REXNORD | CAMBRIDGE ENGINEERED SOLUTIONS

ENGINEERING MANUAL

KLEANTOP® ACTIVE DRIVE™ SPIRAL SYSTEM

RegalRexnord™

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⚠ WARNING

WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

- Read and follow all instructions carefully.
- Disconnect and lock-out power before installation and maintenance.
  Working on or near energized equipment can result in severe injury or death.
- Avoid contact with energized circuits or rotating parts.
- Be sure shaft key is fully captive before unit is energized.
- Do not operate equipment without guards in place. Exposed equipment can result in severe injury or death.

⚠ CAUTION

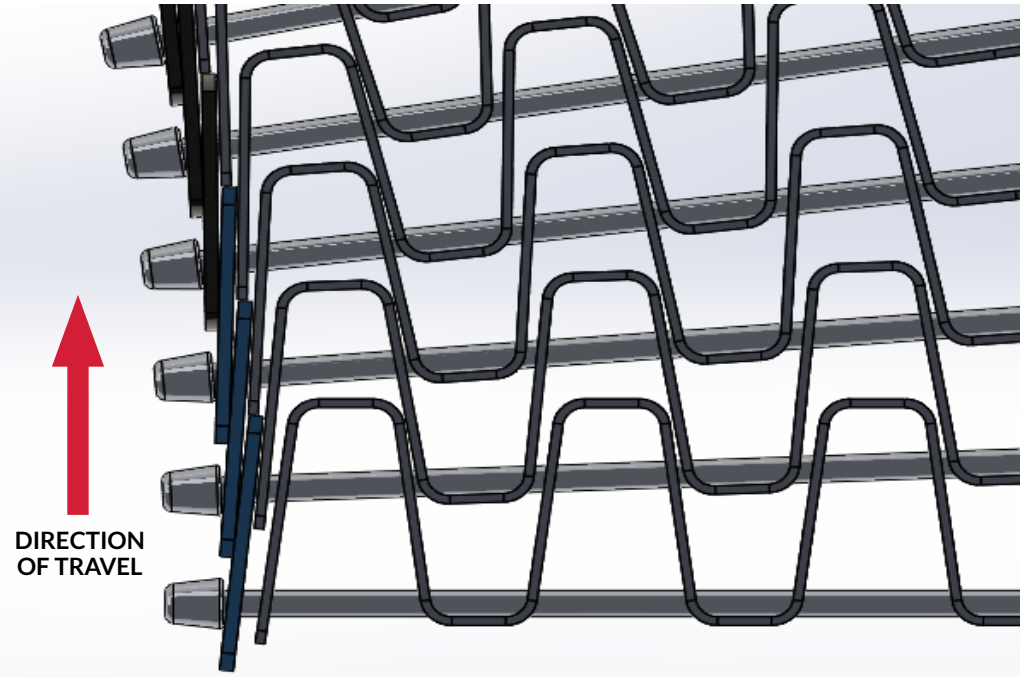
CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

- Periodic inspections should be performed. Failure to perform proper maintenance can result in premature product failure and personal injury.
- All electrical work should be performed by qualified personnel and compliant with local and national electrical codes.

1. General Description of Belt and Intended Applications

1.1 Rexnord® KleanTop® Active Drive™ Spiral System encompasses three (3) types of standard spiral belt offerings: Cam-Grid, Cambri-Link and DuraLite. Each of these belts has been a a standard product offering from Rexnord's KleanTop portfolio for many years. As such, each has been effectively proven in low-tension spiral cage applications. The new Active Drive Belts are fully based on these 3 belts, leveraging their innovative design developed for superior performance.

1.2 Essentially, the main difference between the Active Drive versions of these belts and the former construction lies in the forming of the ends of the rods on the inside edges. In each case, instead of the standard welded buttonhead construction, Active Drive includes a small cone-shaped type of extended buttonhead on the inside edge of each rod. As a result, the belts are considered asymmetric and are not flippable.



1.3 Unless otherwise stated, the construction of the Active Drive Belts does not affect the belt edge tension load-carrying capacity. However, because the Active Drive Spiral System allows the belt to operate at a much lower tension, the effective load-carrying capacity of the belt can be considerably higher. Consult with Regal Rexnord™ engineers to determine the load rating of the belt for each particular spiral application.

1.4 Active Drive Belts of the Cambri-Link or DuraLite patterns may also be constructed with only a single reinforcing bar on both the inside and outside edges. Belts of these types which are not of the Active Drive construction would typically require double rows of bars on one or both edges due to higher belt tension requirements. However, for most applications, Active Drive Belts are expected to operate under much lower tension, and therefore can be optimized to reduce unnecessary components during belt construction.

1.5 Active Drive Belts can be used in applications typical of low-tension spirals including freezing, cooling, proofing and drying.

1.6 Currently, these belts have not been approved for cryogenic freezing applications.

1.7 Active Drive Belts can be used on both up-go and down-go spiral conveyors, with or without offset configurations. For offsets, a ball bearing wheel is the preferred construction. Static rails may be suitable for narrow, lightweight belts. Cage assist returns are not recommended. Also, these belts are not suitable for double-drum systems using a single belt.

2. Belt Specifications

2.1 Active Drive™ Cam-Grid Belts:

1. T304 stainless steel components.
2. Belts are available in Heavy Duty 1" (25,4 mm) or Heavy Duty 1.2" (30,48 mm) pitch, single welds only.
3. Options include rods-only or with a standard mesh overlay.
4. Belt Parameters:
   a. Rod diameter: 0.188" (4,78 mm)
   b. Mesh wire diameter: 0.058" (1,47 mm)
   c. Available nominal belt widths: 12" (304,8 mm) to 60" (1,524 m)
   d. Overall actual belt width: Nominal belt width + 0" / -1/8" (+0 mm / -3,18 mm)
   e. Effective belt product carry width:
      - HD Cam-Grid 1" (25,4 mm) pitch = Nominal belt width – 3-1/8" (-79,38 mm)
      - HD Cam-Grid 1.2" (30,48 mm) pitch = Nominal belt width – 3-1/8" (-79,38 mm)
   f. Maximum belt edge tension:
      - HD Cam-Grid 1" (25,4 mm) pitch = 150 lbs (68 kg)
      - HD Cam-Grid 1.2" (30,48 mm) pitch = 200 lbs (91 kg)
   g. Standard sprocket size:
      - HD Cam-Grid 1" (25,4 mm) pitch = 18T (6.21" PD) (157,73 mm)
      - HD Cam-Grid 1.2" (30,48 mm) pitch = 16T (6.15" PD) (156,21 mm)

2.2 Active Drive Cambri-Link Belts:

1. WRSS stainless steel rods, WRSS stainless steel strip with rounded edges.
2. Belt Parameters:
   a. Nominal belt pitch: 1" (25,4 mm)
   b. Rod diameter: 0.188" (4,78 mm)
   c. Strip dimensions: 0.060" (1,52 mm) thick x 0.500" (12,7 mm) wide.
   d. Available nominal belt widths: 12" (304,8 mm) to 60" (1,524 m)
   e. Overall actual belt width: Nominal belt width + 0" / -1/8" (+0 mm/-3,18 mm)
   f. Effective belt product carry width: Nominal belt width – 5/8" (-15,88 mm)
   g. Maximum belt edge tension: 300 lbs (136 kg)
   h. Standard picket lateral width opening: nominal 1" (25,4 mm) with balanced pattern.
   i. Belt picket available in variable opening pattern.
   j. Standard sprocket size: 18T (6.21" PD) (157,73 mm)

2.3 Active Drive DuraLite Belts:

1. WRSS stainless steel rods, WRSS stainless steel strip with rounded edges
2. Belt Parameters:
   a. Nominal belt pitch: 1.33" (33,78 mm)
   b. Rod diameter: 0.188" (4,78 mm)
   c. Strip dimensions: 0.060" (1,52 mm) thick x 0.500" (12,7 mm) wide.
   d. Available nominal belt widths: 12" (304,8 mm) to 60" (1,524 m)
   e. Overall actual belt width: Nominal belt width + 0" / -1/8" (+0 mm/-3,18 mm)
   f. Effective belt product carry width: Nominal belt width – 5/8" (-15,88 mm)
   g. Maximum belt edge tension: 300 lbs (136 kg)
   h. Standard picket lateral width opening: Nominal 3" (76,2 mm) with 5+1 balanced pattern.
   i. Belt picket available in variable opening pattern.
   j. Standard sprocket size: 14T (6.21" PD) (157,73 mm)

3. Belt Edge Tension and Overall Active Drive Spiral Conveyor Calculations

3.1 The general procedure for calculating the belt tension on an Active Drive™ Spiral System is similar to that used for a low-tension system. Tension at key locations along the trajectory of the belt travel should be calculated in addition to the tangential tension within the spiral tiers (stack).

3.2 The belt tension in the stack is a function of the weight of the belt and product, the geometry of the system (belt width, turn ratio, distance between drive bars, and distance between support strips), along with the friction coefficients between the belt/drive bar caps and belt/support strips.

3.3 Regal Rexnord™ has still to develop a fully functioning executable computer program to calculate the belt tension throughout a spiral conveyor fitted with a KleanTop® Active Drive Belt. Until the development of that program has been completed and released, it is suggested to evaluate the tension of an Active Drive Belt using our standard low-tension spiral program – OSCAR, but reduce the belt tension within the stack by 60% and reduce the effective infeed belt tension to zero. In this way, the user can quickly estimate the effective belt edge tension within the spiral, but also check for high tension locations throughout the return pass if any exist for the particular application.

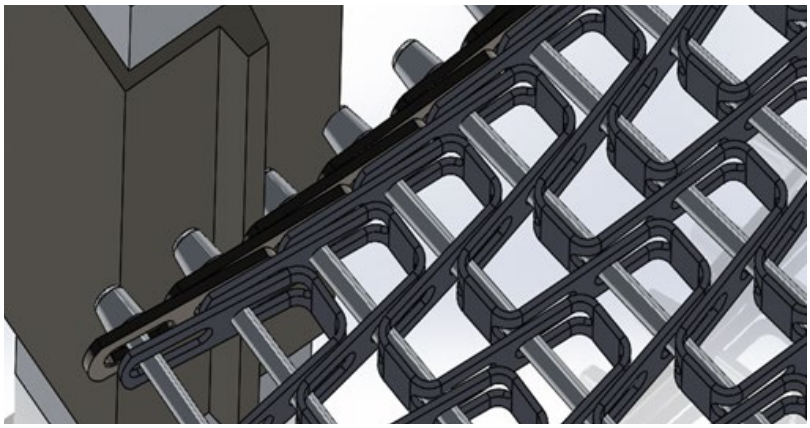
3.4 Though at times, the loading and configuration parameters for a standard low-tension system may result in an overloaded belt, the comparative reduction in actual belt edge tension by 60% for an Active Drive System should lower the expected tension by a sufficient amount to result in an acceptable application of a KleanTop Active Drive Belt.

4. General Spiral Conveyor Design and Construction

4.1 KleanTop® Active Drive™ System:

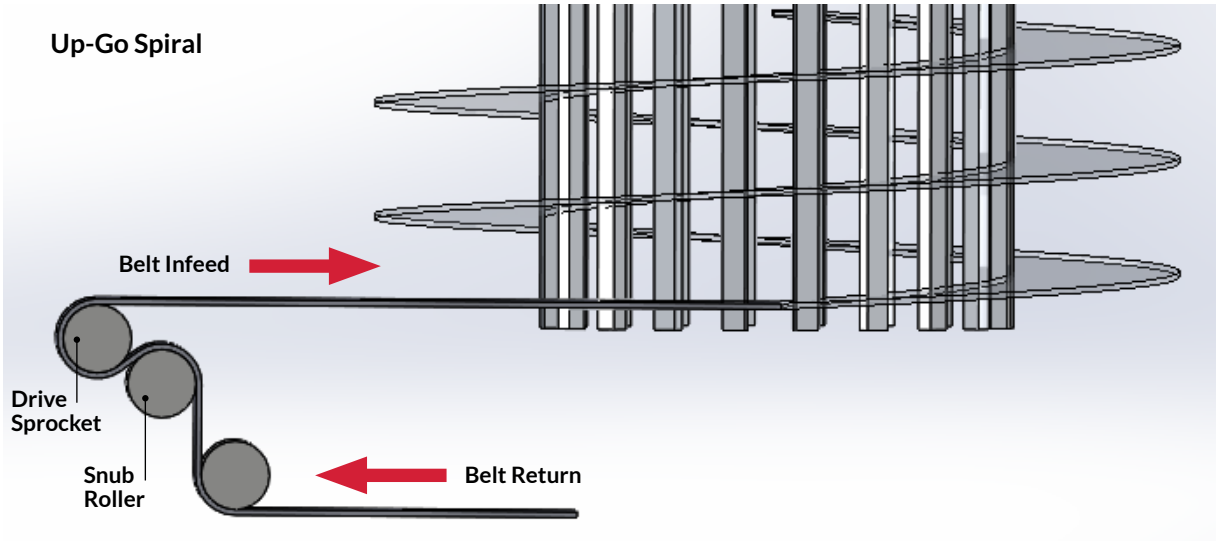
1. The KleanTop Active Drive System is considered to function as an "active" system. That is, instead of passively allowing the belt to solely be pulled into the spiral stack by the ribbed bars on the rotating drum, an adjustable amount of belting is actively fed into the spiral tiers near the infeed section of the conveyor. In this context, this is referred to as "overdriving" the belt in order to slightly increase the amount of belt that goes into the spiral stack, which also effectively reduces the belt edge tension.

2. Special drive bar caps are utilized on every upright member of the main rotating drum. These drive bars have integrated longitudinal ribs that engage the rod cones on the inside edge of the belt to propel the belt forward. (See image.) It is recognized that most OEMs for spiral conveyors prefer a unique or special size and profile for their drive bar caps. Though we would require some commonality for the shape and size of the extended ribs on the drive bar caps that engage with the Active Drive Belts, the overall extruded shape of the drive bar caps can be customized to match the OEM preferences or requirements.



3. For proper operation, this system requires a synchronization between the infeed drive and the main drive for the rotating drum. This synchronization typically requires the drive for each motor to include an encoder in order to match effective rotational speeds without the accumulation of errors due to small differences. By monitoring the rotational speed of each drive on an ongoing basis, the control system for this unit can maintain proper belt speeds and adjustments by utilizing these two (2) drives in a "master-slave" arrangement.

4. The secondary drive is positioned at the infeed of the spiral and feeds belt into the drum at a rate that matches the tangential speed of the drum. A typical layout for an up-go spiral is shown below.



4. General Spiral Conveyor Design and Construction *Cont.*

5. For a down-go spiral, a separate hold-down rail is required on the inside of the spiral over the top of the belt to force the belt to slide downward along the drum bars. There should be a minimum clearance of 1/16" (1,59 mm) between the top of the belt and the underside of the hold-down rail throughout the spiral tiers. Check to be sure that the hold-down rail is not pinching the belt against the underside support rail at any point on any of the tiers.

6. Support rails for the belt should be typical of that used in a standard low-tension spiral, in quantity, size, and placement.

7. Instead of a separate take-up drive typical of a low-tension spiral conveyor, the KleanTop® Active Drive™ Spiral System utilizes a weighted take-up positioned just after the conveyor discharge point. This weighted take-up maintains belt tension from the release point on the rotating drum through the discharge section. The suggested weight of the take-up apparatus, not including the weight of the hanging belt, is 50% greater than the tension generated by the belt through the discharge section. For example, for a combined belt and product weight of 12 lbs. per lineal foot (17.86 kg/m) and a discharge length of 8′ (2,44 m), the estimated belt tension generated by the frictional contact on the support rails would be approx. 16 lbs. (7,25 kg) (assuming a friction coefficient of 0.17 between the support rails and the lower surface of the belt). Therefore, the recommended weight of the take-up apparatus should be approximately 25 lbs. (11,34 kg).

8. The position of the take-up, upper and lower positions, should be monitored using a set of proximity sensors with at least 12" (304,8 mm) of travel between the upper and lower sensors. If the belt within the spiral stack becomes tighter, then the position of the take-up should drop due to higher tension (more elastic elongation of the belt) and less overall belt within the spiral stack itself. If this occurs to the extent the lower proximity sensors is triggered, the control system should slightly increase the speed of the infeed drive to provide overdriving of the belt into the spiral stack. Once the condition has been alleviated, the speed of the infeed drive should again synchronize with the main drive on the rotating drum. Similarly, if the position of the belt within the take-up reaches the upper proximity sensor, this is an indication that the belt is too slack within the spiral stack, therefore a brief slowdown of the infeed drive is necessary to correct this condition. Setting up the controls in this way assures the belt tension within the stack remains within a proper operating zone. Each system designed for the KleanTop Active Drive Spiral should be designed with this type of closed-loop control between the take-up sensors and the infeed drive, or something very similar. A simple flowchart for this control logic is shown on **page 8**.

9. The output torque requirements of both the main drive for the rotating drum and the drive located at the conveyor infeed should be determined based on the operating parameters of the spiral conveyor itself. However, due to the expected reduced belt tension as compared to a standard low-tension spiral conveyor when conveying comparable product loads, a general guideline for selecting these drives for the new Active Drive System would be to size the main drive similar to that for a low-tension system, and the infeed drive at a similar output torque as the take-up drive.

10. When constructing a spiral conveyor for an Active Drive Belt, the following guidelines should be followed:

    a. Do not attempt to install the Active Drive Belts onto a direct drive spiral conveyor that utilizes transitional or ramped drive bars or something similar.

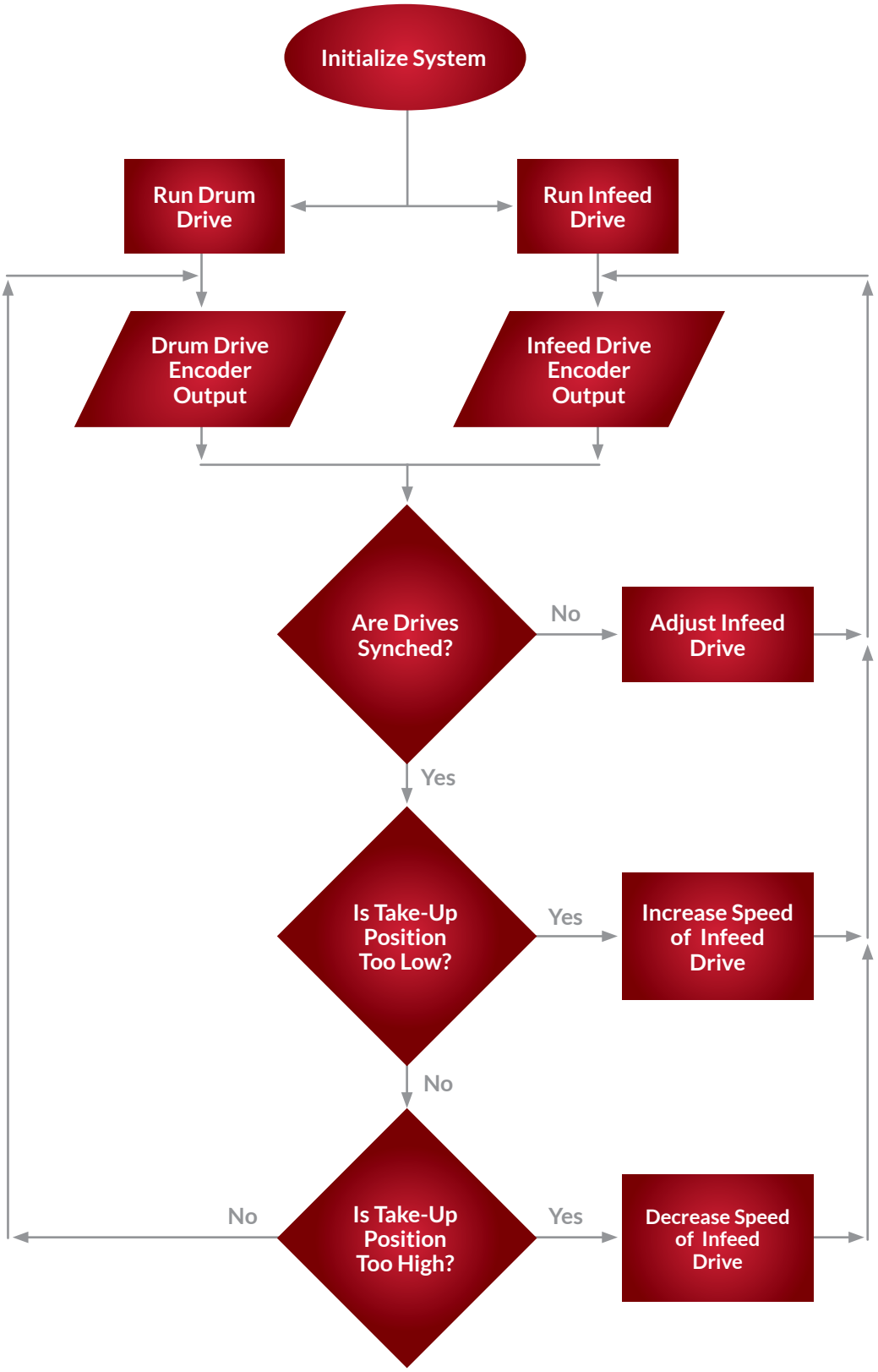
    b. Avoid making ‘chisel’ points or bevels on the drive ribs on the drive bar caps. The ribs on the drive ribs should start and end abruptly.

    c. Always allow the ribbed portions of the drive bars to extend beyond the elevations of both the top and bottom tiers of the spiral conveyor.

    d. Avoid construction of the spiral such that the entrance tier is at a steeper angle than the tiers of the spiral themselves.

    e. Avoid the use of a guide block on the inside edge of the belt near the exit tier.

4. General Spiral Conveyor Design and Construction *Cont.*



5. Belt Installation and Maintenance

5.1 General Belt Installation Instructions and Guidelines:

The following guidelines are intended to function as 'general-use' only and may or may not specifically apply to each and every Active Drive™ Belt installation. Instances where these guidelines differ from conventional spiral belts, installation guidelines will be specifically noted.

> ***Tools Typically Required:***
> *Wrenches, Vise-Grips, Clamps, Bolt Cutters, Hammer, Welder, Cut-off Wheel, File, Grinder, and Safety Shield.*

CAUTION: Improper installation procedures can cause premature failures, damage to the belt or conveyor, reduced performance, or unnecessary downtime.

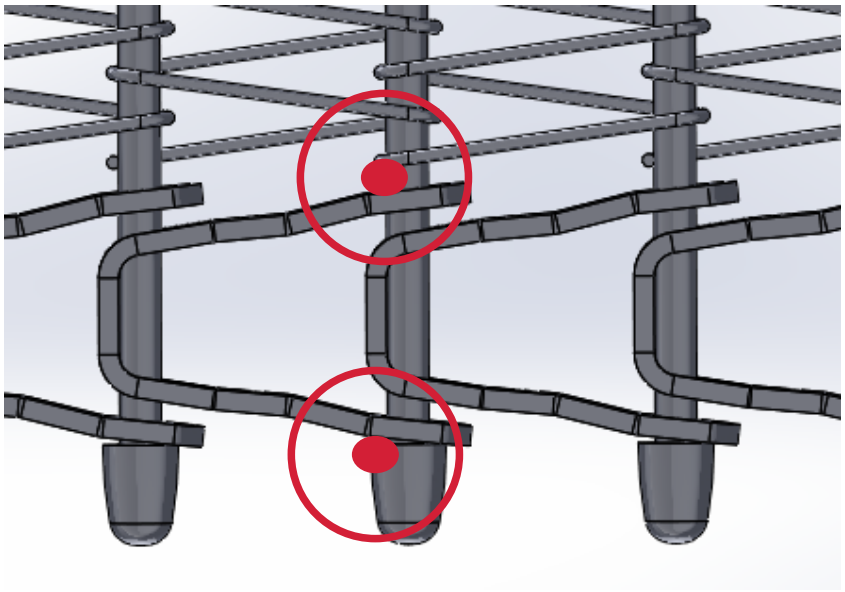
CAUTION: Portions of the conveyor drive may be exposed during belt installation resulting in 'pinch-points' that can endanger personnel. Extreme care must be taken at all times when working around sprocket-driven equipment such as a spiral conveyor.

SAFETY WARNING: Never attempt installation or maintenance on a moving conveyor belt. Conveyor must be "off" with the power source locked out. Always wear proper safety equipment when performing installation or maintenance. Keep clear of moving conveyor belts at all times.

1. Prior to installing a new belt on the spiral conveyor, check the condition of the wear strips, belt supports, and drive bar caps. Each should be clean and provide a relatively smooth path for the belt to travel throughout the entire system. Pay particular attention to transitions between lengths of separate wear strips.
2. Individual sections of Active Drive Belting as shipped from Regal Rexnord™ will typically be rolled in 50 ft. lengths. One should carefully note the orientation of the belt on the pallet and orient the pallet such that the belt can be correctly fed onto the spiral conveyor. As the belt is installed, each successive roll must be likewise correctly oriented according to the manner in which the belt was placed on that particular pallet.
3. Sections of new belting should normally be fed onto the conveyor at the location of the infeed section of the unit. This allows the belt to feed from the pallet onto the conveyor in a straight (not collapsed) orientation.
4. If there is currently no belt on the spiral conveyor, the first section of new belting will have to be fed onto the conveyor by hand until sufficient belt has been installed to engage with both the infeed drive sprockets and the drive bar caps. If an existing belt is to be utilized to pull the new belt through the system, then the new and old belts must be adequately connected together. This is best accomplished with the use of a connecting rod at the junction between the two belts.
5. Slowly but gradually feed the first new belt section onto the conveyor. As the new belt approaches a ribbed drive bar cap, make certain the belt edge and bar cap will properly engage. Re-adjust the position of the belt if necessary. Continue to feed the belt onto the conveyor until it engages with at least 2-3 ribbed caps. At this point, the belt should be tied-off to one of the ribbed caps to ensure engagement, but not so tightly to prohibit the belt from sliding up or down the bar cap as it is pulled around the spiral tiers. The speed at which the belt is pulled onto the spiral should be slow enough to permit a close watch of the belt to ensure it is properly guided throughout.
6. Stop the conveyor once most of the first belt section has been loaded onto the conveyor. Bring the belt from the next pallet and align the belt edges for connection. It is very important that the links and/or rebars on both belt edges are properly nested together. Check for proper arrangement prior to completing the connection.
7. Insert the splice rod at the point of connection between the successive belt sections. The splice rod must be inserted such that the threaded end is directed toward the outside (non-collapsed) edge of the belt and away from the rotating drum. (Note this matches the standard practice normally associated with spiral belt systems.)

5. Belt Installation and Maintenance *Cont.*

8. Thread the nut on the end of the splice rod and adjust to match the belt width to that of the finished belt. Double-check the proper nesting of the belt side bars on both belt edges prior to completing the splice. Weld the nut in place and remove excess rod length if necessary. For grid-type belts if applicable, it is also necessary to weld the rod to the links on both edges, see sketch below for weld locations on the inside belt edge. Match the size and locations of these welds to the pattern established by the factory manufactured belt.



9. Continue to install successive belt sections in a similar manner until all the spiral conveyor has been fully loaded with new belt.

5.2 Final Belt Connections and Adjustments:

1. For the belt to be operational it must be cut to the proper length and made endless. To set the proper length, continue to feed the new belt through the return sections of the conveyor until more than enough belt is in place to make it endless, including sufficient belt for the take-up loop.
2. Draw the excess belt through the return until the two loose ends of the belt overlap. Measure or count the number of belt links to be removed to make the belt endless.
3. Remove the excess belt by cutting the rod with bolt cutters. Be careful not to damage the belt pickets, links, or wire mesh overlay.
4. Connect the loose ends of the belt together using a splice rod, taking care to orient the rod with the threaded end toward the outside edge of the belt (away from the edge of the belt with extended buttonheads). Complete the connection by installing the nut and welding it in place. For grid-type belts, weld the link to the rod as per previous splices during installation.
5. Prior to starting the spiral conveyor, check the position of the sprocket teeth at the infeed drive relative to the drive point locations on the underside of the belt. For proper engagement, sprockets should be located at the 3rd opening on the belt from each edge with remaining sprockets evenly spaced across the width of the belt, but always driving against the pin. For grid-type belts, only 2 sprockets are required to engage with the U-shaped links on each side of the belt. But rollers should be positioned across the width of the belt to provide additional support to the mesh and rods. All sprockets should be positioned such that engagement and disengagement with the belt occurs smoothly.

5. Belt Installation and Maintenance *Cont.*

6. **NOTICE!** For an Active Drive™ system to operate properly, a small amount of excess belt should be provided and maintained between the infeed drive and the first tangent point of engagement between the inside edge of the belt and the rotating drum. This should be field-adjustable by varying the speed of the infeed drive. Too much excess belt can cause the belt to lift from the supports and tent-up; too little can cause the belt to be too tight on the spiral tiers. Consult the spiral OEM for specific recommendations for correct adjustment and for access to the control panel to make any changes to the speed of the infeed drive.

7. Once the belt has been fully installed and the proper initial adjustments have been made, slowly start the conveyor and carefully watch the belt for several cycles. Gradually adjust the speed of the unit until operational speed has been reached. Note and correct any problems with the belt or conveyor prior to starting production on the unit.

5.3 Care and Maintenance of Active Drive Belts:

1. If properly maintained, KleanTop® Active Drive Belt should provide many years of trouble-free service as these belts are already established for use in low-tension spiral systems.

2. Once properly installed and setup for the application, the most important step in maintaining the belt and realizing a long service life is to regularly clean the belt and spiral. Depending on the product and application, this could mean a CIP system for the belt or frequent washdowns of the belt and system in order to maintain conditions that provide relatively low friction between the belt and the plastic surfaces that it must contact.

3. Periodically spot-check the belt on the spiral stack to determine if the belt is running abnormally tight. For most if not all Active Drive systems, the belt should easily pull away from the drum. If exceptional force is needed to do this, then likely the belt tension is higher than desired. This higher belt tension could be the result of insufficient belt within the spiral stack – slightly adjust the speed of the infeed drive to feed additional belt into the system. It could also be the result of belt/spiral contamination resulting in higher coefficients of friction than initially planned - thoroughly clean the system, including belt, rails and uprights. If this is still not effective, a slight application of an acceptable lubricant to the top surface of the outer rail may be necessary. Excessive belt edge tension could damage the belt and/or the spiral conveyor and should be avoided. Consult Regal Rexnord™ Engineering for assistance if needed.

4. Periodically inspect the belt for damaged sections and bent components. If found, try to determine root cause to prevent additional damage from occurring. Repair or replace damaged belt as soon as possible.

5. Frequently inspect the belt for abnormal wear, especially along the edges of the belt as this can be a sign of contact with the frame or misplaced conveyor guides. If found, make the necessary adjustments to alleviate this issue as soon as possible.

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