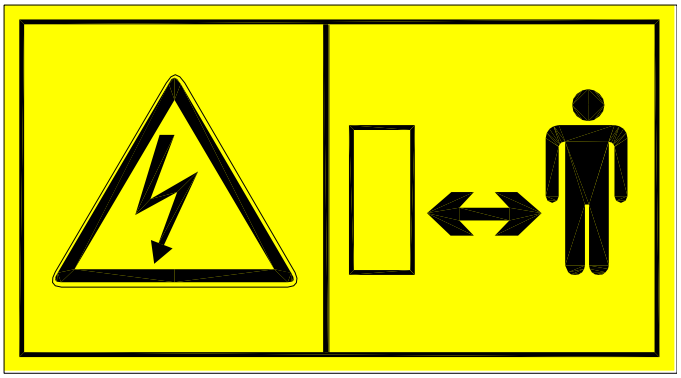
CRUSHING/PINCHING POINT. KEEP CLEAR FROM HAZARDOUS AREAS WHILE EQUIPMENT IS IN OPERATION. PARTS MAY MOVE WITHOUT NOTICE.



**DO NOT WALK OR CRAWL UNDER THE CONVEYOR WHILE IN OPERATION.
PERSONAL INJURY MAY RESULT.**



THIS OWNERS MANUAL MUST BE THOUROUGHLY READ BY MAINTENANCE AND OPERATIONAL PERSONNEL BEFORE ATTEMPTING ANY WORK WITH THE EQUIPMENT.



ELECTRICAL HAZARD

FOLOW LOACKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE ON THE SITE BEFORE ATTEMPTING ANY MAINTENANCE WORK

TYPICAL SHUTTLEWORTH CONVEYOR IDENTIFICATION PLATE

3.3 Typical Minimal Lockout Or Tagout System Procedures

Developing a lockout or tagout policy and procedure is the responsibility of the owner/employer. The following guideline is provided for reference in developing such a procedure. This procedure may be used when there are a limited number or types of machines or equipment or when there is a single power source. For more complex systems, a more comprehensive procedure will need to be developed, documented and implemented.

3.3.1 PURPOSE

A lockout / tagout procedure establishes the minimum requirements for the lockout & tagout of conveyor systems and devices. It is used to ensure that the machine or equipment is isolated from all potentially hazardous energy sources; that isolators, valves, switches etc. are locked & tagged before employees can perform any servicing or maintenance activities where the unexpected energizing, start-up or release of stored energy could cause injury or damage to machinery or personnel. Examples of events where possible injury and damage might occur should be included.

3.3.2 RESPONSIBILITY

Appropriate employees must be instructed in the safety significance of the lockout / tagout procedure. Each new or transferred employee and other employees whose work operations are or may be in the area should be instructed in the purpose and use of the lockout / tagout procedure. Departments and job titles of those who are responsible for implementing and following the procedure should be listed.

3.3.3 PREPARATION

Survey the equipment to locate and identify all isolating devices to be certain which switch (es), valve(s) or other energy isolating devices apply to the equipment to be locked or tagged out. More than one energy source (electrical, mechanical, pneumatic, gravity) may be involved. Types and locations of energy isolating means, such as motor isolators, valves and switches should be listed.

3.3.3 SEQUENCE OF LOCKOUT/TAGOUT

1. Notify all affected employees that a lockout/ tagout system is going to be utilized and the reasoning behind it. The authorized employee should know the type and magnitude of energy used by the machine and should understand the hazards involved.

2. If the machine or equipment is operating, stop it by the normal shut down procedure (depress stop button, open toggle switch, etc.).

3. Operate the switch, valve or other energy isolating devices to ensure that the equipment is isolated from its energy sources. Stored energy (such as is contained in springs, elevated machine members, rotating flywheels, hydraulic systems, air, gas, steam or water pressure) must be dissipated or restrained by methods such as repositioning, blocking, bleeding etc.

4. Lockout & tagout the energy isolating devices with assigned individual lock(s) & tag(s).

5. After ensuring that no personnel are exposed and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain that the equipment will not operate. Return operating controls to **"NEUTRAL"** or **"OFF"** after the test.

6. The equipment is now locked out & tagged out.

3.3.4 RESTARTING MACHINE

After maintenance or repair has been completed, the equipment has been re-assembled and tools have been removed, check the area surrounding the equipment to ensure that all guards and safety devices are in place.

Check to make sure that all personnel are clear of the equipment, then remove all locks & tags. Operate the energy isolating devices to restore energy to the equipment.

4.0 INSTALLATION

4.1 Reception

Shuttleworth conveyors are normally shipped by truck. The system is as fully assembled as shipping constraints allow. The conveyors are fixed wooden skids (up to 6 meters long). The conveyor frame is supported and braced where necessary and the units are covered in plastic sheeting. The skid will look similar to the picture below.

4.2 Inspection

Inspect the system prior to unloading. Carefully check the units for any visible signs of damage.

DO NOT SIT, STAND OR WALK ON THE CONVEYOR AT ANY TIME.

The conveyor roller surface can be easily damaged by excessive weight.

1. **Verify** the items received against the pro forma invoice/packing slip.
2. **Report** any damage or shortages to the shipping company and to Shuttleworth immediately.
3. **Look** for any special unloading or uncrating instructions, which may be attached to the crating. These instructions may indicate the order in which the crates are to be unloaded or if the skids are secured by additional methods.

4.3 Unloading

Avoid any undue flexing and/or dropping of the skid as damage to the equipment may result.

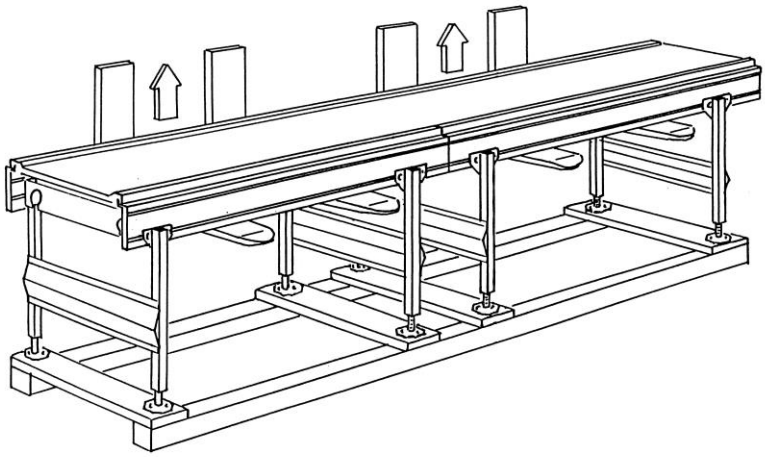
Approximate weight of any given conveyor including legs, motors etc.: 63 kg/m^2

To unload the system from the truck, attach a strap or chain to the centre of the skid and carefully pull the skid from the truck with a fork truck. Do not lift the end of the skid any more than is necessary. Once all the equipment has been unloaded, remove the protective plastic and re-inspect for damage and/or missing parts.

4.4 Uncrating

Carefully transport the skids to the installation site with a minimum of flexing. Remove additional supports under the conveyor or mechanisms, being careful to avoid dropping crating materials on the conveyor. The majority of handling damage occurs at this point. Remove all screws and fasteners attaching the conveyor to the skid. Smaller sections may be lifted from the skid by hand. Larger sections may require one or more fork lift trucks. Position the forks of the lift under both side rails of the frame. Place a board on each fork to contact and protect both side rails. Ensure that the forks are far apart as possible and will not damage other components when they are raised. Slowly raise the section to clear the skid. If two sections are joined, two forklifts will be required (see picture). Be careful to raise both lifts evenly.

DO NOT FLEX the joint unnecessarily. Slide the skid from under the conveyor and lower the conveyor to the floor gently. Carefully retract the forks from the section and proceed to the next skid.



4.5 Storage

DO NOT STORE CONVEYOR UNITS OUTDOOR. Condensed moisture can cause corrosion and sunlight can damage plastic components.

DO NOT STORE UNITS IN CONSTRUCTION AREAS UNLESS FULLY SEALED IN PLASTIC SHEETING. Fine airborne construction dust such as dry wall dust, concrete dust, and metal shavings may collect on and between rollers and other components causing squeaking and, possibly, excessive wear.

4.6 Installation

DO NOT SIT, STAND OR WALK ON THE CONVEYOR AT ANY TIME.

DO NOT PUSH OR DRAG the equipment once it has been removed from the skid. Always lift and place the section into position.

The conveyor sections are numbered with (red and white) direction of flow labels, which are located on the side rail. Refer to the system floor plan print to locate the sections in their proper position. The conveyor sections should be checked for squareness. The frame, if handled carelessly during shipping and installation, can be forced out of square. This will result in product moving towards one side of the conveyor surface as it travels. To verify that the frame is square, measure the frame diagonally form corner to corner. If both measurements are not within 3mm, the frame is out of square. If the frame cannot easily be pushed back into square, it may have been damaged during shipping. Please contact Shuttleworth.

Once the units are roughly located, level each conveyor section starting at one end of the system and progressing towards the other. To level the conveyor, place a spirit level on the roller surface and adjust the feet as described below. Check for level along the length and across the width of the conveyor.

Loosen the lock nut on the foot and turn it with a spanner to raise or lower the conveyor. Re-tighten the lock nut.

Reinstall the joint plates connecting the sections of conveyor together. The joint plates, joint keys, etc. are attached to one end of the conveyor section.

CHECK THAT THE ROLLER SURFACES OF ADJOINING CONVEYOR SECTIONS ARE LEVEL WITH EACH OTHER. This can best be done by placing a straight edge on the roller surface of the two conveyor sections. Re-install all components which may have been removed for shipping such as guide rails, side mounted drive motors, product turners etc.

INSTALLING CORNER SECTIONS

Often, systems must be partially disassembled for shipping purposes. Normally the sections need only be re-attached at the joints as described above. When a system is disassembled at a corner and a drive shaft is left protruding on the adjacent straight section, the corner must be reassembled as follows:

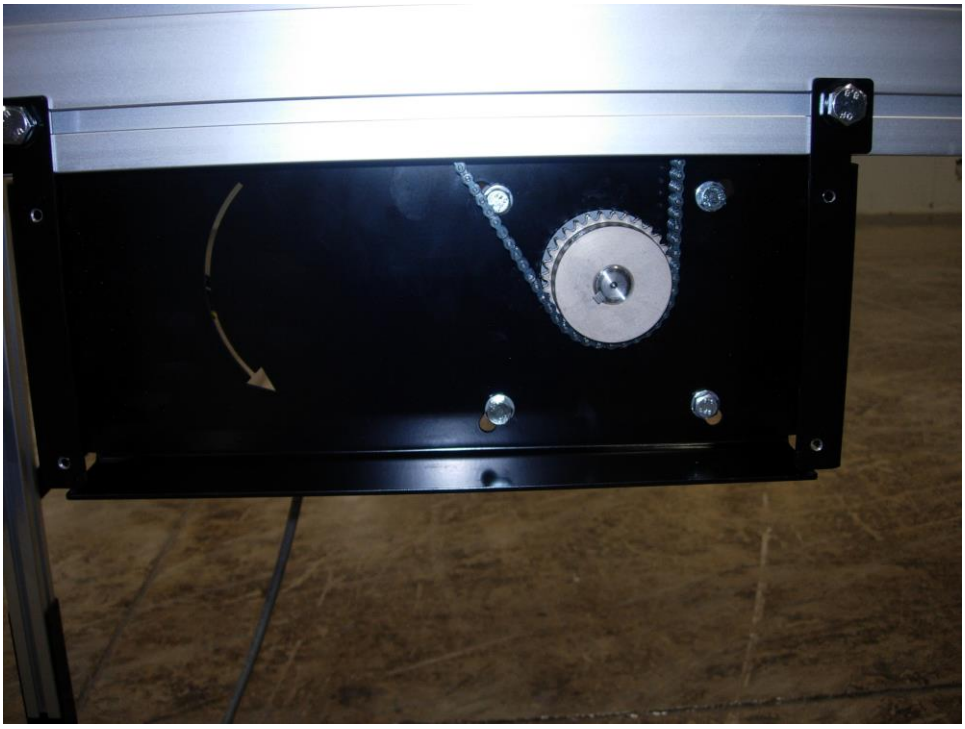
1. Remove all roller shafts from the half of the corner into which the drive shaft must be inserted. These shafts have been placed in position for shipping. Carefully slide the drive shaft half way into the corner. Replace the 1st bearing and hang the drive belts on the drive shaft.
2. Replace the sprocket/timing belt pulley and the 2nd bearing. Ensure that there are an adequate number of belts on each side of the sprocket / timing belt pulley. Slide the drive shaft completely into the corner and install the joint plates or keys. Position and tighten the bearings.
3. Re-connect the chain or timing belt to the 90^{O} gearbox (if used), then tighten and align the sprocket / timing belt pulley.
4. Install the roller shafts, ensuring that the belts are twisted identically to the belted roller shafts on the remainder of the section.
5. Check the chain / timing belt alignment on start-up if a 90^{O} gearbox is used.

4.7 Start-Up

DO NOT START THE CONVEYOR UNTIL ALL GUARDS AND COVERS ARE IN PLACE. REFER TO THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

Once the equipment is completely reassembled, levelled, checked for squareness and positioned, wiring and air connections can be made. Power up the system and check each motor individually. Ensure that all chains and timing belts are adjusted properly and all covers and guide rails do not contact any moving components. Check each drive for proper drive shaft rotation. After successful performance testing, the equipment should be anchored to the floor using standard anchor bolts through the conveyor feet. It is not necessary to move the conveyor to install the anchors.

ON CHAIN DRIVE CONVEYOR, CAREFULLY BUMP ON/OFF POWER TO DRIVE TO MAKE SURE MOTOR ROTATION IS CORRECT. RUNNING THE SYSTEM IN REVERSE MAY CAUSE SERIOUS DAMAGE TO THE CHAIN TENSIONSER.



5.0 FINE TUNING BELT DRIVE SLIP-TORQUE® CONVEYORS

A characteristic of Slip-Torque® is the ease with which many of its conveying characteristics can be fine-tuned. This can usually be done by the owner on his premises without special tools. Some of the possibilities are described in the following paragraphs.

NOTE: Any assistance needed in fine tuning your Slip-Torque® conveyor may be obtained by contacting Shuttleworth's Customer Service Department.

Fine tuning options:

ROLLER SURFACE

- Roller sizes
- Spring loaded rollers
- Press fit rollers
- Surface friction rollers
- Tubular rollers
- Electro-static discharge (ESD) control with rollers

CONVEYOR SURFACE SPEED

- Roller sizes
- Speed-up zones
- Overall conveyor speed

GUIDE RAILS

5.1 Roller Surface

5.1.1 ROLLERS SIZE

Slip-Torque® rollers are manufactured in three diameters: Coarse Pitch 32mm dia., Standard Pitch 21mm dia. and Fine Pitch 17mm dia.

Roller size - effect on line pressure

Line pressure is the amount of forward drive the conveyor imparts on the product being conveyed. It is expressed as a percentage of the weight of the product being conveyed. E.g. a 1000 g product placed on a standard pitch conveyor surface will press forward with a pressure of 60g (≈ 6% of its weight). The relationship of the respective diameters of the roller shaft to the roller determines the line pressure. Small rollers will have a higher line pressure than larger rollers of the same material.

Line pressures of standard pitch Slip Torque® rollers:

- Coarse Pitch - 3%
- Standard Pitch - 6%
- Fine Pitch - 12%

5.1.2 SPRING LOADED ROLLERS

Spring loading increases the drive of the roller surface. It is often useful when greater acceleration of the product is required. Existing roller shaft assemblies can easily be spring-loaded by adding springs, set collars and special cover rollers. Parts may be ordered from Shuttleworth and installed by the owner. Refer to the illustration for example part numbers.

The spring presses the rollers against set collars on each end, creating more friction between adjacent rollers and therefore more drive. Adjusting the spring tension will vary the amount of extra drive needed. The more spring tension, the more drive.

NOTE: *Use only enough tension to obtain the desired result. The rollers must be free to slip before the drive belt slips, otherwise premature wear of the belt occurs.*

Spring loaded roller shaft assembly

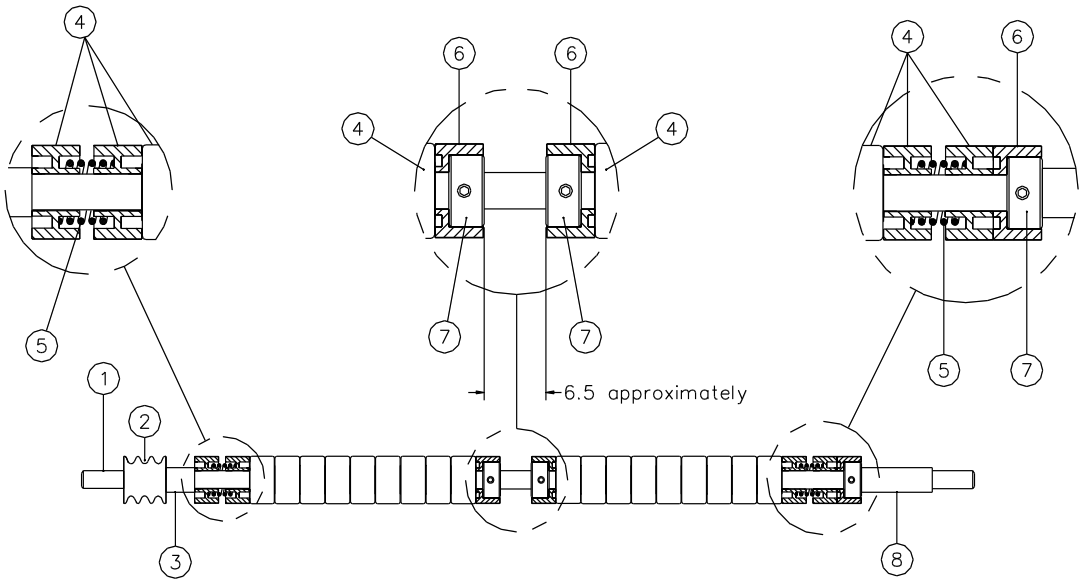
Typical Standard Pitch Assembly Parts List		
Item No.	**Part Number**	**Description**
1	015792-xxxx	Roller shaft, see parts list
2	016044-0036	Pulley
3	017896-0021	spacer, sleeve roller, L = 13 mm *(optional)*
4	018894-xxxx	Roller, cored, low friction, see parts list
5	016573-0000	Spring, stainless steel
6	017160-xxxx	Roller, set collar cover, white
7	021944-0001	Collar, set, stainless steel, ∅ 16 mm (ext.)
8	021997-0033	Sleeve, L = 33 mm

Typical Fine Pitch Assembly Parts List		
Item No.	**Part Number**	**Description**
1	015792-xxxx	Roller shaft, see parts list
2	017260-0036	Pulley
3	017896-0021	spacer, sleeve roller, L = 13 mm *(optional)*
4	017607-xxxx	Roller, solid, low friction, see parts list
5	017763-0000	Spring, stainless steel
6	017762-xxxx	Roller, spring cover, see parts list
7	021945-0000	Collar, set, stainless steel, ∅ 17 mm (ext.)
8	021997-0033	Sleeve, L = 33 mm

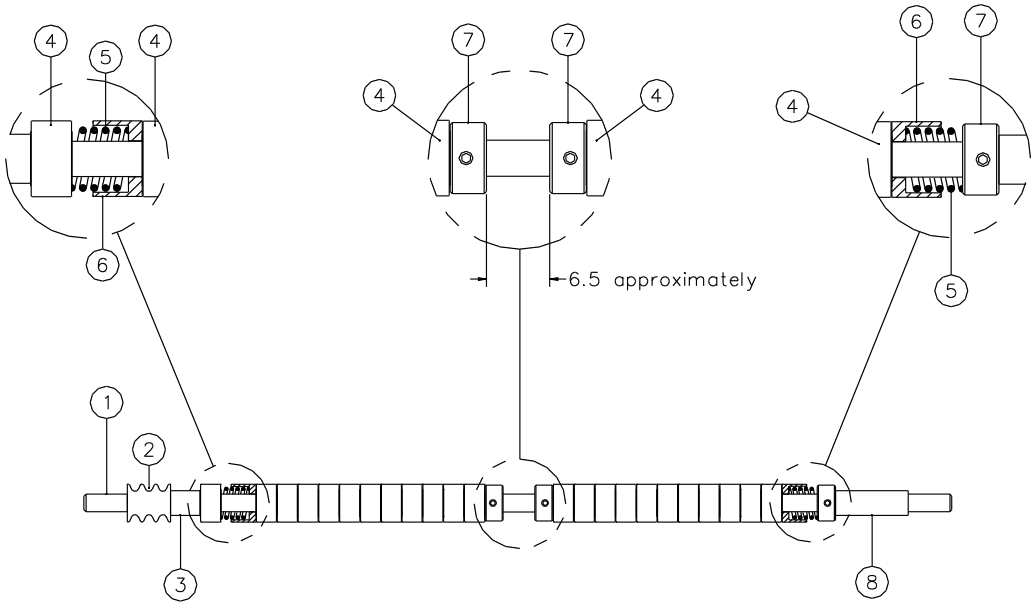
This parts listing is intended to provide a quick reference for finding common parts.

The following drawings represent a typical design and contain common standard parts. Variations of this assembly are common, and too numerous to include in this listing. Actual parts and numbers may vary from this listing.

Also, in many cases, the last four digits of the part number represent the size or material of the part or the conveyor width in which it is installed. These digits are represented with the letter "X".



Standard Pitch Assembly



Fine Pitch Assembly

5.1.3 PRESS FIT ROLLERS

Normally, the rollers used on Slip-Torque® are free to rotate or slip on the roller shaft. Various compounds of rubber and plastic materials are used in these rollers so that a variety of drive characteristics may be obtained.

Shuttleworth generally recommends the use of spring-loaded rollers when extra drive is needed since they still slip on the roller shaft.

If extra drive is required and accumulation of product is not needed in the immediate area of the extra drive requirement, press fit rollers may be used. These rollers are available in hard and soft materials and are used to increase the acceleration or drive in limited areas.

NOTE: *The drive belts should not slip on the pulley. If press fit rollers are used where the product accumulates or stops, the drive belts will stall and eventually fail.*

5.1.4 SURFACE FRICTION OF ROLLERS

Whether high or low line pressure is preferred it is sometimes beneficial to have a roller with high surface friction to make sure that it will not slip under the product. Shuttleworth offers a number of press fit and slip fit rollers for this purpose. All sizes are available in 90A durometer urethane or silicone rubber and some are available in conductive EPDM rubber.

Increasing surface friction is most often done at stops for singulation. The higher friction rollers are typically on the high speed shafts to accelerate the product more quickly. Sometimes the high friction rollers are also on several of the low speed shafts to retard the second product & allow a more consistent gap between products for the stop.

5.1.5 TUBULAR ROLLERS

There are a few instances when a solid tubular roller is superior to the segmented plastic roller. When the product is being pushed across the roller surface with guide rails or with a pusher mechanism, tubular plastic or steel rollers may be beneficial. They are often suggested if the product is very abrasive or if it has sharp edges which might catch on the segmented rollers. Their conveying characteristics are similar to the standard plastic roller but they are more durable.

5.1.6 ELECTRO STATIC DISCHARGE (ESD) CONTROL WITH ROLLERS

Non-conductive materials, which move or rotate, are capable of building up electrostatic charges. Under certain conditions, parts of the Slip-Torque conveyor may emit sparks due to accumulation of static electricity. This can be both an annoyance and a safety hazard. Shuttleworth electrically conductive plastic rollers eliminate this. In addition, electrically conductive bushings can be installed to ground the roller shafts to the conveyor frame. The combination of these provides a complete electrical path, which effectively dissipates static charges. For extremely static sensitive areas, other conductive parts are available.

QUESTION ABOUT ROLLERS?

Shuttleworth's Customer Service Department will be happy to advise you on the selection and quantity of rollers to achieve any desired result.

5.2 Conveyor Surface Speed

5.2.1 ROLLER SIZE - EFFECT ON SURFACE SPEED

For any given roller shaft pulley diameter, the speed of the roller surface will be proportional to the roller size, with coarse pitch rollers conveying the fastest.

If the pulley size is changed in proportion with the roller diameter, the conveyor speed will not change; e.g. a change from fine pitch rollers with fine pitch pulleys to standard pitch rollers with standard pitch pulleys will not affect the surface speed.

Increasing the roller diameter relative to the pulley diameter will increase the surface speed. Decreasing the roller diameter relative to the pulley diameter will reduce the surface speed.

5.2.2 SPEED UP ZONES

Speed up zones in Slip-Torque® can be an extremely useful tool. A speed up zone normally consists of a few roller shafts that can run up to twice the speed of the rest of the system. Speed up zones can be used to create gaps in rows of conveyed products. When the speed up zone has created a gap between products, a pin or blade stop can be automatically inserted to interrupt product flow for traffic control.

Methods of making speed up zones vary. Often, an extra drive shaft can be added on the opposite side of the conveyor to the main drive shaft. This speed up shaft rotates faster than the main drive shaft. Any number of shafts can be run at the faster speed by simply belting them to the speed up shaft instead of the main shaft.

Where space does not permit a second drive shaft, a speed up collar or sleeve may be mounted on the main drive shaft, increasing its diameter and therefore its effective speed. This speed up collar requires longer belts and special pulleys. Contact Shuttleworth's Customer Service Department for further details.

If a speed change is located at the drive motor, the drive shaft can be split into two shafts, located on a common side of the frame. With the use of a double output reducer, different sprockets/pulleys are used on each side allowing a speed change.

Product conveying surface can be reduced dynamically by changing the direction of rotation of selected shafts in the conveyor surface. This will result in a slowdown in speed with a smooth deceleration.

5.2.3 OVERALL SPEED

Overall conveyor speed can be increased or decreased by changing the size of the main drive sprocket / timing belt pulley or the ratio of the motor reducer speed. If you plan to increase the conveyor speed by more than 10%, contact Shuttleworth's Customer Service Department to make sure that the existing motor will carry the additional load.

5.3 Guide Rails

In mass accumulation, the spacing, contour and guide rail materials can have considerable influence over line pressure. Where the spacing between guide rails narrows, the flow of products will be retarded due to friction of product against the guide rails. Sometimes restrictions caused by guide rails are surprisingly high and some experimentation is required to remove the bottleneck. For example, round products, such as bottles or cans, have a preferred or natural orientation. Ultimately there is an ideal guide rail setting which results in minimum drag or loss of line pressure.

Often, guide rails diverting products in single filing applications need to be adjusted often for different product sizes. Quick adjust guide rail brackets are available for this purpose.

6.0 MAINTENANCE

The sub-sections are broken down to the replaceable component level. For part numbers, please refer to your Bill of Material. Paragraph E of this section is dedicated to the chain driven Slip Torque® conveyor maintenance. Chain and belt driven conveyors are closely related and much of the information concerning belt driven conveyors is also applicable to chain driven conveyors.

!!! WARNING!!!

DO NOT ATTEMPT TO DO ANY MAINTENANCE, CLEANING OR REPAIR WORK ON THE CONVEYOR AND ASSOCIATED DEVICES WHILE IN OPERATION. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

DO NOT WALK OR CRAWL UNDER THE CONVEYOR WHILE IN OPERATION. DAMAGE TO THE CONVEYOR OR PERSONAL INJURY MAY RESULT. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

DO NOT SIT, STAND OR WALK ON THE CONVEYOR AT ANY TIME.

6.1 Slip-Torque Components Maintenance

6.1.1 BUSHING HOLDERS

Bushing holders do not need to be replaced under normal conditions. However, they may need to be replaced periodically under extreme conditions of chemical attack or heat. Consider the use of stainless steel bushing holder if frequent replacement is required.

Procedure for bushing holder replacement:
Remove the roller shafts from the conveyor. **Be careful not to over-stretch the drive belts** if they are to be re-used. Pry the bushing holder from the frame with a screwdriver. Once removed, bushing holders should not be re-used. Note that the bushing holder has an "inside" and an "outside". Hold it in place with the alignment tab engaged in the slot on the frame flange. Carefully working from the center, hammer the new bushing holder onto the frame flange making sure that the alignment tab stays engaged in the slot. Ensure it is evenly seated from end to end.

Install the bushings, making sure they are evenly seated. Install all **new** bushings with the injection molding mark on the bottom so that as they wear, you will always know which side was used first. At some stage in the future, the bushings may be inverted to increase their life. Reinstall the roller shafts and attach the drive belts into their original grooves on the pulleys. Using the wrong grooves may cause the belts to wear prematurely or jump from the pulley onto the roller shaft.

6.1.2 DRIVE BELTS REPLACEMENT

Drive belts are kept in stock at Shuttleworth at all times. Since drive belts deteriorate (though very slowly) over time, we suggest that you do not stock large quantities and that you rotate your stock.

Replacing a very small quantity of drive belts:
Start at the end of the conveyor away from the drive. Loosen the drive shaft bearing setscrews and tap it inward so that the bearing mount is free.

Using the required number of drive belts, hook them over the drive shaft as shown on page 4 of this section. A total of 4 extra belts per bearing mount may be added as spares. Work the belts, a few at a time, down the shaft and over the loose bearing. Re-install the bearing by pulling down on the shaft and tapping it into the bearing mount. Re-tighten the bearing set screws.

Work the belts down the shaft as shown. It is not necessary to disconnect the existing belts. Loosen the next bearing and tap it out of the bearing mount as before. Work the needed spare belts over this bearing and reinstall the bearing.

NOTE: Do not over stretch belts when installing on roller shafts. Overstretch reduces belt life. When working on conveyors having two drive pulleys per roller shaft, the belts on one side can be installed with almost no overstretch. Use a belt hook to stretch the belts on the other side over the end of the roller shaft and pulley, keeping this stretch to an absolute minimum.

DO NOT LEAVE LOOSE BELTS HANGING ON THE DRIVE SHAFT. DAMAGE TO THE CONVEYOR OR PERSONAL INJURY MAY RESULT. USE SPARE BELT RETAINERS TO HOLD ADDITIONAL BELTS.

Replacing all drive belts:
An inspection of the conveyor unit should be made if all drive belts are to be replaced. Worn drive chains, timing belts, sprockets and bearings should be replaced at the same time.

Cut the old belts off and throw them away. Do not re-use spare belts. Carefully remove the roller shafts from the conveyor frame, making sure not to lose any rollers or bushings. If the conveyor has bearing retainer plates (triangular plates fastening the bearings to the bearing mount), remove them.

Loosen the drive shaft bearing setscrews and move the bearings enough to allow the drive shaft to be removed. Not all bearings will need to be loosened.

Make sure the new drive belts and drive shaft are free from oil. Clean if necessary. Replace the drive shaft sprocket or timing belt pulley at this time if necessary. Hang the new drive belts on the drive shaft, remembering to add at least 4 spares for each drive mount. Remember to hang belts on each side of the drive shaft sprocket or timing belt pulley.

Reinstall the drive shaft, checking the clearance on each end of the shaft. Re-tighten all bearings set screws. Replace the bearing retainer plates if applicable.

Relocate the roller shafts on the conveyor frame and attach the drive belts to the original grooves in the pulleys. Be sure to twist the belts in the proper direction. If the belts are twisted the wrong way, the conveyor surface will run backwards. Also, using the wrong grooves may cause the belts to wear prematurely or jump from the pulley onto the roller shaft.

NOTE: Do not over stretch belts when installing on roller shafts. Over stretch reduces belt life. When working on conveyors having two drive pulleys per roller shaft, the belts on one side can be installed with almost no over-stretch. Use a belt hook to stretch the belts on the other side over the end of the roller shaft and pulley, keeping this stretch to an absolute minimum.

If you are installing new bearings:
Drive shaft bearings should not all face the same direction. Check to make sure that the bearings are re-installed facing the same direction as the originals. In general, half of the bearings should face one direction and the other half should face the opposite direction.

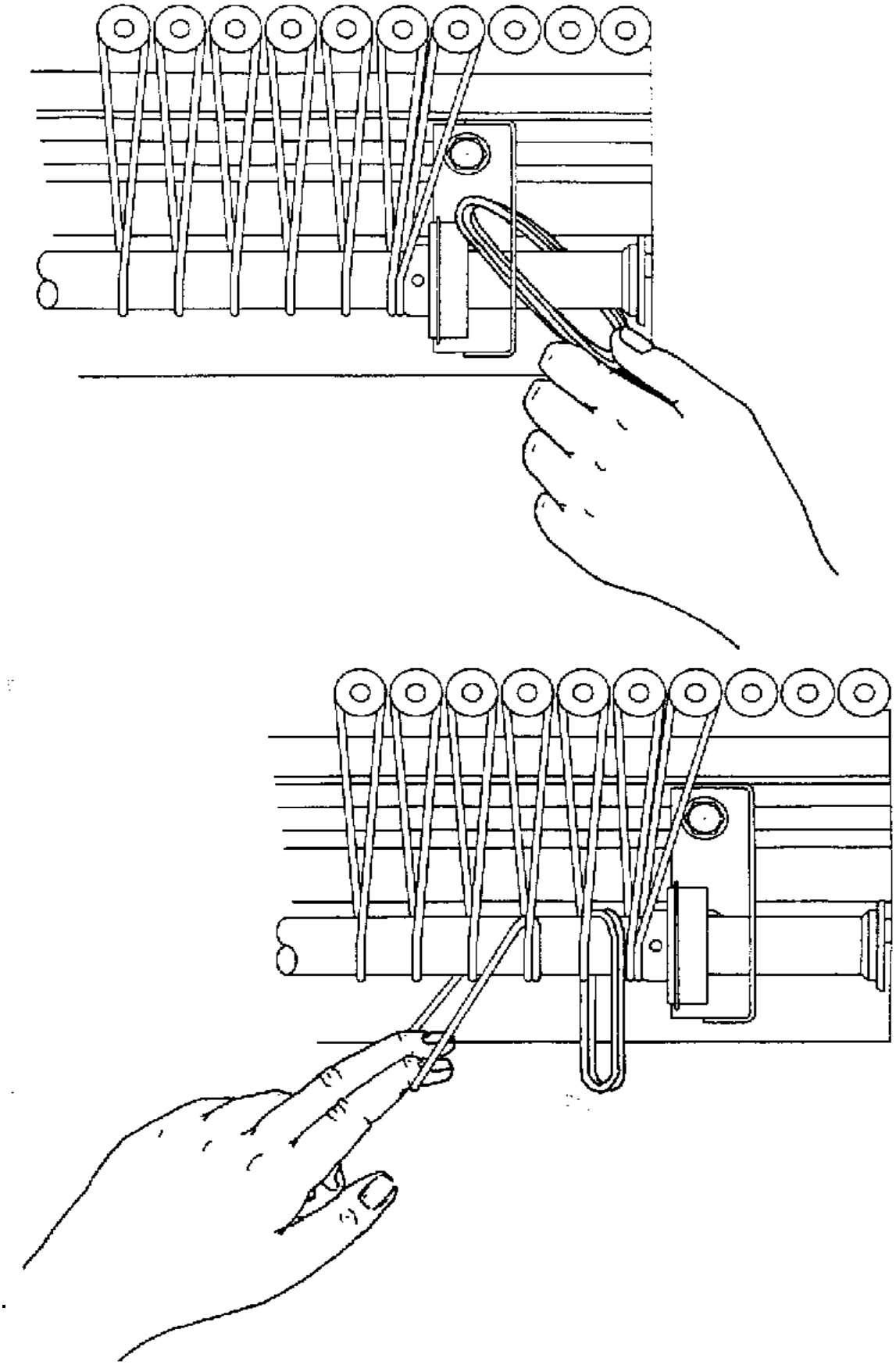
After the conveyor has run for a few hours, check for slow or stalled roller shafts. These could result from excess grease leaking out of the bearings. Following the proper safety precautions, wipe the excess grease from the belts and drive shaft. See "Care and Cleaning of Drive Belts" in this section for further information.

6.1.3 DRIVE SHAFT BEARINGS REPLACEMENT

See the procedure above for replacing all drive belts. Due to the labor involved in replacing drive shaft bearings, Shuttleworth recommends that belts **always** be replaced at the same time. The same procedure as above applies, just install new bearings in place of old ones.

6.1.4 CARE AND CLEANING OF DRIVE BELTS

The urethane drive belts used to power the rollers on Slip Torque® conveyor are immune to most industrial situations. Under normal circumstances, they do not require any treatment of any kind. In the case of an accidental spill of lubricating oil or similar materials, the driving traction of the belts may be completely lost. In this case the belt can readily be cleaned in several ways.



Perhaps the most satisfactory method is to spray the belt with "K2R" made by Texize Chemical Co., div. of Dow Consumer Products, Inc. This is a spot-removing compound, packed in both spray cans and tubes. The spray can is most convenient. Clean the belt by lightly spraying the belts and drive shaft from underneath with the conveyor turned off. Do not spray the pulleys or bushings. Always work from underneath the conveyor. Another method is to wipe the belts and drive shaft with a clean cloth and an acceptable solvent (see below).

Always turn the conveyor off before wiping shafts and belts. If slippage persists after re-starting the conveyor, stop the conveyor and wipe again, using a clean cloth. To clean inaccessible belts, spray the belts with "K2R" or wipe with recommended solvents as described below. Follow the manufacturer's recommendations for skin and eye protection, flammability, etc. Replace all guards before restarting the conveyor.

Generally speaking, even weak acids will attack and harden urethane. Acid vapor (enough to smell) can harm the belts in time. Bases (especially strong ones) can also have a negative effect on the material. Solvents (particularly chlorinated solvents) will often swell and discolor urethane, especially when in constant contact. Higher temperatures will increase the rate of attack.

A quick test for attack can be done by tying a belt into several tight knots and immersing it in the material in question. Attack is indicated by general swelling or discoloration or cracks in the knotted areas. Materials exhibiting the above should not be used near the belts. Longer-term tests will often be required to approve a materiel for contact with the urethane belts.

NOTE: Many Slip Torque® components are plastic materials. Most of these plastic components are located on or support the conveying surface. **THESE PLASTIC PARTS REQUIRE NO LUBRICATION** and in doing so will cause plastic parts to function improperly.

Solvents which will not damage the belts:

Naptha	*Methanol*	*Freon*
Amyl Alcohol	*Isopropanol*	*Turpentine*

*Generally speaking, soap detergents will not affect the drive belts.

Chemicals which will not damage the belts:
The following is a list of chemicals and solvents, which are known to attack the belt material. For chemicals not listed here, contact Shuttleworth's Engineering Department.

Dimethyl Moramide	*Vinyl Pyrrolidine*
Pyridine	*Normal Methylpyrrolidine*
Meresol	*Tetrahydrofuran*
Methylene Chloride	*Dimenthysulphoxide*
Trichloroethylene	*Dimethylformamide*
Dimethylacetamide	*Xylene*
Methyl Ethyl Ketone	*Ethylene Dichloride*

6.2 Cleaning of Slip-Torque Conveyors

NOTE: KEEP CONVEYOR CLEAN AT ALL TIME TO ENSURE A HIGH LEVEL OF PERFORMANCE.

6.2.1 STAINLESS STEEL SLIP TORQUE® CONVEYORS (WASH DOWN IS REQUIRED)

GREASE ALL REGREASABLE BEARINGS PRIOR TO EVERY WASHDOWN TO KEEP THEM WATERPROOF.

In many sanitary applications, cleaning Slip Torque® is necessary on a regular basis. Aside from sanitary and housekeeping benefits, cleaning will prevent a collection of food and other residues which will result in stalled shafts, worn belts and unwanted accumulation pressures.

Equipment:
High-pressure hoses and nozzles are commonly used for wash-down cleaning. These may use hot or cold water, detergent mixtures or caustics (usually below 2%). Nozzles deliver the solution at high velocity and relatively low volume. A high-pressure wash is recommended for thorough cleaning. In addition, some facilities use low pressure, high volume hoses (2 Bar) using plain water, either hot or cold to rinse the conveyor.

Each shift:
Inspect for and remove all debris such as glass, caps, labels, glue or other foreign objects. Free any stalled shafts, which may have resulted.

Daily:
Flushing or rinsing may be administered as often as required without damage to the conveyor. In some instances, this may be done more often than once per day. Plain hot or cold water will suffice.

Bushing covers should be left in place to protect the drive shaft bearings from as much direct impact as possible and the conveyor should be left running.

The objective is to remove all broken glass, labels, caps and spilled liquids. It affords an opportunity to inspect and report mechanical problems. Shut off the conveyor after washing. This allows some run time to clean water off drive belts and bushings.

Immediately following shutdown (8 hours or more):
The danger at these times is that spilled liquids will dry, causing the rollers to adhere to the shaft or to each other. Once stuck, subsequent cleaning becomes more difficult. As the conveyor becomes dirty, the potential for stalled shafts and other types of failure increases.

The ideal procedure for preventing adverse maintenance conditions is a high-pressure wash with detergent solution, followed by a plain hot or cold water rinse.

The operator should inspect for and remove (or report) all debris such as glass, caps etc. Any mechanical problems should be reported to maintenance. Bushing covers should be left in place and the conveyor running. Stop the conveyor following wash-down.

General:
Routine washing is most often done from a position above the conveyor.
For good sanitation, a periodic high-pressure wash from beneath is desirable. This is good practice and will not harm the conveyor. In the interest of extended component life and safety, the operator should be advised to avoid direct velocity impact on electric motors and connections, gearboxes, chains, drive shaft bearings and seals and roller shaft bushings. During washing with hot water the belts will become noticeable limp, but they will regain their normal tension within half an hour.

NOTE: If other cleaning procedures are used in your plant, which you would prefer to use on Slip Torque® please consult Shuttleworth's Customer Service Department for their recommendations and approval to avoid potential difficulties.

6.2.2 SLIP-TORQUE® CONVEYORS (WASHDOWN IS NOT POSSIBLE)

In many relatively clean applications, it is still necessary to clean Slip Torque® cleaning will prevent the collection of debris, which will result in stalled shafts, worn belts and unwanted accumulation pressures.

The following instructions are recommended for most relatively clean manufacturing environments. The cleaning equipment usually consists of the following:

- High Suction vacuum for removing dust and debris on the roller surface and under the covers.
- Conveyor surface; wipe down with a clean cloth and water or an acceptable solvent.

Materials:
Cleaning materials will vary, depending on the type of contamination being removed from the conveyor. The component most likely to be attacked by a solvent is the drive belt. For a list of acceptable solvents, refer to page 5 in this section.

Frequency:
Cleaning may be done as often as desired without damage to the conveyor.

Inspection:
The system should be inspected each shift. Mechanical problems should be reported and fixed. As the conveyor becomes dirty, the potential for stalled shafts and other types of failure increases. It is important that the stalled shafts be set in motion and that rollers which have adhered to each other, be loosened.

If other cleaning procedures or agents are used in your plant, which you would like to use on Slip Torque® please consult the Shuttleworth Customer Service Department for their recommendation and approval to avoid potential difficulties

6.2.3 CLEANROOM SLIP TORQUE® CONVEYORS

All wiping and vacuuming procedures should be done starting at the top of the system and working down.

At installation

Remove the conveyor from the skid per the instructions displayed in section 5-paragraph D. Before proceeding to the next step, remove the skid, cardboard and other shipping materials from the area. The conveyor should be located near the cleanroom entrance.

Vacuum the conveyor to remove large particles using a cleanroom vacuum if possible. If a cleanroom vacuum is not available, use a conventional vacuum and attach a 5m hose to keep discharged air away from the system.

Move the conveyor into a staging area if possible. Vacuum the entire conveyor with a cleanroom vacuum. Wipe all surfaces with a cleanroom detergent mixed per the manufacturer's instructions, or a 50 - 50 mix of isopropyl alcohol and de-ionized water. Be sure to use cleanroom wipes. Swabs are sometimes helpful.

Rinse with pure de-ionized water and clean wipes.

Inspection can be aided with a black light, which helps illuminate wiper residue and other particles which might otherwise be missed.

Routine cleaning:

Periodical wipe down of the system is recommended for cleanroom systems. The frequency will depend on the conveyor speed, product weight and material and the desired cleanroom level. Unless oily deposits are found, a mixture of 10% isopropyl alcohol and 90% de-ionized water is sufficient. The guides, mechanisms and roller surface should be wiped, starting at the top of the system and working down. Wipers should be changed frequently. Be sure to manually turn the rollers while wiping to clean all sides.

6.3 Conveyor Drive Components Maintenance

A variety of motors, gearboxes, chains, and timing belts are used on Slip Torque® conveyors.

6.3.1 GEARMOTORS

Preventive maintenance:

Shuttleworth uses a number of different gear motor sizes and styles. Refer to the manufacturer documentation for specific maintenance and trouble shooting.

!!! WARNING!!!

CONTACT SHUTTLEWORTH ENGINEERING DEPARTMENT IF A CHANGE IN OPERATING PARAMETERS IS REQUIRED AS THE CONVEYOR PERFORMANCES MAY BE ALTERED.

Repair:

DO NOT ATTEMPT TO DO ANY MAINTENANCE, CLEANING OR REPAIR WORK ON THE CONVEYOR AND ASSOCIATED DEVICES WHILE IN OPERATION. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

Please report gear motors problems to Shuttleworth. The gear motor may be under the manufacturer's warranty. The serial number will be required.

Out-of-warranty gear motor repair can best be handled through your nearest authorized relevant distributor.

Oil leakage:
Check housing bolts and tighten if necessary. Replace oil seals if required.

Oil temperature:
Check reducer temperature for undue rise above levels normally encountered and not accountable for by rise in ambient. Low oil level and abnormal loading are possible sources.

Replacement:
When re-installing the motor, Shuttleworth recommends coating the motor shaft with an Anti-Seize compound to aid in motor removal in the future.

6.3.2 ROLLER CHAIN DRIVES

Adjustment:
As roller chains wear, they get longer. This is normal. Periodically, the chain will need to be tightened. Chain take-up means vary, depending on the application. Here are some recommended procedures and hints for chain take-up:

1. If a drive has more than one chain, replace all of the chains at the same time.
2. Always leave one of the side guards on the drive enclosure while adjusting chains. This helps keep the drive frame square.
3. Do not over-tighten the chains. Leave a little slack in the chain.
4. While the chains are off, inspect all of the sprockets for wear. Wear on one side of the sprocket teeth indicates an alignment problem.
5. Check alignment visually, and by laying a straight edge on the flat side of the drive shaft sprocket. Make sure that the reducer output shafts are parallel to the drive shaft.

Chain
Shuttleworth uses 1/2" pitch steel roller chain as standard. This chain is lightly lubricated by the manufacturer, and will require periodic lubrication. Shuttleworth recommends a 30-weight, non-detergent oil, applied with a brush. Brown dust, excessive vibration, and sprocket wear are signs of inadequate lubrication.

Sprockets
Shuttleworth uses only hardened-tooth sprockets. Soft sprockets will wear too quickly. Shuttleworth's standard drive shaft sprockets use a tapered-bore mount. These sprockets are available only through Shuttleworth. Refer to the parts listing in section 8 for part numbers. Although conventional tools can be used, removal of the tapered-bore sprockets can be more easily accomplished with a spanner wrench (P/N 021424-0000) to hold the sprocket, and a Crow's foot wrench (P/N 001775-0000) to turn the nut on the tapered sprocket mount. The crow's foot wrench attaches to a conventional 1/2" ratchet.

6.3.3 TIMING BELT DRIVES

Timing belt drives are used for a number of reasons. They offer excellent life with little maintenance if they are properly aligned and tensioned.

Adjustment:
Tension of Shuttleworth's standard 8mm pitch HTD belt can be checked using the following procedure:

1. Measure the distance of the belt span between pulleys.
2. Apply a force of 10-20 N in the center of the belt span.
3. Belt deflection should be 16 mm per meter of span

Alignment can be checked by laying a straight edge across the flange of the drive shaft sprocket. The straight edge should line up correctly with the other sprocket(s).

Maintenance:
Timing belts require no maintenance. A small amount of dust from belt-face wear is expected as the belt "wears in".

6.4 Pneumatic Components

!!! WARNING!!!

CONTACT SHUTTLEWORTH ENGINEERING DEPARTMENT IF A CHANGE IN OPERATING PARAMETERS IS REQUIRED AS THE CONVEYOR PERFORMANCES MAY BE ALTERED.

Shuttleworth supplies pneumatic equipment in many sizes and for various purposes. Almost all pneumatic devices use a linear thruster that include a mounting plate, guide rods, and bushings with an air cylinder for power and use exhaust flow controls to adjust speed. Any of several models may be used, depending on the system. Check your Bill of Material for specific reference or part number/description of the component used on your system. Refer also to the manufacturer's documentation.

6.4.1 ROLLER CHAIN DRIVES

Preventive maintenance:
All air cylinders are supplied pre-lubricated and do not require additional lubrication. Models with ball bushings for the rod bearings may require periodic lubrication. A few drops of oil every 1 000 000 cycles is usually sufficient. Thrusters in dirty environments or with long strokes may require more frequent lubrication. All ball bushing models have two lubrication points on one face of the thruster. To lubricate the ball bushing, use a pointed dispenser or a syringe to depress the spring-loaded ball that protects the two lubrication holes. Place a few drops of 10 weight oil in each bearing cavity.

Cleanroom systems typically require little repeat lubrication. When needed in a critical area, use a minimal amount of a low out-gassing oil.

Repair:

DO NOT ATTEMPT TO DO ANY MAINTENANCE, CLEANING OR REPAIR WORK ON THE CONVEYOR AND ASSOCIATED DEVICES WHILE IN OPERATION. TURN THE CONVEYOR OFF BY OBSERVING THE LOCKOUT AND TAGOUT PROCEDURES CURRENTLY IN FORCE AT THE SITE.

With routine maintenance, thrusters will normally last the lifetime of the system. If repair is needed, the following instructions apply.

Thrusters with replaceable cylinders:
These cylinders are “throw away” cylinders and can be obtained from Shuttleworth. Those nose-mount cylinders are attached to the thruster body with a spring steel plate. When installing the new cylinder, DO NOT tighten the mounting nut. There should be approximately 0.25mm clearance between the nut and the spring steel mounting plate. This allows the cylinder to “float” in the mount. Tightening the nut may cause damage to the cylinder.

Thrusters with integral cylinders:
These cylinders can be re-built. The normal wear parts of the cylinder are available through Shuttleworth’s parts department.

Rods and bearings:
Rods and rod bearing failure is normally not practical to repair. The unit should be replaced.

7.0 FIELD MAINTENANCE SUPPORT

Our parts and service team have been specifically trained to listen, acknowledge and solve customer concerns. That's why when we say, "We'll take care of it," you can depend on Shuttleworth, Inc. With more than 40 years of experience, we have the know-how to supply your conveyor system needs, including the modification and reconfiguring of equipment. We've installed and serviced more than 15,000 systems worldwide and when you're looking for replacement parts or retrofitting an entire system, our parts and service department is ready to take your order. All you have to do is contact us for complete customer service satisfaction.

7.1 Maintenance Offerings

Conveyor Rebuilds
Shuttleworth provides the following:

- One person to train maintenance employees and to oversee the project is completed to appropriate specifications.
- Adequate Service Technicians to correctly complete rework. *Benefits are:* 1) ability to rebuild more conveyors in a shorter period of time, and 2) maximize the amount of work done in a small downtime window.

Conveyor Rework (Reconfiguration)
Shuttleworth provides the following:

- Assist the customer with new efficient line layouts. *Benefits are:* 1) Using existing equipment saves money and time, and 2) The system will perform as new.

Service Contracts
Shuttleworth provides the following:

- Ability to provide visits quarterly, every six months, or one a year. *Benefits are:* 1) reduction in downtime, and 2) allows the Customer's maintenance personnel to focus on other equipment.
- Offer a 15% discount on additional parts needed not included in the contract.

Timing Belt Upgrades
Shuttleworth provides the following:

- Ability to retrofit timing belts to replace drive chains. *Benefits are:* 1) timing belts need little maintenance, 2) provide quieter operation, 3) and have a cleaner appearance.

Component Upgrades
Shuttleworth offers:

- Highly specialized plastics that can vastly improve performance and maintenance such as drive belts, bushings, T-bar materials, ultra slick rollers, etc.

- Contact Klaus Daenzer, Senior Plastics R&D Engineer, for specific plastic issues at 260-359-7885.

Star Roller™ Conversions
Shuttleworth provides the following:

- Star Roller retrofit on most systems. Benefits are: 1) rollers virtually eliminate shingling when conveying loose stacks of paper, and 2) testing with different products specific to your needs can provide proven results.

Chain Driven Conversions
Shuttleworth provides the following:

- Ability to fit with chain drive components with a bolt on conversion kit for SS frames and Aluminum frames. *Benefits are:* 1) bolt on kit is less expensive and quick to install, and 2) kit uses the Low Profile™ side rail providing enclosure to keep the chain away from foreign materials and debris.

  Note: This kit cannot be used in all applications. It adds width to the overall width of the conveyor. Other conversions can still be done as needed.

Swinger® Pattern Former Upgrades
Shuttleworth offers the following:

- Upgraded panel with current components. *Benefits are:* 1) customers receive parts in a timely manner should a failure occur, and 2) virtually new equipment when performed with a mechanical rebuilds which is less costly than new.

Roller Shaft Bearings
Shuttleworth offers the following:

- Shielded (not sealed) ball bearings, and
- Needle bearings (this is a direct replacement using standard bushing holders). *Benefit is:* Shuttleworth's Service Department will run various tests to determine which bearing is right for your system.

Used and Rebuilt Slip-Torque®
Shuttleworth offers the following:

- Shuttleworth often acquires used equipment that can be reconfigured and rebuild to your exact needs. This offers you a used system with a new warranty at reduced costs. Availability various.

Contact our Customer Service Department for more details at 1-260-359-7820.

7.2 Routine Maintenance Schedule

Maintenance Schedule (Aluminum Frame)																												
	TIME REQ'D	AS NEEDED	ONCE A WK	3 MONTHS	6 MONTHS	9 MONTHS	1 YEAR	15 MONTHS	18 MONTHS	21 MONTHS	2 YEARS	27 MONTHS	30 MONTHS	33 MONTHS	3 YEARS	39 MONTHS	42 MONTHS	45 MONTHS	4 YEARS	51 MONTHS	54 MONTHS	57 MONTHS	5 YEARS	63 MONTHS	66 MONTHS	69 MONTHS	6 YEARS
VISUAL INSPECTION (ALL)	15m		X																								
INSPECT/ADJUST LUBE STRIP (EACH)	5m			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
INSPECT BUSHINGS, SPRKTS AND T-BAR (ALL)	1hr				X		X		X		X		X		X		X		X		X		X		X		X
INSPECT CHAIN, IDLERS & WEAR STRIP (ALL)	1hr						X				X				X				X				X				X
INSPECT/ADJUST TIMING BELT TENSION (ALL)	1hr						X				X				X				X				X				X
REPLACE MISSING OR DAMAGED PARTS	N/A	X																									X
REPLACE ROLLER SHAFT BUSHING (EACH)	2m	X																									X
REPLACE LUBE STRIP (EACH)	10m	X					X				X				X				X				X				X
REPLACE CHAIN AND WEAR STRIP (EACH)	1hr														X												X
REPLACE ROLLER SHAFT SPROCKETS (EACH)	2m	X																									X
REPLACE IDLERS (EACH)	10m																										X
REPLACE T-BAR (EACH)	5m	X													X												X

8.0 SPARE PARTS

Project: XXXXXX RECOMMENDED SPARE PARTS						XX/XX/XXXX
Item Number	Description	QTY	UNIT	UNIT PRICE	TOTAL	"DAYS"
Red: Special Order - Critical Items - Potential Long Lead						
Yellow: Consumables						
Blue: Electrical Function						
	JUMP BELTS					
	DRIVE BELTS					
	ROLLER SHAFT BUSHINGS					
	DRIVE SHAFT BEARING					
	TEE BAR					
	THRUSTERS					
	OTHER MECHANICAL ITEMS					
	GEARMOTOR					
	VFD					
	SOLINOID VALVES					
	FUSING					
	CONTROL ITEMS					
	OTHER ELECTRICAL ITEMS					

COLOR KEY
Red: Special Order - Critical Items - Potential Long Lead
Yellow: Consumables
Blue: Electrical Function

9.0 BILL OF MATERIAL

Shuttleworth Inc. has thousands of standard parts that go into machinery for many different industries. In addition to standard parts, many parts are designed as required for each individual system. Because it is impractical to make a generic part listing for our customers, we provide you with the Bill of Material that was used for manufacturing your equipment.

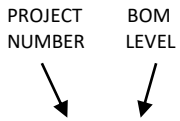
The Customized Bill of Material:
The Customized Bill of Material is a complete listing of the parts that make up your Shuttleworth equipment. The only parts that are excluded are standard hardware... nuts and bolts. Your **Customized Bill of Material** report follows this section of the Owner's Manual. It is included to help you identify part numbers for components on your system. Along with this Bill of Material, you can refer to your system layout drawing that will indicate conveyor unit numbers and major assembly numbers.

Should you need assistance in identifying parts or have questions contact Shuttleworth's Customer Service department at 1-260-359-7820.

9.1 Reading Your Customized Bill of Material

Following is a brief description of the Bill of Material structure. The first page is the System's master list. This list contains:

1. The Bill of Material number also referred to as the project number. This six-digit number is underlined and is located in the upper left corner, to the right of Project. This number is assigned to the entire system. This number is generally the same as the quotation number.



2. A listing of all of the major assemblies, or BOM levels (123456-8xxx).
3. The company name and customer number to which the equipment was sold.

Our standard groupings usually follow in this order.

1. Frames (basic conveyor sections) (starts at -8001) One BOM level per frame.
2. Pulley and bushing covers. One BOM level per system is typical.
3. Drive units. One BOM level per unique drive configuration is typical. One drive can power multiple frames.
4. Leg supports. One BOM level per frame width and/or leg type.
5. Devices. One BOM level per unique device.
6. Guiderails. One BOM level per system is typical.
7. Pneumatics. One BOM level per system is typical (air preparation & plumbing).
8. Other parts and mechanisms.
9. Control hardware (123456-5xxx) One BOM level each for cabinets, and system components.

Each BOM page following the system page:

1. The Project number, company name and customer number ti which the equipment was sold
2. The BOM level as noted above (123456-8xxx or -5xxx)
3. A structured listing of individual part numbers, descriptions and quantities. Manufacturer's part numbers are shown when possible and practical.