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Extend the wear life of roller chains

Roller chain drives are one of the primary systems used in industry to transmit power and convey products. Since roller chain drives are widely used, productivity is highly dependent on the performance of roller chain. Roller chain that suffers from premature elongation (stretch) due to wear and needs to be replaced on a frequent basis will negatively impact productivity and increase the cost of the operation.

This article provides information that goes beyond the obvious factors that prolong roller chain wear life (lubrication and general maintenance) and examines other factors such as roller chain component parts fabrication, preparation and assembly. These factors are essential to achieving maximum wear life.

Lubrication and maintenance: The importance of proper lubrication and maintenance of roller chain during operation cannot be overstated. Close adherence to lubrication type and method, based on the drive's specifications, will not only reduce wear but produce other benefits such as cushion impact loads and heat dissipation. But lubrication is only part of the process that is necessary to maximize your drive's service life. Selecting a quality chain will be just as important.

Chain wear: A roller chain is a series of connected journal bearings that articulate as they enter and leave the sprockets. This articulation results in wear on the pins and bushings. As material is worn away from these surfaces, the roller chain gradually elongates .

Elongation due to wear is a normal phenomena during drive operation. The rate of wear is dependent on several factors; these include: proper lubrication, load, and the frequency and degree of articulation between pins and bushings. Manufacturing of the critical wear components, the pins and bushings, requires the strictest attention to detail. This starts with the proper selection of raw

material, the part fabrication, and part preparation prior to and including assembly. All of these are critical elements in achieving maximum performance. If the wear components are not of the highest quality, the wear life of the roller chain will suffer regardless of other factors.

Wear elongation measurement: Wear measurements can be made to determine if the chain has elongated to a length where replacement is necessary. To ensure accurate results, length measurements on roller chain must be done when the chain is in tension. If the chain is measured while still on the sprockets, the system must be turned off and all safety procedures followed. Measure the tight span of the chain. If the chain has been removed from the sprockets, the specified measuring load should be applied to the chain so that the slack has been removed.

Measure as close as possible from the center of one pin to the center of another. The more pitches (pins) contained within the measurement increase the accuracy. If the measured value exceeds the nominal by more than the allowable percentage, you should replace the chain. The maximum allowable wear elongation is approximately 3 percent for most industrial applications, based upon sprocket design. The allowable chain wear, in percentage, for large sprockets with 68 teeth or greater can be calculated using the relationship 200/N, where N is the number of teeth in the large sprocket. This relationship is often useful since the normal maximum allowable chain wear elongation of 3 percent is valid only up to 67 teeth in the large sprocket. In drives having fixed center distances, chains running in parallel or where smoother operation is required, limit wear to approximately 1.5 percent.

For example, if 12 pitches of a chain were measured and the result was 300 mm or greater (using 3 percent as the maximum allowable wear), we should replace the chain. Anything less than 300.360 mm would still be acceptable by most industrial standards.

Fabrication: Fabrication of the wear components must be done so that the desired assembly and performance is obtained per the chain manufacturer's

specifications. Pins are "cold drawn" through a die to create a diameter with very close dimensional tolerances. The pins then go through a centerless grinding process that removes any surface imperfections, leaving the pin surface with a mirror-like finish. This finish gives the surface a uniform bearing area that distributes the load-bearing pressure evenly across the entire length of the pin. Ultimately, the wear on the pin is evenly distributed across the length of the pin, prolonging chain life.

The bushings also go through a grinding process to ensure a uniform bearing surface. Tight tolerances on the bushing's inside and outside diameters are specified to ensure roundness. Roundness of the bushing is critical, providing the maximum contact area between the pin and bushing. Any irregular surface within the contact area leads to accelerated wear and a shortened chain life. Each step of a chain manufacturer's fabrication processes is designed to impart onto the wear components characteristics that collectively maximize the wear performance of the chain.

Heat treatment: Proper heat treatment of the wear components is a critical aspect to optimise wear life. Mechanical and physical properties of the wear components can be altered so much by heat treatment that, if done improperly, more harm than good could result. Therefore, heat treatment must be understood and closely controlled to obtain the most effective results. With these criteria in mind, some chain manufacturers employ their own metallurgist and lab personnel to closely monitor and maintain the highest quality standards.

Standard pins and bushings are carburized or case hardened. This process transforms the outside of the parts into a hard, wear-resistant surface but allows the inner core to remain tough and ductile to absorb normal shock loads.

The two key elements of wear component heat treatment are case hardness and case depth. These elements must be within the range that allows for maximum wear resistance and durability. If the depth of the case hardness is too deep, the part becomes brittle and can break during operation. If the depth of the case hardness is too shallow, the case hardness will wear prematurely and usher in

rapid elongation.

Shallow case depth is detrimental to the wear life of the chain, causing it to elongate rapidly after the shallow case hardness has worn away.

Because of the fine line between a wear component that has been properly heat-treated and one that has not, some chain manufacturers operate their own heat treatment department to ensure that all aspects of the process are closely controlled.

Preload: After assembly, the chain manufacturer applies an initial load to the chains, called preload. This preloading approximates the recommended maximum loading in service. Preloading can be done either statically or dynamically. Preloading is done as a final alignment of the various chain components such as pins, bushings and link plates.

Preloading helps to greatly eliminate the initial elongation often found in lower-quality chains. Elimination of this initial elongation can increase usable service life. The chain that has no or little preload applied will experience a significant amount of elongation during initial start-up of the drive before leveling off. The chain will then elongate at a steady rate until the case hardness on the wear components is gone and the chain experiences rapid elongation. The chain that has been properly preloaded has very little elongation during initial start-up, which results in additional wear life.

Cost benefits: Ultimately, what all of this adds up to is a high-quality, high-performance roller chain that will improve our drives performance and, in the long term, keep costs low.