

WHAT BUCKET ELEVATOR?

Ray Hensley, Renold Jeffrey, provides an introduction to the different types of bucket elevators and their various attachments.

Introduction

Bucket elevators are used to move a variety of materials in many industries: everything from food to fertilizer can be moved using bucket elevators. Bucket elevators are one of the most commonplace pieces of equipment, because they are extremely efficient at handling any bulk loose material that does not contain lumps too big for the buckets and is not too sticky to be discharged. There are many different manufacturers of bucket elevator systems, but there are four basic types: centrifugal, continuous, super-capacity, and positive or perfect discharge. Identifying the type of elevator will help operators to understand the capabilities and limitations of that piece of equipment and how its potential can best be maximised.



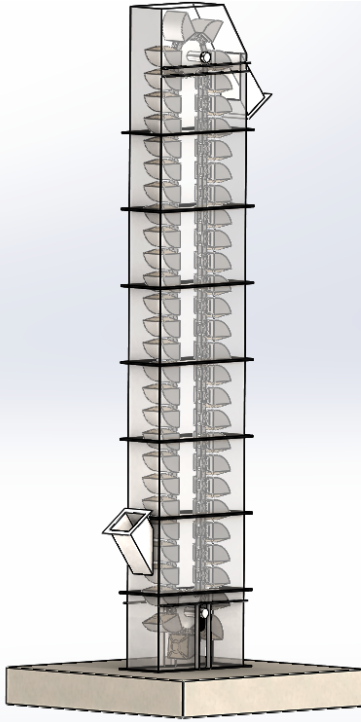


Figure 1. Continuous bucket elevator.

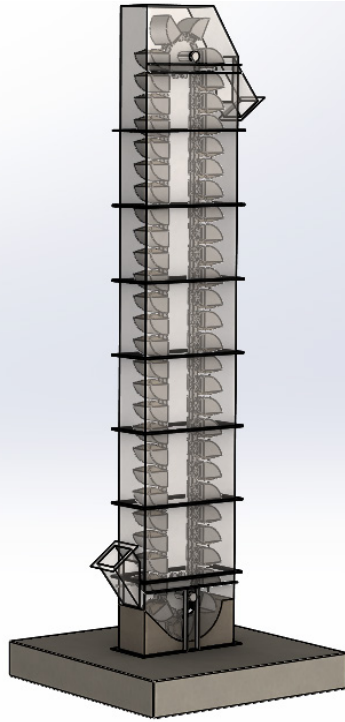


Figure 2. Centrifugal discharge elevator.

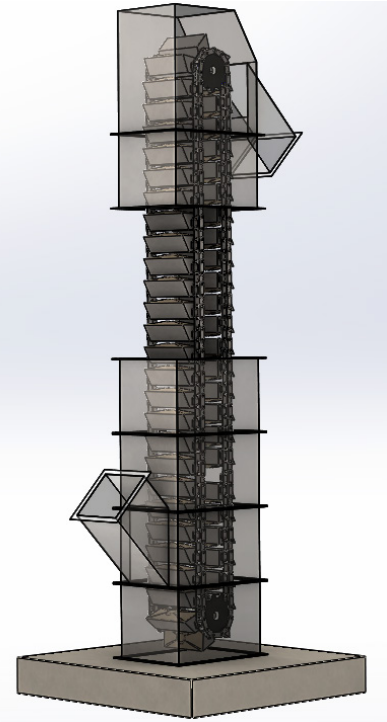


Figure 3. Super-capacity elevator.

Bucket elevators comprise three basic segments: a head end, a foot end, and intermediate sections. The head end includes the head shaft and sprocket, bearings, drive assembly, supporting structure, buckets, chain, and casing. The foot end includes the foot shaft and sprocket, bearings with a take-up, supporting structure, casing, buckets, and chain. Intermediate sections normally consist of the elevator supporting structure. In most cases, elevator casings are used to support the machinery and control dust.

Most elevator chains feature straight sidebars, hardened bushings, and are rollerless. The exception is high-capacity elevator chains, which feature hardened rollers that ride on vertical guides to keep the chain and buckets aligned within the elevator casing. Occasionally, an offset sidebar chain is used.

Bucket elevators that utilise engineering-class steel chains can lift massive quantities of heavy materials to substantial heights. Super-capacity elevators are frequently capable of lifting up to 750 tph of material weighing 125 lb/ft³ as high as 120 ft. When even higher-rated performance is desired, special chains can be engineered by a quality chain manufacturer to meet those specifications.

There are many different elevator designs; the focus of this article will be limited to identifying medium or heavy-duty types, with an emphasis on chains, attachments, and buckets.

Continuous bucket elevator

The continuous bucket – or continuous discharge – elevator (Figure 1) typically operates at speeds of 100 – 125 ft/min. It is unique in that the buckets are spaced continuously and have flat fronts and projecting sides, so that each bucket

acts as a chute for material discharged by the bucket directly behind it. This combination of continuous buckets and moderate speed means that the capacity of the continuous bucket elevator is nearly twice that of the positive discharge elevator. It is however less than that of the high-speed centrifugal discharge elevator. Buckets are fed through a loading leg or chute which, combined with the gentle method of discharge, makes continuous bucket elevators well-suited to handle fragile materials.

Positive (or perfect) discharge elevator

Positive (or perfect) discharge elevators move relatively slowly (usually well under 120 ft/min.) and feature end-hung buckets between a double strand of engineering-class chain. A pair of snub wheels completely invert the buckets over the discharge spout. This deliberate method of discharge is ideal for powdery material and for sluggish loads that tend to stick in the buckets. Pulverised coal, powdered feldspar, and wet sugar beet pulp are typical loads.

Centrifugal discharge elevator

Centrifugal discharge elevators (Figure 2) are designed to use the buckets to scoop material from the elevator boot and discharge it by centrifugal force as they pass over the head sprocket. Centrifugal elevators run at relatively high speeds. The head shaft speed varies with the diameter of the head and sprocket, as well as nature of the material, but is typically between 35 – 50 rpm. Centrifugal discharge elevators work best with fine, loose material, such as ash, grain, cement, and crushed coal: materials that can be thrown from the buckets and are not fragile.

Because the chain is in direct contact with the material in the boot when the buckets are loaded, steel-bushed

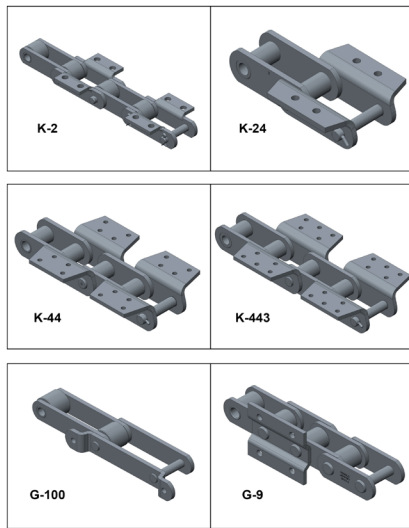


Figure 4. Attachments.

Table 1. Common elevator chain attachment configurations.	
Attachment	Number of holes
K-2	2
K-24	4
K-44	8
K-443	10
G-100	4
G-9	4

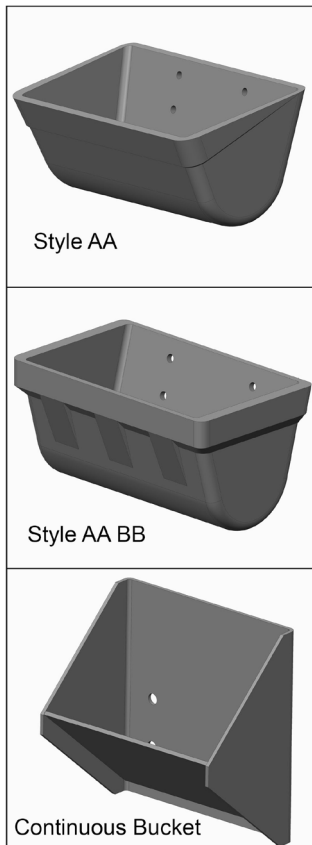


Figure 5. Elevator buckets.

rollerless chain should be used. When dealing with particularly abrasive materials, chains featuring sealed joint technology or components featuring increased wear resistance are recommended. The chain pitch varies depending on the size of the buckets and the weight of the material but, since the speed must be comparatively high, a single strand chain with a pitch of 6 in. is used in most applications.

Super-capacity elevator

Super-capacity elevators (Figure 3) feature extra wide buckets that are end-hung between two strands of chain and carry heavy loads – from fine sand to large lumps of coal and ore. Since the super-capacity elevator carries very heavy loads, a smooth run is required. To achieve effective discharge, a long-pitch bushed straight-sidebar roller chain is normally used. Rollers between the sidebars allow the chains to roll smoothly along tracks fixed to the inside of the casing. The material is fed directly into the buckets from a hopper, so that it does not enter the chain joint. This prevents excessive wear inside the diameter of the roller and outside the diameter of the bushing, which is common with scoop-type loading.

Super-capacity buckets are typically mounted to the double strands of chain using G attachments. This allows the buckets to assume a more vertical position, which places the back of the bucket past the chain centre line. The sides of the bucket also extend outward more than those of the regular-capacity continuous buckets and are shaped so that, when inverted, each bucket forms a deep trough to receive the material being discharged from the following bucket.

Attachments

When a single strand of chain is used, the buckets are bolted to K-type attachments with two holes. The number of holes is dependent on the forces and impact created through conveying the material. For larger capacities, K attachments with more holes are used with buckets up to 24 in. wide (Figure 4). For centrifugal discharge elevators, double strand chain is not recommended. Common elevator chain attachment configurations are shown in Table 1.

Elevator buckets

Because the buckets for centrifugal discharge elevators are the loading apparatus, durability and resistance to abrasion should be a key concern. Centrifugal elevator buckets are typically spaced further apart to optimise material fill and reduce the amount of interference between buckets. Buckets are commonly attached to every third or fourth chain pitch, which is 2.5 – 3 times the projection of the bucket. The load discharged from one bucket should be thrown clear of the preceding bucket. Exceptions are for specially-designed buckets or high-speed discharge. Specially-shaped buckets are available for large capacity or very fine or wet material. Reinforced welded steel buckets are used for high-speed cement or grain elevators. Buckets made of nonmetallic materials, such as high-density polyethylene and nylon, are also available for special handling requirements. The bucket length is governed by

the rule of thumb that it should not exceed five times the chain bushing length.

Different styles of elevator bucket include the following (see also Figure 5):

- Style A elevator buckets are used when very small buckets are required for handling cement, ashes, coal, sand, gravel, and similar materials.
- Style AA elevator buckets are reinforced buckets generally used for heavy materials. They feature a heavy reinforcing band along the front, which is ideal for use with most types of free-flowing material in centrifugal discharge elevators.
- Style AA-BB elevator buckets are used to handle highly-abrasive materials in demanding conditions, where impact conditions are present. They are similar to style AA buckets, but have even more reinforcement and feature ribs on the front and backs that are twice the standard thickness.
- Style AC buckets increase elevator capacity through closer bucket spacing. Style AC buckets are frequently used to handle materials, such as crushed clinker and finished cement. Air ports are punched in the bottom of the bucket to allow for faster loading and unloading of light, fluffy materials.
- Style B elevator buckets are for handling coarsely broken materials, such as coke, stone, and ore. The low front allows for a clean discharge at a relatively slow speed.
- Style C elevator buckets are designed to handle wet or sticky materials that tend to pack and stick to the

buckets. Materials such as clay, salt, wet grain, and pulverised wet ore are well suited to handling by Style C elevator buckets.

- Style SC elevator buckets have an extra heavy body and feature a reinforcing band along the front edge and ends to improve abrasion resistance. They are well suited to handling foundry sand.
- Salem steel elevator buckets are used for powdered or granular free-flowing materials. They are formed from sheet metal and have a smooth rounded contour for clean handling and discharge of materials. The front and ends of these buckets do not have seams and the bucket backs are reinforced for additional strength.

Conclusion

The proper identification of the type of bucket elevator, along with a better understanding of how the components, such as buckets, attachments, and chains, work together, opens the door to getting the most out of a plant and its equipment. Small adjustments to the features of the components, such as adding a reinforced lip to buckets or selecting a chain with a sealed joint to protect against wear, can help an elevator reach its maximum potential. The next time you see a bucket elevator, will you be able to identify what type of bucket elevator it is? 🌐

About the author

Ray Hensley is the Director of Engineering Sales for Renold Jeffrey.