



ELEVATOR KNOW-HOW

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Introduction

The problems that can occur with a cement elevator can sometimes seem endless: flooded boot conditions, fretting, galling, abrasion, corrosion, and overloading – to name a few. This is where maintenance staff can either sink or swim. Their number one goal is to ensure that the equipment is running safely and continues to perform as it was originally designed. However, in many cases, the problem that is occurring is the result of change. A small adjustment has been made to try to meet an increase in demand: the machinery is now required to produce more, run faster, manage additional tonnes of material per hour/per day. But have you become your own worst enemy?

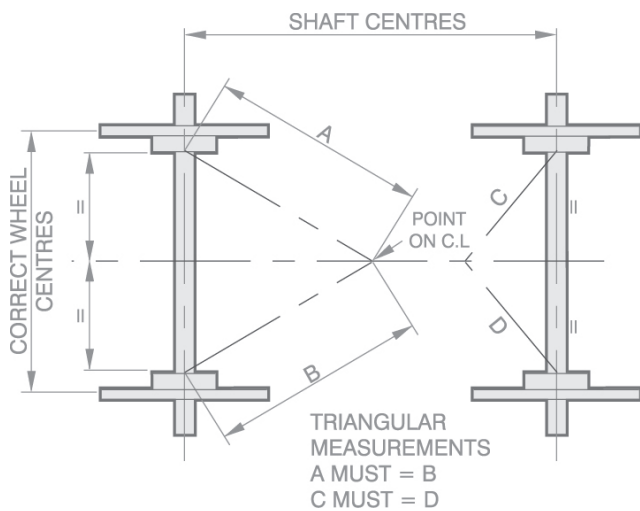
A variety of factors can come together to create the perfect storm of problems, even when proper maintenance is being done.

This article will discuss some key information, design features, upgrades, and solutions to assure the maximum life of an elevator chain.

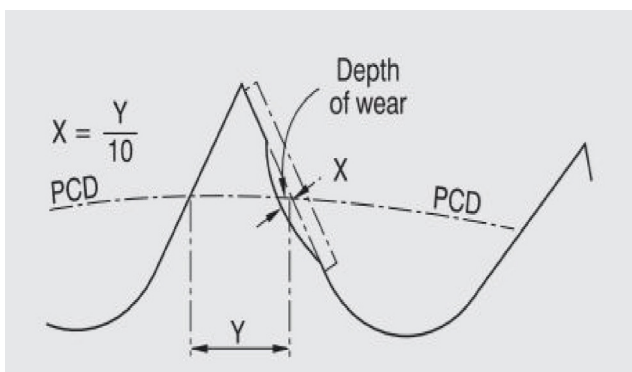
Alignment

Alignment can be one of the biggest challenges when it comes to cement elevators. While basic in definition, alignment means that two surfaces are square, in a straight line, or in a position of agreement or alliance. Aligning two head sprockets across a 36 in. shaft may seem easy to do, but if all the other elements are not properly set-up, alignment will never take place, no matter how many lasers are used.

Square and level pillow block bearings give a level footing to work from, when installing the shafts and sprockets. In fact, full system alignment starts with the pillow block roller bearings. If the pillow block bearings are not in good working condition and installed correctly



Ensure that the sprockets are in correct alignment.



This illustration demonstrates how to calculate sprocket wear.



This chain was damaged on the inside link due to misalignment.

(square and perpendicular to direction and elevation), then nothing else matters. Taking extra time to ensure that the top flange is level by correctly placing steel shims where needed will save a lot of time and trouble in the long run.

The next task is to make sure the shaft for the head and tail sprockets are true in circumference, straight in length, and that the keyways have been machined straight, true, and in-line. A shaft that is not true in circumference and straight in length, can result in premature wear on the pillow blocks, premature chain wear, and overload conditions to one side of the chain. It can also cause the chain to sway or move rhythmically from side to side, which can result in the chain hitting the housing or structural supports of the elevator casing, potentially resulting in a catastrophic failure.

Sprockets

The pillow blocks and the shafts are square and perpendicular to direction and elevation. The upfront work has been done to assure true sprocket alignment, so now it is time to install the sprockets.

Often the quality of the sprocket is overlooked when it comes to performance. As with the pillow blocks and the shafts, the sprockets play a major part in assuring overall true elevator alignment.

A properly machined sprocket consists of straight machined keyways, straight and perpendicular machined bores, proper tooth design, proper tooth angle, proper pitch-line clearance of the teeth, and sprocket teeth that have been heat treated correctly using the correct material and thermal process.

Falling short of having a properly machined sprocket can result in alignment issues, premature loading, and premature chain and sprocket wear. Saving a little money on the front end with sprockets can mean big money later.

The chain

In some cases the elevator chain can be the most expensive part of the elevator. Selecting a good elevator chain is important. If an elevator is running under extreme conditions, choosing the right chain is imperative. A standard chain is a standard chain, meaning the basics are covered and the chain meets the minimum working load. A high-quality chain, however, can meet and exceed minimum standards, meaning greater flexibility in production because there is no concern about over stressing the chain.

A high-quality chain comes from a chain manufacturer that is committed to using the highest of grades of ASTM steels; this ensures that the steel used to construct the chain is free from impurities, inclusions, and stringers. Choosing a chain that is crafted to the highest standards ensures maximum service life under extreme conditions. The chain will be capable of doing more than the minimum and will last longer and function more reliably because it is not maxed out on a day-to-day basis. If you are not sure if your chain meets these criteria, then ask your supplier. The single best time investment is to become



Note the deformity on the bottom bucket in this image. Keep an eye on these signs for warning of more serious and costly issues.



A sealed joint chain costs more upfront, but it is an upgrade that can save money down the road.

more involved in the selection process of the chain that keeps an operation running and profitable.

Buckets

While buckets come in all shapes and sizes, the important thing to remember about buckets is FFF: fit, form, and function.

- **Fit:** The ability to connect to or become an integral part of the system. Does it work with the rest of the system?
- **Form:** Are the shape, size, dimensions, mass, and weight appropriate for the elevator and materials?
- **Function:** Does it get the job done? Does it efficiently move the materials?

When buckets are damaged – and they will be – it is important to be watchful for any deformity in the geometry of the buckets or damaged area around the attachment holes where the chain and bucket connect. A damaged bucket can mean inefficient movement of materials, spillage, the beginnings of shearing off attachment bolts, and flooded boot conditions. In some cases, the damaged bucket could hit structural supports in the walls of the elevator. When it comes to damaged buckets, being proactive is the best policy: avoid the troubles and replace that bad bucket sooner rather than later.

Check list completed

Pillow blocks, good; shaft alignment, good; sprockets, good; chain, good; buckets, good. It is go time!

Properly installing the new chain and sprockets can help prevent downtime and keep the production cycle on track. Here are tried and true suggestions to follow that should help keep the chains and sprockets up and running for a long time.

- **Installation (new or replacement):** Check list has been completed. Pillow blocks, head and tail shaft, sprockets, and buckets are all good. All alignment has been confirmed. All components are ready to run. Elevator structure and casing looks good. No buildup of product in the bottom or sides of the elevator. The boot of the elevator is completely clean. It is go time.
- **After installation:** Run the elevator at very slow speeds to assure alignment and running conditions are good. Confirm that the chain and sprockets are performing mechanically correctly. Also, be sure the chain is engaging and disengaging the sprockets correctly. Be sure to check for any obstructions. The chain is running straight and not swaying or moving from side to side. If everything is good, then it is time to move on to the next step. If something is wrong, however, it is very important to stop and fix it. Too often operators rush under the pressure of getting back up and running, overlooking what appear to be minor details or conditions. But this can lead to big issues later on.
- **Once running conditions are confirmed to be good:** Now the elevator speed can be increased to half speed. It should be run at this speed for a minimum of 30 – 60 min. Once the run time is completed, shut the elevator down. Inspect for abnormal wear marks or conditions. Confirm that all hardware is tight. Overall elevator running conditions are good. Again do not forget the minor details or conditions that can lead to bigger issues later on.
- **Final inspection:** This is the final step before loading or running product. Run the elevator at three-fourths speed for 30 – 60 min. Shut the elevator down and perform the inspection process once again. After making any adjustments, it is ready to go.

The elite level: upgrades and solutions

In the high stress environment of cement production, upgrading the chain is a wise idea. Though the initial cost will be higher, it is important to consider return on investment (ROI). If a better chain is installed that lasts longer and minimises breakdowns, the payback period will increase, along with the resulting peace of mind.

In most cases, the life of the chain can be extended to prevent premature wear and replacement. Here are upgrades that are recommended.

1. Sealed joint chains can often increase chain life by two years, depending on usage patterns. Sealed joint chains are designed to lock in lube and lock out dirt and debris. This can help mitigate the risk of premature elongation, joint lockage and dry cavitation, among other things. Sealed joint chains are designed to dramatically increase wear life, resulting in reduced production downtime and maintenance costs.
2. Engineering design-specific heat-treated stainless pins and knuckles can often be the solution for severe corrosion problems. Elevator chains are used in a variety of applications. Severely corrosive conditions can often be seen with grain, lime, carbon, and phosphate elevators. Engineering design-specific heat-treated stainless materials can alleviate the severe corrosion problems that result in premature joint wear, tight joints, dry cavitation, or extreme conditions with stress corrosion cracking that leads to catastrophic chain failure.
3. Special mechanically treated pins to extend service life. Extremely abrasive conditions, as well as applications where the raw products being conveyed pack into the joint area, can create a grinding condition that results in extreme joint wear and premature chain elongation. This condition can be prevented using specially designed mechanical treated pins that provide a harder work surface on the pins, which can dramatically reduce excessive joint wear.
4. For the best overall result for the toughest and most extreme conditions, combine the seal joint design with the specially mechanically treated pins. This design will provide the maximum service life, no matter how tough an application is, so you can overcome concerns and downtime and maximise productivity.

Conclusion

With a little elevator know-how, the service life of a bucket elevator can be extended. Properly maintaining and frequently inspecting an elevator will allow downtime to be reduced and production to be increased. The key is to make sure that each element is into account: alignment, sprockets, chain, and buckets. Learn to interpret the signs and take corrective actions, or seek out upgrades to resolve frequent problem areas. 🌐