

Flat-top conveyor basics

By John R Henry

Dan Pollak once opened a presentation with the statement that “Conveyors are intelligent bridges between islands of automation”. That was almost 20 years ago and I have never forgotten it.

A packaging line consists of a series of machines such as a filler, a capper, a labeler and so on. These are the “islands of automation”. Each, on its own, can accomplish very little. The labeler, for example, can’t do anything until it receives full, closed bottles.

After labeling it can’t do much until the bottle is taken away. Sometimes this is manual but more often they are connected, or “bridged”, by conveyors.

Conveyors must know when to take away product from one machine and when feed it to the next one. To do this, they need some intelligence. Thus, “intelligent bridges”.

Properly designed and controlled conveyors are essential to efficient packaging line operations.

Too often conveyors are treated as the proverbial rented mule of packaging lines. A lot of care and attention to detail go into the rest of the machines on the line. Once everything else has been bought: "Oh, yeah. How much budget is left over? We need some conveyors to tie everything together." What's available and affordable becomes what's bought.

There are many types of conveyors used in packaging. Flat-top chain, matt-top chain, belt, cable, pneumatic, magnetic, roller and more. Within each of these general types, there are dozens of variations.

Conveyor chain

The most common type of conveyor used in automated packaging lines, at least up to the case packer or bundler, is the flat-top chain. This is sometimes called "Table-Top chain but this is a tradename of Rexnord industries and should be applied only to their brand of chain.

Flat-top chain gets its name because it provided a smooth, flat, surface for conveying. In

use, it is not always smooth. Lugs, pushers, or fixtures are sometimes attached to the

plates. One variation, called roller-top or low back pressure has rollers mounted to the

chain flights. Flat-top chain is available in a variety of materials but most commonly

acetyl plastic (Delrin), steel or stainless steel. Some chains may have coated flights to

increase or reduce friction. Flat top chain is available in standard widths from 1" to 15".

Multiple rows of chain can be used when greater widths are required.

Flights, or links, can be one or two piece. One piece flights are molded as a single piece

of plastic or formed from a single piece of metal. The basic form includes a male and

female section that allow linking with pins. Pins are normally stainless steel. Some

applications may not permit the use of metal pins. A metal detector would detect the

pins rather than product contamination. Non-metallic pins are available for these

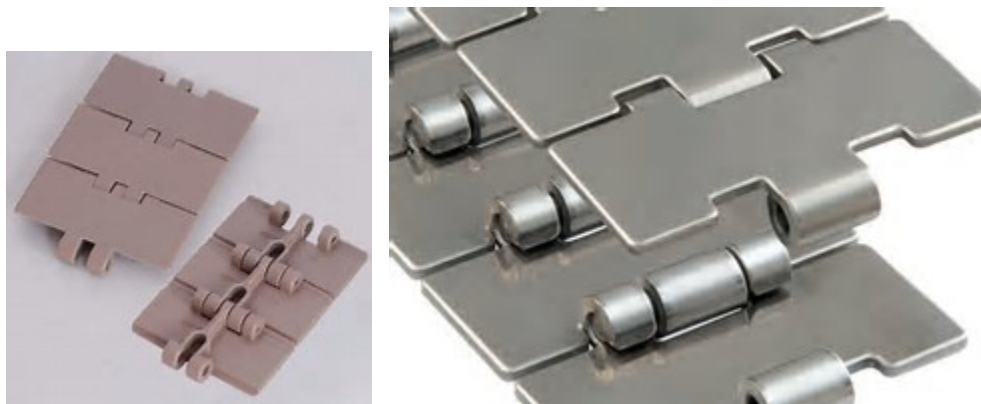
applications.

Chains can be designed as straight running which minimizes gaps between chain

flights. This is especially good for smaller products or products that might otherwise get

caught in the gaps between flights. They will not go around curves.

Below are top and bottom views of one piece plastic and metal straight running chains.



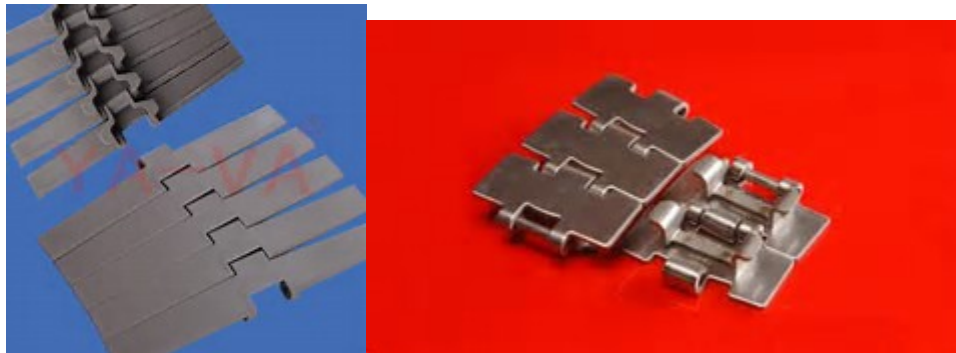
Side-flexing chains have play in the connecting pins which allows them to flex from side

to side as they go around curves. The flights are also tapered to curve, resulting in gaps

between flights. This may be unacceptable in some applications. Below are top and

bottom pictures of plastic and metal sideflexing chain. Note the side tabs on the bottom.

These engage with the conveyor frame to prevent the chain from rising up as it goes around a curve.



One-piece chain, of metal or plastic, is less expensive than two-piece chain. It is fine for relatively short and/or relatively lightly loaded conveyors. Longer, more heavily loaded conveyors may create too much tension for the single piece chain. The plastic chain can break, the metal chain can deform.

Two-piece chain is recommended for these applications. Two-piece chain uses a roller chain to carry the conveyor tension. Plastic or metal top plates are attached to the chain and carry no tensile load. The roller chain allows for very heavy loading and long runs.

Two-piece chain is available for straight running or side flexing.

Shown below is a two-piece straight running chain with plastic flights



Conveyor Frames

Various frame styles are used for flat-top conveyors. Different builders may have different names for the styles.

The plate frame is generally the most rigid of all styles. It is particularly useful where high loading is required or where vibration may be problematic. It consists of 2 mild steel, stainless steel, aluminum or plastic plates, generally 1/8" to 1/2" thick. The plates are separated by spacers and the chain rides on top of the plate edges.

The channel frame consists of 2 sheet metal "U" or channel sections, usually formed from stainless or painted steel. The frame channels are held apart by spacers and the

chain rides in the open gap. This style is extremely versatile and can be used in a wide variety of applications. Since it formed of sheet rather than plate, fabrication costs are relatively low.

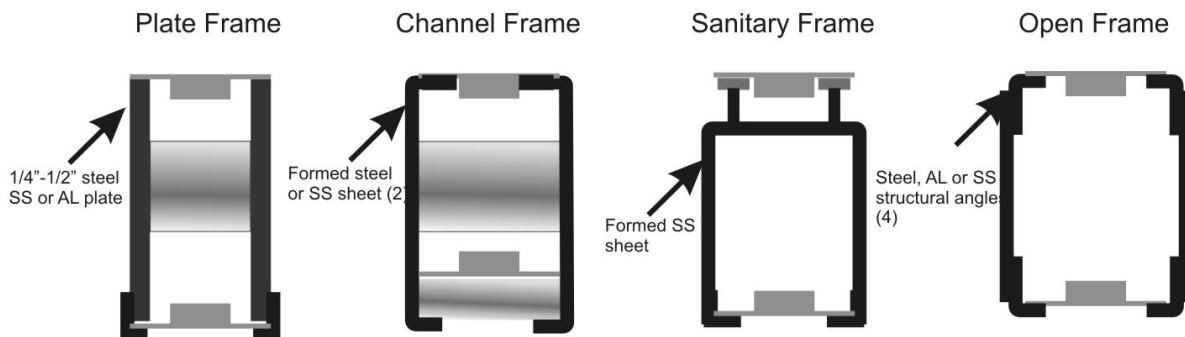
Some builders prefabricate modular sections that can be combined to make up the desired layout. A 19' long conveyor would be made by combining a 10' and 6' frame section with 18" long tail and drive ends. Bolt on the motor, side rails and support legs and it can be ready to ship in hours instead of weeks.

Sanitary frame conveyor is the standard for many pharmaceutical applications but finds uses in other industries as well. They are almost always stainless steel for cleanliness though there is no structural reason mild steel would not serve. There are various styles but the frame sections are generally formed of a single inverted U, closed side up. Two rails are raised above the top of the U on spacers and the chain rides on these rails.

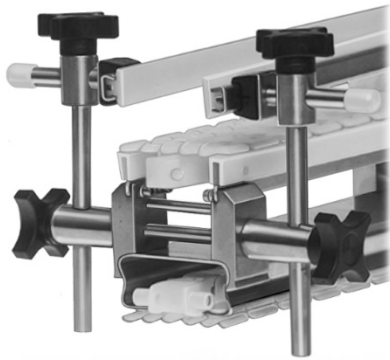
There is usually an inch or so of clearance under the rails to allow easy hand access for cleaning. The advantage to the sanitary style conveyor is that in the event of a spill they

can be easily cleaned without the need to remove the chain since product cannot spill inside.

Some beverage plants use open frame conveyor for ease of cleaning. Their relatively low cost can make them attractive in other applications as well. The frame consists of 4 structural angles. These are held in position by cross pieces every few feet but are otherwise open. This allows easy washdown or removal of broken bottles that may get into the frame.



Another style, called "sanitary" by the builder but structurally more like an open frame conveyor is shown below. It was developed especially for pharmaceutical applications where cleanliness and ease of inspection is particularly critical.



Courtesy Autopak Engineering

Several companies offer conveyors based on extruded aluminum frame sections. These are generally sold in 10' sections then cut and spliced as needed for the applications.

Drives, rails and support legs complete the conveyor.

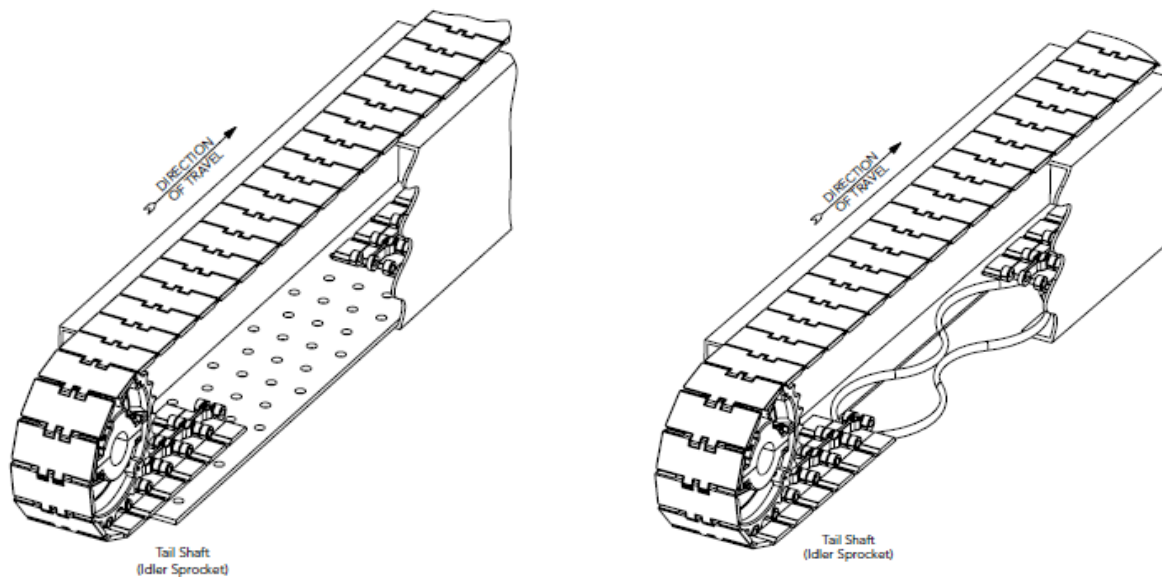


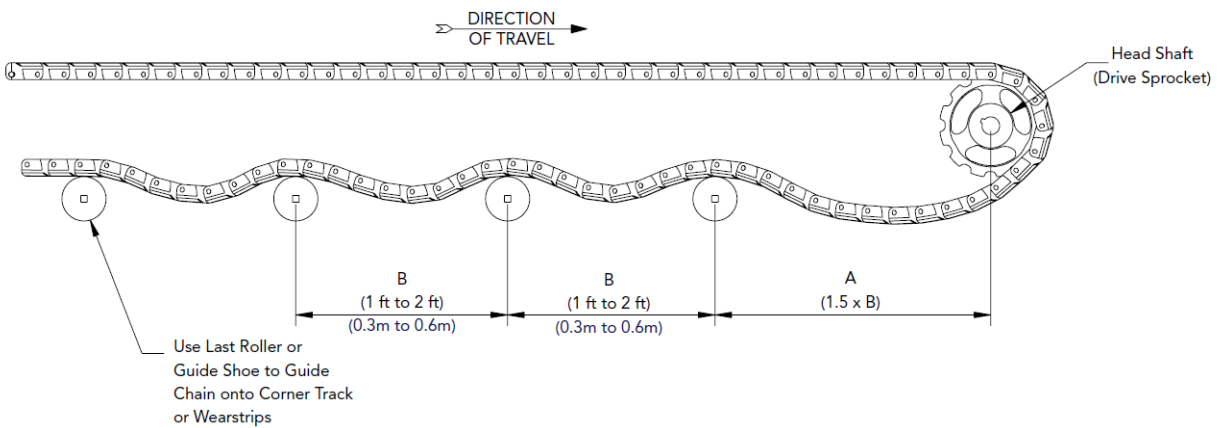
FlexLink Conveyor www.flexlink.com

The chain in all of the above conveyor rides on top of the frame. It is highly recommended that wear strips be used between frame and chain to prevent wear to the

frame. These are commonly “U” shaped sections of ultra high molecular weight polyethylene (UHMWPE, pronounced “umpy”) These slip over the frame and are held by screws. Oil impregnated wood is sometimes used with metal chains, high speed or other applications that would wear the plastic excessively. Flat brass strips are sometimes used with metal chains.

Provision must be made for the chain return under the conveyor. The return should be open, eg; perforated rather than solid plate. This allows any product falling into the conveyor to fall through rather than accumulating inside the conveyor.





From the Rexnord Engineering manual available at www.rexnord.com

Chain can also be supported by angles on the underside of the frame to support the edge of the chain (See plate frame sketch above) or guides to support the tabs where tabbed chain is used.

Drives

Flat-top chain conveyors should always be pulled toward the discharge end rather than toward the infeed end. Pushing the chain toward the discharge end is likely to result in the chain flights buckling up. If it is absolutely necessary to push the chain, and it may

occasionally be, guides must be provided on the top edges of the chain to prevent buckling.

DC motors are frequently used to drive conveyors. They are inexpensive, reliable and speed can be easily controlled with a potentiometer. AC motors with variable frequency controls, fixed speed AC or DC motors with or without mechanical speed adjustment, servo motors, pneumatic drives may also be used to power the conveyor. Generally, the motors will drive through a gearbox to reduce the relatively high speed of the motor to the relatively low speed required at the conveyor sprocket. This gear box should be sized so that the motor can run at near its normal speed. A motor that is slowed too much below its normal speed may cause the chain to jerk rather than move smoothly.

In most cases conveyors will run continuously but some applications, such as an inline filler, may require frequent starting and stopping. Starting puts a high load on a motor so they will need to be upsized to take care of this. Indexing conveyors should be driven by a servo motor, a clutch/brake or other mechanism optimized for constant starting and stopping in a precise manner.

Pro-Tips:

All conveyors should have tachometers mounted to indicate the speed. Almost none do.

Speed is frequently set by eye and the operator's or mechanic's opinion. Often neither the optimum nor the actual speed is known. Efficient line operations requires conveyors running at the proper speeds to keep everything in balance.

Stainless steel construction will add 20-25% to the price of a channel frame conveyor but is worth it. A painted conveyor will probably, in a few years, become stained and chipped. The first time that the conveyor has to be repainted the additional cost and then some of the stainless will have been recouped. A stainless conveyor will always look good and a good-looking packaging line tends to run better.

Conveyors seem simple and are. Don't let that simplicity fool you. They are a critical part of the packaging line. Make sure they are properly designed, built and operated.