IBT White Paper: Specification of a Package Handling Conveyor System
Table of Contents

1. Introduction ................................................................................................................... 1
2. Application Parameters .................................................................................................... 1
   2.1 Know your products .................................................................................................. 1
   2.2 Know your processes ............................................................................................... 2
   2.3 Know your goals and budget ................................................................................... 4
   2.4 Look into the Crystal Ball ......................................................................................... 4
3. System Layout .................................................................................................................. 4
   3.1 Existing Building/Equipment Layout ........................................................................ 4
   3.2 Flow of Processes ..................................................................................................... 5
   3.3 Operator/Equipment Interaction with Conveyor .................................................... 5
   3.4 Conveyor Elevations ................................................................................................. 5
   3.5 Merging, Diverting, Sorting .................................................................................... 6
   3.6 Accumulation, Buffers and Gaps ............................................................................. 7
   3.7 Guarding and Safety ................................................................................................. 7
   3.8 Additional Considerations ....................................................................................... 8
4. Conveyors Used in Package Handling ............................................................................. 8
   4.1 Gravity Conveyors ..................................................................................................... 8
   4.2 Belt ............................................................................................................................ 9
   4.3 Roller ........................................................................................................................ 11
   4.4 Chain ......................................................................................................................... 11
   4.5 Accumulation Conveyors ......................................................................................... 12
   4.6 Sortation Conveyors .............................................................................................. 12
   4.7 Accessories ............................................................................................................ 13
5. Application Calculations .................................................................................................. 13
   5.1 Length ....................................................................................................................... 13
   5.2 Width ......................................................................................................................... 14
   5.3 Total Load (Static and Live) .................................................................................... 15
   5.4 Concentrated Load .................................................................................................... 16
   5.5 Speed ......................................................................................................................... 16
   5.6 Elevation ................................................................................................................... 17
   5.7 Roller Spacing .......................................................................................................... 19
6. Conveyor Selection and Specification .......................................................................... 19
   6.1 Type and Style Selection ......................................................................................... 19
   6.2 Gravity Conveyor Specification ............................................................................... 21
   6.3 Belt Conveyor Specification .................................................................................... 23
   6.4 Powered Roller Conveyor Specification .................................................................. 24
   6.5 Chain Conveyor Specification ................................................................................ 24
   6.6 Additional Specification Details ............................................................................. 25
7. Lay It All In .................................................................................................................... 30
8. Controls ......................................................................................................................... 30
   8.1 Purpose of Controls ................................................................................................. 30
   8.2 Relay Based Controls .............................................................................................. 30
   8.3 PLC Based Controls ............................................................................................... 30
   8.4 PC Based Controls .................................................................................................. 31
   8.5 Operator Controls .................................................................................................... 31
9. Summary ........................................................................................................................ 31
10. References ..................................................................................................................... 32
Specification of a Packaging Handling Conveyor System

1. Introduction

This white paper provides an overview of the steps to be taken to specify a package handling conveyor system. Package handling conveyor systems are used extensively in manufacturing, distribution, and warehousing to transport products throughout the operation. Along the way, the product may be involved in a variety of processes before reaching its final destination. Package handling conveyor systems are becoming increasingly important as businesses look to increase their productivity and improve the flexibility of their operations.

This paper is not intended to be an in-depth design guide for package handling conveyor systems. Rather, it details the steps a business would need to go through when investigating and specifying a package handling conveyor system. An understanding of the ideas and concepts presented in this paper will provide the individual with a solid background for preparing bid specifications or a request for quote (RFQ) for a package handling conveyor system. The design details for the system should be left to individuals who specialize in conveyor system design.

2. Application Parameters

2.1 Know your products

In order to properly design and specify your package handling conveyor system, you need to know intimately every product to be conveyed on the system. A thorough understanding of the products to be conveyed will ensure that the conveyors selected are compatible with your products and will provide the desired performance. Table 1 lists the product properties that will be important to know.

<table>
<thead>
<tr>
<th>Product Property</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Box, bag, barrel, pallet, crate, tote, tray, bucket, can, pouch</td>
</tr>
<tr>
<td>Minimum, average, and maximum size</td>
<td>Length, width, height, diameter, weight</td>
</tr>
<tr>
<td>Shape</td>
<td>Rectangular, round, cylindrical, cube, irregular</td>
</tr>
<tr>
<td>Conveying surface (surface of product that is in contact with the conveyor)</td>
<td>Flat, wavy, ring, irregular, feet, conforming</td>
</tr>
<tr>
<td>Physical attributes</td>
<td>Solid, soft, stable, unstable, shifting, loose, pliable</td>
</tr>
<tr>
<td>Product condition</td>
<td>Corrosive, abrasive, sticky, slick, wet, hot, cold, dusty</td>
</tr>
<tr>
<td>Product orientation</td>
<td>Consistent, random, leading side width</td>
</tr>
</tbody>
</table>

Table 1: Product Properties
2.2 Know your processes

A thorough understanding of the processes the package handling conveyor system will interact with is necessary to properly specify the system. The conveyor system will likely transport the product between multiple processes, and may also be an integral part of the processes themselves.

It is often helpful to start with a flow chart showing the current processes and how the product flows through the system. At critical points in the process, you should assign a throughput rate. The throughput rate should include both an average rate and a maximum rate. Each process should also be identified as a batch process or a continuous process.

A thorough analysis of the product requirements for each process should be performed. Some important questions to be asked:

- How will products be presented to the conveyor?
- How will the products be oriented on the conveyor? Is orientation critical?
- Is accumulation of product before, during, or after the process required?
- Will the conveyors be started and stopped? How often? Under full load?
- Is a gap required between the products? If so, how much?
- What is the maximum throughput for each piece of equipment involved in the process?
- What is the duty cycle?
- What are the surrounding environmental conditions?
Packaging Room - 80 degrees F - VERY Humid! - Washdown

Pack Product A
4/min avg.
5/min max.

Pack Product B
4/min avg.
6/min max.

Pack Product C
6/min avg.
10/min max.

Pack Product D
4/min avg.
5/min max.

18 cases/min avg.
26 cases/min max.

36" leading edge to
leading edge spacing
required

Checkweigher rated for
30 cases/min

Rated for 25 cases/min
Requires 12" gap between
products

Product Specifications:
Corrugated box
* 18" L x 10" W x 10" H x 20 lbs.
* 16" L x 12" W x 12" H x 24 lbs.
* Taped bottom - flat
* Stable load - evenly distributed
* Conveyed narrow side leading

Checkweigh Products

Print & Apply
Label

Product Height
<= 10"

Yes
No

Case heights 10" and
below
15 cases/min max

Tape Case I

Tape Case II

Case heights above 10"
15 cases/min max

Merge
Products

Merge
Products

Scan Bar
Codes

Sort by
Carrier

UPS

USPS

Freezer Storage
0 deg. F

Fed-Ex

Ground

TITLE: Figure 1: Sample Process Flow
2.3 Know your goals and budget

Upper management (or whoever is driving the project) needs to clearly convey to the project team the goals and justification for the project in quantifiable terms. Without clearly defined goals, it will be difficult to measure success. While your goals probably will not be mutually exclusive, it may be possible that you may need to sacrifice some goals to satisfy others. In this case, a priority for the goals should be established. Examples of typical goals for a package handling conveyor system include:

- Increased productivity
- Improved sanitation
- Improved Safety and Ergonomics
- Increased throughput
- Reduced floor space
- Replace worn out existing equipment
- Improved Quality Control
- Lean Manufacturing
- Introduce New product/process
- Tighter Process Control
- Decreased Downtime and Maintenance

It is also important that a budget for the project be established before commencing the system design and specification. The budget for the project will often dictate the direction of the design. It is possible that the goals and budget are incompatible. In such a case, management will need to reevaluate and revise the goals/and or budget.

2.4 Look into the Crystal Ball

Any material-handling project that is undertaken without an eye towards the future is destined to be outdated before its time. While nobody can predict the future with 100% certainty, it is important to look at the direction of your business so that you can design your package handling conveyor system to accommodate or easily be modified to accommodate future changes and growth. Questions that need to be asked:

- How will your product change? Will the packaging size, shape, or type change?
- What new processes will be added?
- Will throughput need to be increased?
- Will additional processes need to be introduced?
- Will the system need to be expanded or relocated?
- Will the system need to be further automated?

3. System Layout

3.1 Existing Building/Equipment Layout

A dimensionally accurate, scaled, plan-view drawing is necessary to begin the system layout. If the layout is not available in CAD (Computer Aided Drafting) format, now is the time to...
have it drawn electronically. This is also a good time to verify the dimensional accuracy of the layout, not when you are trying to squeeze conveyors in place. The drawing should show the complete building structure, including: columns, process pipes, walls, ceiling elevations, mezzanines, and changes in floor elevation. In addition, the drawing should show all existing machinery and equipment, and any fork-truck or pedestrian aisle ways. Any location where a clearance elevation is critical should be shaded and noted on the drawing.

3.2 Flow of Processes

Using the Process Flow Chart created previously, draw the flow of product on the layout. A simple line drawing with arrows indicating direction of flow of product is acceptable at this time. If the building is new or the equipment layout is being reconfigured, draw in the ideal flow.

When the product flow is drawn on the layout, inefficiencies in the movement of product may become obvious. It is recommended that you reconfigure your equipment layout to streamline the flow and minimize handling of the product before beginning the design of the package handling conveyor system.

3.3 Operator/Equipment Interaction with Conveyor

At different points in your process, equipment and/or operators will be interacting with the product on the conveyor. Identify each of these points on your layout. Note on the drawing locations for any operator control stations and emergency pull cords. Detail any operational parameters or requirements for these interactions. For example:

- Does product need to be oriented in a certain way?
- Is a gap required between products?
- Does the product need to be at a critical elevation?
- Is the process a batch or continuous process?
- Should product be indexed into position and stopped, or will operations be performed on-the-fly?
- Are there any positional requirements for the product? If so, what are the tolerances?

3.4 Conveyor Elevations

When you lay out your package handling conveyor system, you may determine that one conveyor elevation meets your requirements. More likely, however, it will be necessary for the conveyors to change elevation throughout the system. When the Equipment Layout was generated, clearance elevations were noted for equipment, aisle ways, etc. Critical elevations were also noted for equipment/operator interaction points. The conveyor system elevation will change to meet these clearances and critical elevations.

Note on the layout drawing locations where elevation changes will need to take place. Note the actual elevations and/or clearances required at critical locations. Later in this discussion,
the calculations necessary to determine maximum incline and decline angles will be presented. At this point, approximate elevation change locations are acceptable.

There is one important caveat to note. Conveyor layout drawings are typically shown with elevations to the top of the conveying surface. T.O.R. (top of roller), T.O.B. (top of belt), or T.O.C. (top of conveyor) are often used to notate the elevation of the conveyor. These elevations do not indicate clearance dimensions, however. The type and configuration of the conveyor will determine the clearance dimensions for the conveyor. It is critical that the elevation dimensions shown on the layout drawing are identified as top of conveying surface elevations or clearance dimensions. After the conveyors are specified, top of conveying surface elevations will be provided for all of the conveyors.

3.5 Merging, Diverting, Sorting

Your process flow may dictate that the product flow through in a straight-line configuration. Often, however, products will be merged and diverted from conveyors at various points in the system. This is analogous to an interstate system with on and off ramps. The interstate is the main conveyor line, and the on and off ramps are the merges and diverts.

There are a number of reasons why you might need to merge or divert products:
- Products originating in multiple locations need to be transported to a common machine/process
- Throughput for a single piece of equipment or work area will not meet the maximum production rate, so the throughput must be distributed over several pieces of equipment or work areas
- Different product configurations are fed to different processes
- Out of specification or scrap product needs to be rejected
- Product is sorted based on final destination or freight carrier
- Products are sorted based on contents

Merges and diverts can be accomplished by a number of different means. It is beyond the scope of this paper to discuss all of these in detail. Depending on the method used, it is possible to perform a merge or divert at any angle between 0 degrees and 90 degrees. Common configurations are 30 degrees, 45 degrees, 60 degrees, and 90 degrees. It is important to note that some methods of merging and diverting may change the product orientation. If product orientation is critical, particular attention needs to be paid to the method(s) specified.

Depending on the application, it may not be obvious whether to merge products from multiple origination points onto a single conveyor or to run dedicated conveyor lines for each origination point. For example, you may have multiple production lines producing product that needs to be transported to a palletizing room for palletizing. There may be a dedicated palletizer for each production line. In such a scenario, it would be possible to run dedicated conveyor lines from each production area to each palletizer, or the products...
from the multiple production areas could be merged onto one conveyor line and the sorted to each palletizer.

There are advantages and disadvantages to each method that must be weighed to determine the best method.

Advantages of merging products onto one conveyor line:
- Lower initial equipment and installation costs
- Lower maintenance and utility costs
- Less floor space required
- Ability to divert products to different palletizers

Advantages of dedicated lines:
- Less complex controls
- No mixing of products; 100% accuracy
- If one line goes down, it will not shut down the other lines

3.6 Accumulation, Buffers and Gaps

Some of your processes may be continuous processes, while others are batch processes. It also may be possible that you will need to stop a downstream process while the upstream process continues to operate. In such cases, you will need to accumulate products. Indicate on the layout drawing any area where you will need to accumulate product. You should note the total maximum number of products that will need to be accumulated at any one time.

Some equipment or processes may require a gap exists between the products. The gap may be distance based or time based. Some examples are labeling equipment, checkweighers, case tapers, and sorters. Indicate any locations requiring a gap between the products and note the gap or time spacing. It is important to note that some processes and equipment require a specific gap between the trailing edge of one product and the leading edge of the next, while others require a specific pitch from the leading edge of one product to the leading edge of the next. Be sure to clarify the requirements for your particular processes and equipment.

3.7 Guarding and Safety

You should take into consideration the guarding and safety of your package handling conveyor system during the design phase. The conveyors you purchase should come with the appropriate guarding and safety features. However, the method of application of the conveyors may create additional safety concerns.

Overhead conveyors require special consideration. Conveyors above exit passageways, aisles, or corridors should have a minimum clearance of 6’-8”. If there is a danger of product or rollers falling from the overhead conveyor, a net or other means should be provided to catch falling product. The transition point between conveyors can create a pinch point that always requires special attention.
3.8 Additional Considerations

Depending on your application, there may be other factors that need to be weighed during the design of the system. Some of these are listed below:

- How will the conveyors be anchored/supported? Is the concrete floor or overhead structure sufficient to support the conveyor? If not, what modifications will be required?
- How will the conveyors and other equipment be serviced? Is there enough clearance at critical points to service the equipment?
- Are there points in the process or plant with special environmental considerations? Is the environment hot, cold, damp, corrosive, dusty, abrasive, etc.?
- Where will pneumatic and electric power for the system originate? Can the power requirements for the system be met, or will additional services have to be run?

4. Conveyors Used in Package Handling

4.1 Gravity Conveyors

Gravity conveyors are non-powered conveyors. They require external forces to move products on them. This force is typically provided either by an operator pushing the product on the conveyor or the pull of the earth’s gravitational force. In cases where gravity will move the product, the conveyors are installed with the elevation declining towards the discharge end of the conveyor to provide the necessary pitch to move the products. The degree of decline will depend on the type of conveyor, the conveying surface, the type of bearings, the weight of the package, and the desired speed.

Gravity conveyors are available with several different conveying surfaces. The most common conveying surfaces are roller, skatewheel, ball, and chute.

Roller

A tubular roller with bearings at each end and a shaft down the center is mounted in a frame. The roller can be steel, aluminum, PVC, or other material to meet the requirements of the application. A wide variety of bearings are available, depending on the application.

The advantage of a gravity roller conveyor is that the roller, bearing, and shaft size and material can be specified for a wide variety of applications. The rollers can be spaced to economize the number of rollers required. The continuous conveying surface across the width of the conveyor provided by the roller makes this conveyor a good solution for irregular bottom packages. Brakes can be added to slow or stop the flow of products.
Skatewheel

Gravity skatewheel conveyors utilize multiple wheels on a common axle to create the conveying surface. The axle is mounted in a structural framework. As with gravity roller conveyor, the wheels and bearings are available in a wide variety of sizes and materials. The wheel spacing and axle spacing can be set to optimize the number of wheels under the product.

Skatewheel conveyor is typically more economical than gravity roller conveyor. Product will generally roll easier on skatewheel conveyor. However, gravity skatewheel conveyor should only be used with products that have a smooth, flat bottom. It is generally used for light-duty applications.

Ball

Gravity ball conveyors utilize a hardened ball set in a bearing. Most often, the ball is steel and the bearing is a ball or composite bearing. The balls are mounted to a plate, which is mounted to a structural framework. The balls can be spaced for optimum economy and performance.

Given the nature of the design, product can be moved in any direction on a gravity ball conveyor. These conveyors are most often mounted level, and an operator manipulates the product on the conveyor. This type of conveyor is relatively expensive, so their use is usually limited to work stations or other applications that require the product to be rotated or transferred in multiple directions.

Chute

Although technically not a conveyor, chutes are often used in package handling conveyor systems to transport product. The chute utilizes gravitational forces to cause the product to slide on a solid surface. The chute is typically constructed from steel or fiberglass and can be specially configured for the application. The chute typically provides enough structural stability that a separate structural framework is not required. Spiral chutes are often supplied where space is at a premium.

Because of their simple design, chutes are the most economical type of gravity conveyor. They are often custom designed for the application. The friction for a chute is much higher than that for other types of gravity conveyors, so a greater degree of pitch is required to move the product.

4.2 Belt

Belt conveyors are widely used because of their simplicity and effectiveness. Belt conveyors use a belt that the product rides on to transport the product. The product does not move relative to the belt (except in accumulating applications), so the product speed is the belt
speed. The belt returns on the underside of the conveyor. Depending on the drive configuration, belt conveyors can often be operated in reverse direction, as well. Some belt conveyors even come in curved configurations.

There are a multitude of belt styles and materials available for every application. Selection criteria will be detailed in the following section. Some of the available belt types include: fabric, wire mesh, plastic (table top and mat top), composite, v-belt, and o-ring. The most commonly used belt type in package handling applications is the fabric style belt. A fabric belt has a carcass of fabric or chords that give the belt its longitudinal and lateral strength, and a cover that protects the carcass and gives the belt its conveying properties. The belt is joined on the ends by lacing, or is welded together to form an endless splice. A number of belt modifications are available. Some common belt modifications are: cleats, dimples, sidewalls, perforations, v-belt guides, and attached fixtures.

The conveyor belt is supported on a bed that is either fixed or is made up of rollers. The slider bed belt conveyor is a fixed bed conveyor that utilizes a steel bed to support the belt. The slider bed conveyor is relatively simple and inexpensive. However, the load capacities and speeds of this conveyor are limited because of the high friction associated with the slider bed. The belt is not captured with this type of conveyor, so it has to be “tracked” to keep it in the center of the bed.

In order to reduce friction, the fixed bed on the conveyor often is constructed of low-friction materials. UHMW-PE or other man made composites are used to form the conveyor bed and provide a low friction surface that can withstand the pressures seen in conveying applications. The bed can be constructed with a groove or guide to accept a guide on the conveyor belt to minimize tracking problems.

In high speed or high load applications, roller bed belt conveyors are used. These are similar in design to the slider bed belt conveyors, but instead of a steel bed, rollers are used. As a result, the friction is reduced. The rollers are sized and spaced to support the load, while the belt provides the necessary drive force to move the load.

Belt conveyors are often used in incline and decline applications because they can be outfitted with high friction belting. Depending on the degree of incline or decline, two standard options are typically available to improve performance of the conveyor. The first is a power feeder. A power feeder is a separate section of powered belt conveyor at the lowest end of the conveyor that is coupled to the main conveyor. The power feeder helps products make the transition between the horizontal conveyor and the inclined conveyor. The second is a noseover at the upper end of the conveyor. A noseover is a separate frame section(s) from the main conveyor frame. The noseover breaks the angle between the inclined conveyor and the horizontal conveyor into one or more smaller angles using short frame sections. This helps to minimize the “slamming” that takes place as a product transitions from inclined to horizontal, or vice versa.
4.3 Roller

Roller conveyors are commonly used for transport and accumulation of products in package handling conveyor systems. Roller conveyors utilize rollers powered by various means to provide the driving force necessary to move products. As with the gravity roller conveyor, a wide variety of bearing and roller sizes and styles are available. The rollers are mounted in a frame to provide the necessary structural strength.

The rollers on a powered roller conveyor can be powered by a number of different means. One method involves the friction between a power transmission element and the roller. Common power transmission elements include flat belts, v-belts, padded roller chain, and cable. The power transmission element contacts the bottom of the roller and causes the roller to turn. Increasing the pressure between the power transmission element and the roller increases the roller drive pressure.

A second type of powered roller conveyor is the line shaft conveyor. A common powered line shaft runs beneath the conveyor parallel to the direction of travel. Belt or o-rings transmit power from the line shaft to each individual roller. The line shaft style conveyor can power a long length of conveyor with a single drive. In addition, the line shaft can be used to power transfers.

For heavier loads, the chain driven roller style conveyor uses rollers powered with roller chain. Sprockets are welded to the rollers. Roller chain then transmits power from roller to roller. This conveyor is very good for heavy loads, but is limited in speed and tends to require more maintenance.

A more specialized type of roller conveyor utilizes individual powered rollers. With this style of conveyor, each powered roller contains an electric motor and gear transmission within the roller tube. Each powered roller can power several gravity rollers using belts or o-rings. Because there is no drive for the conveyor, the powered roller conveyor has a very low profile. This style of conveyor can be expensive, so its use is limited to applications with special requirements.

4.4 Chain

Chain conveyors are similar in application to belt conveyors. The product rides on top of the chain, and the chain rides on some type of wearstrip. Single pitch or double pitch roller chain is utilized, and there are often multiple strands powered from the same drive. Attachments can be attached to the conveyor chain for special fixtures or applications. The steel chain is capable of conveying a very heavy load, but is limited in conveying speeds. Chain conveyors are typically used in heavy load applications or special applications requiring chain attachments.
4.5 Accumulation Conveyors

Accumulation conveyors are modifications of belt, roller, or chain conveyors. They allow products to be accumulated while the conveyors are running. Many processes require that the flow of products downstream be stopped while the flow of products upstream continues. Accumulating conveyors will accumulate the product between the two processes until the downstream process is ready to receive the product.

There are two types of accumulation used in package handling conveyor systems. Minimum pressure accumulation uses a mechanical means to stop the flow of product on the conveyor without removing the conveyor drive pressure. The force stopping the flow of products is greater than the drive pressure, so the products are stopped. The products are back-to-back when minimum pressure accumulation is utilized, and drive pressure builds up as more products are accumulated. Minimum pressure accumulation conveyors are set-up to provide the minimum amount of drive pressure necessary to keep products flowing. Belt conveyors utilize low friction belts, and roller conveyors have adjustable roller drive belt pressure to minimize the accumulation backpressure.

The second type of accumulation used is zero-pressure accumulation. Drive pressure is completely removed from the products, and the products do not exert pressure on one another. The conveyor is divided into zones, which are the smallest section of conveyor from which drive pressure can be removed. Either mechanical or electrical sensors are used to sense the presence of a product in each zone. When a product is sensed, belt and chain conveyors lift the product off of the belt or chain, while roller conveyors stop the drive pressure to the rollers. A variety of methods are used to create the accumulation effect. Many of the new zero pressure accumulation conveyors utilize smart electronic sensors that can be programmed to perform various timing functions and multiple methods of release.

4.6 Sortation Conveyors

Sortation conveyors are used to sort products from one infeed to specific outfeed. Sortation conveyors are common in distribution centers where products are sorted to lanes based on freight carrier or final destination. It is beyond the scope of this paper to discuss sortation applications in any detail. The application of sortation conveyors can be very complex. It is recommended that you consult an expert when designing any sortation conveyor system.

A number of methods are used to sort products off of the sortation conveyor. The product may be pushed off, diverted off, tilted off, or conveyed off of the sortation conveyor. Regardless of the method used, all sortation conveyors require that the product be tracked from the induction point to the discharge point.
4.7 Accessories

A wide variety of accessories are available for package handling conveyor applications. A number of these accessories are standard, while some are custom designed and built per the application. Some of the more common accessories are listed below.

**Stops** – Stops are used to stop the flow of product on minimum pressure conveyors. The stop may pop-up from beneath the conveyor, or clamp the product from the sides. Most stops are pneumatically or electrically actuated. Manually operated stops are also available.

**Transfers** – Powered transfers transfer product off of or onto a conveyor. Chain transfers, v-belt transfers, o-ring transfers and pivot transfers are some of the more common types of transfers. Transfers can be independently powered or powered from a lineshaft conveyor.

**Pushers** – Pushers can be used to transfer product from a conveyor, or move a product onto a conveyor. Pushers are generally pneumatically powered.

**Plows** – Plows are used to divert product off of one conveyor onto another conveyor at an angle of 30 or 45 degrees. Plows can have a flat plow face or a powered belt face. Plows are actuated pneumatically, electrically, or manually.

**Gates** – Gates allow sections of conveyor to be lifted up or pivoted out of the way to allow pedestrian or fork truck traffic to pass through. The gate can be balanced so that an operator can easily move it by hand.

**Case Rotaters** – Case rotaters change the orientation of a product on a conveyor. Two common types of case rotaters are bump turns and pop-up star rotaters. A bump turn contacts the product on a leading corner and causes the product to rotate 90 degrees. Pop-up star rotaters are mounted between rollers and lift the product off of the rollers and rotates it 90 or 180 degrees.

**Traffic Cops** – Traffic cops are mechanical devices that control the merging of two conveyor lines. As product on one line is allowed to pass by, the mechanically interlocked traffic cop arm stops product on the other line.

5. Application Calculations

5.1 Length

From the System Layout you created, you should be able to determine the required lengths of straight conveyor. It is generally desirable to supply straight runs of conveyor as long as possible to minimize the number of drives required. The limiting factors on conveyor length...
are the load and the capacity of the drive. Each manufacturer will specify a maximum standard length for their conveyor models. You should check, however, that you do not exceed the live load capacity at that length.

5.2 Width

The required conveyor width will be based the maximum width of product to be conveyed. It is possible that you will have different conveyor widths in different parts of your system. Consideration should be given to standardizing on one width of conveyor to minimize spare parts inventory.

For roller conveyor, the recommended roller width is at least 2” wider than the maximum product width. In some cases, it is acceptable for the product to be as wide as the roller. You should avoid having product wider than the roller width because the product may hang up on the conveyor frame or other peripheral devices. Roller conveyor widths are often expressed in BF, or between frame widths. The BF is the inside distance between the two frame members and is slightly larger than the actual roller width.

The belt width on a belt conveyor is less than the overall frame width. Best practice is to have the maximum product width no greater than the belt width. It is acceptable to have the maximum product width equal the overall conveyor frame width. In such cases, you should check that the product will not hang up on the conveyor frame or other peripheral components.

Chain conveyors afford some latitude in width or spacing, since additional strands can be added as required and driven from a common drive. The number of strands depends on the chain specified and the load to be conveyed. The product bottom must be capable of support the product load based on the chain spacing. The product will typically overhang the chains on both sides to ensure that the product does not wander off of the outside chains.

Conveyor curves present a special problem. As the product travels around the curve, the arc of travel of the corners of the product will be greater than the arc of travel of the midpoint of the edge, as shown in figure 3.
Figure 3: Minimum Curve Width

A minimum gap of 2” is recommended between the outermost arc of travel of the product and the inside edge of the outer frame member. For rectangular products, the following formula can be used to calculate the minimum BF required.

\[ BF = \sqrt{((IR + W)^2 + (L/2)^2) - (IR - 2)} \]  

(5.2.1)

5.3 Total Load (Static and Live)

The total static load on the conveyor is the maximum total weight of product on the conveyor at any one time. The total static load will dictate the minimum conveyor frame load rating required. The total static load should be calculated for the worst-case scenario. Take the maximum weight product and multiply by the maximum number of products that will be on the conveyor at any one time.
The total live load is the maximum total weight of product being moved on the conveyor at any one time. The conveyor drive will be sized for the total live load. For all conveyors except accumulating conveyors, the live load will equal the static load. Accumulating conveyors may only move a fraction of the total number of products on the conveyor at any one time. The total live load is calculated by summing the total maximum weight of the maximum number of products being conveyed.

5.4 Concentrated Load

The product conveying surface will impact how the product load is distributed on the conveying surface of the conveyor. Flat bottoms will evenly distribute the load. Irregular bottoms, feet, rings, or bottom boards can cause the product load to be concentrated at the contact points. Conveyor rollers will also only contact the product at certain points.

Calculate the maximum concentrated loading at any one point. The concentrated loading will be used to determine the load rating requirements of the belt, roller, or chain.

5.5 Speed

Conveyors can be supplied to operate over a wide speed range. Conveying speed is expressed in feet per minute (fpm). Ideally, you will operate your conveyors at the minimum speed required to meet your throughput requirements. Keeping the speed as low as possible decreases wear and noise and increases control of the product.

The minimum speed required can be calculated by multiplying the maximum throughput rate times the average box length:

\[
\text{minimum speed (fpm)} = \text{avg. length (ft)} \times \text{throughput (cases/minute)} \quad (5.5.1)
\]

At this minimum speed, the packages would be conveyed back to back. In real world applications, you may want to operate at a slightly higher speed to create a small gap between the products.

It may be desirable to create a gap between products for certain operations. These were noted on the process flow layout. Running the second conveyor at a speed greater than the first conveyor will create a gap between products as they transition from the first conveyor to the second. The spacing between products can be calculated by using the following formula:

\[
d_i / s_i = d_f / s_f 
\]

Where:
- \(d_i\) = initial distance leading edge to leading edge
- \(d_f\) = final distance leading edge to leading edge
- \(s_i\) = speed of first conveyor
- \(s_f\) = speed of second conveyor
The gap between the two products is then,

$$\text{gap} = d_f - \text{leading product length} \tag{5.5.3}$$

It is important to note that while the gap between the products has increased, the throughput remains unchanged.

### 5.6 Elevation

Elevation changes are typically achieved with incline and decline belt conveyors. The maximum angle of incline is dependent on two factors: 
1). The coefficient of friction between the product conveying surface and the conveying belt; 
2). The relationship between the center of gravity of the product and the product conveying surface length.

1). Coefficient of friction between the belt and the product

Sufficient frictional force between the conveyor belt (or other conveying surface) and the product conveying surface is necessary to overcome the gravitational pull on the product and keep it from slipping. As the incline angle is increased, the force of the gravitational pull parallel to the conveying surface will increase, and the frictional force will decrease. When the gravitational pull exceeds the frictional force parallel to the conveying surface, the product will slip. Figure 4 shows the relationship between gravitational pull and the incline angle.

**Figure 4: Product on an incline**

The frictional force the belt exerts on the product parallel to the conveying surface is,
The gravitational pull on the product parallel to the conveyor surface is,

\[ F_{\mu} = F_n \cdot \mu = W \cdot \cos(\theta) \cdot \mu \]  

The product will not slip as long as the following equation is true,

\[ F_{\mu} > F_g \]  

or,

\[ \mu \cdot \cos(\theta) > \sin(\theta) \]

Where,
- \( F \) = Force
- \( W \) = Weight of product
- \( \mu \) = Coefficient of friction between product and conveyor belt
- \( \theta \) = Angle of incline

Most conveyor belt manufacturers publish coefficient of friction values for their belting for various products. These values should be used with caution. Factors such as temperature, humidity, product condition, and belt age can affect the coefficient of friction. If the angle of incline is questionable, product testing is recommended.

2). Product center of gravity versus product length

The gravitational pull on a product is always straight down towards the center of the earth. A vector originating from the center of gravity of the product pointing down represents this force. As the angle of incline increases, the intersection of this vector relative to the conveying surface moves towards the back edge of the product. When this intersection point moves back beyond the edge of the product, the product will tumble backwards. In real world conveying applications, the product will likely tumble before this point. A good rule of thumb is for the intersection point to fall in the middle third of the product. The following formula can be used to estimate the tumbling angle:

\[ \theta = \text{Arc Tan} \left( \frac{\text{Length}}{3 \times \text{Height}} \right) \]

This formula assumes that the center of gravity is located at the geometric center of the product. Often, products are packaged such that the center of gravity is lower than the center. In such a case, the angle of incline may be increased. Product testing is recommended if operating near the tumbling angle.

Many times the layout will dictate that the conveyor must incline or decline at an angle greater than that achievable with a belt conveyor. In such cases, special conveyors exist to
overcome the slippage and tumbling issues. Some examples are side-gripping conveyor belts, continuous vertical conveyors, and spiral conveyors.

5.7 Roller Spacing

Roller conveyors, as well as skatewheel conveyors, present the special problem that the product is supported at points of contact and not continuously over the conveying surface. If the product is not supported at enough points, the product will convey unevenly or may stall.

The recommendation for roller conveyors is a minimum of 3 rollers beneath the product at any given time. The maximum roller center spacing can be calculated by dividing the shortest product length by three.

\[
\text{minimum roller spacing} = \frac{\text{minimum product length}}{3} \quad (5.7.1)
\]

The minimum roller spacing will have to be rounded down to an available roller spacing.

6. Conveyor Selection and Specification

6.1 Type and Style Selection

At this point, you have gathered all of the information available for the application and have a firm understanding of your products and processes. The flow of the system has been laid out on a plant drawing, with pertinent information at critical points. You also have gained an understanding of the types of conveyors used in package handling conveyor systems. All required application calculations have been performed. It is finally time to make a selection of the type and style of conveyors to be used and to specify the important details for each conveyor.

Considerations

A number of factors will enter into your selection of the type and style of conveyor to be used. More than likely, your system will include a number of different types and styles. Different conveyor types may present different benefits and trade-offs, and there may not be a clear-cut “best” conveyor for your application. You will have to weigh the different factors to make your final decision.

Some of the factors that you will consider when making your final selection should include:

- Product conveying surface and any other pertinent physical product characteristic
- Total static and live load on the conveyor
- Concentrated loading on the conveyor
- Speed the conveyor will need to operate
- Functional requirements of the conveyor
- Environment the conveyor will be operating in
- Changes in elevation required
- Required widths
- Ability to accumulate or transfer product
- Hygiene of the conveyor
- Maintenance of the conveyor
- Cost of purchasing, installing, operating, and maintaining the conveyor

All other factors being equal, cost will usually dictate the final decision. However, you should be careful not to make a decision based purely on equipment cost without considering performance and long-term ownership costs.

**Gravity vs. Powered**

The first decision you will have to make is whether to use powered or gravity conveyor. Gravity conveyor is usually the least expensive conveyor to purchase, operate, and maintain. However, gravity affords little control over the product speed or movement. You will be reliant on operators or gravity to move the product, and speed is difficult to control. If you use gravity to move the product, you will need enough elevation change to start and maintain movement of the product. Different weight products or products with different conveying surfaces will travel at different speeds.

Powered conveyor allows you to control the movement of products precisely. The product can be conveyed at controlled speeds and can be started, stopped, or accumulated as required. A variety of elevation changes are possible with powered conveyor and products can be automatically manipulated on the conveyor. Powered conveyors are preferred for all except the most basic applications.

**Roller vs. Belt vs. Chain**

The choice between roller conveyor, belt conveyor, and chain conveyor is not always black and white, and is often a matter of personal preference. The three conveyor types each excel in different types of applications, and there is quite a bit of overlap in performance. Within a given conveyor type, the different styles of conveyor (e.g. flat belt driven roller vs. chain driven roller vs. v-belt driven roller) will provide varying levels of performance for a given application.

Table 2 is presented as a guideline in selecting the different types of conveyors. Where different styles of a given type of conveyor provide different performance levels, a range is given. The table is only a guideline, and further investigation should be performed prior to making a final selection.
### PERFORMANCE RATINGS

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>BELT</th>
<th>ROLLER</th>
<th>CHAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveying surface compatible with a variety of products</td>
<td>5</td>
<td>3 – 4</td>
<td>2</td>
</tr>
<tr>
<td>Total Load Capacity</td>
<td>2 – 4</td>
<td>3 – 5</td>
<td>4 - 5</td>
</tr>
<tr>
<td>Concentrated Load Tolerance</td>
<td>2 – 4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Speed Range</td>
<td>3 – 5</td>
<td>3 - 4</td>
<td>2</td>
</tr>
<tr>
<td>Environmental</td>
<td>2 – 5</td>
<td>3 – 4</td>
<td>2</td>
</tr>
<tr>
<td>Elevation Changes</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Available widths</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Accumulation options</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Transfer to/from options</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Hygiene</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Maintenance</td>
<td>3 – 4</td>
<td>3 - 5</td>
<td>3</td>
</tr>
<tr>
<td>Cost</td>
<td>3 – 5</td>
<td>3 – 4</td>
<td>3</td>
</tr>
</tbody>
</table>

5 – Excellent; 4 – Good; 3 – Average; 2 – Fair; 1 - Poor

Table 2: Typical Conveyor Performance Ratings

### 6.2 Gravity Conveyor Specification

When selecting gravity conveyor, you will choose from roller, skatewheel, chute, and ball conveyors. Chute conveyors and ball conveyors are usually reserved for special applications.

Chute conveyors are used where a large elevation change is required over a short distance. The pitch of the chute needs to be great enough to overcome the friction between the chute and the product. Chutes are normally custom fabricated for the application.

Ball conveyors are more expensive than roller or skatewheel gravity conveyors. Because they allow product travel in any direction, they are used at workstations or transfer locations.

Roller and skatewheel gravity conveyor are the two styles typically used in package handling conveyor systems. Skatewheel conveyor is usually less costly than roller conveyor, but it cannot handle the wide variety of products that gravity roller conveyor can handle. Figure 5 provides recommendations for the types of products to be handled on the two styles of conveyors.
Figure 5: Gravity Conveyor Recommendations (1)

Gravity roller conveyor will require a minimum of 3 rollers beneath the product at all times. A minimum of 10 gravity skatewheels beneath the product at all times is recommended for skatewheel conveyor. Varying both the axle spacing and the number of wheels per axle can satisfy the 10 wheel minimum.

Per your calculations, you will know the static, live, and concentrated load requirements for the application. The minimum conveyor frame rating must exceed the live and static load requirements. The roller or skatewheels must satisfy the concentrated load requirements.

If the gravity conveyor will rely on gravity to move the product, then the conveyor will need to be pitched towards the discharge end. It is recommended that you test your product to determine the optimum conveyor pitch. Table 3 shows some typical gravity conveyor pitches for common products.
6.3 Belt Conveyor Specification

The two major considerations in specifying a belt conveyor are selection of the belt and frame style. Based on the calculations performed, the conveyor selected must have a static and live load capacity rating in excess of that for the application, and the dimensional requirements must also be satisfied.

The product characteristics, load, speed, environment, and functions to be performed will dictate the type of belt selected. In certain food applications, USDA or FDA approval may also be necessary. Belt characteristics to consider when selecting a belt include: conveying surface, coefficient of friction (top and bottom surface), material compatibility, maximum speed, sanitation, minimum pulley diameter, strength, lacing type, and modifications available.

The belt selected and the live and static load will dictate the conveyor frame style. Fixed bed style conveyors tend to have higher friction coefficients, and therefore lower load ratings than roller bed style conveyors. For conveyor lengths less than 2-1/2 times the belt width, some type of belt guiding device (e.g. v-belt welded to the underside of the bed) and track in
the frame are recommended. For high-speed requirements, balanced pulleys, timing belt drives, and precision bearings are recommended.

Belt conveyors are often used in incline and decline applications. In applications where the pitch angle exceeds 5 degrees, power feeder belts and noseovers are recommended.

6.4 Powered Roller Conveyor Specification

To specify a powered roller conveyor, decisions will need to be made on the roller specifications and the drive type. The conveyor frame should have a static load rating in excess of that calculated for the application.

The roller specification will include the material, diameter, thickness, width, shaft, bearings, and spacing. The roller should be selected so that its rating exceeds the maximum concentrated loading calculated. The roller material must be compatible with the product, the process, and the environment. Roller spacing should be selected to be less than the minimum roller spacing required.

There are a number of different methods available to drive conveyor rollers that were detailed previously. The first consideration should be total live load. For a given roller size and spacing, some methods will have higher load ratings than others. Among those drive methods that exceed the total live load requirements, selection is usually made on environmental considerations or personal preference.

High-speed applications require special consideration with roller conveyors. As roller diameter decreases, rpm increases for a given conveying speed. High-speed applications require precision bearings in the rollers and a timing belt drive.

6.5 Chain Conveyor Specification

The main consideration in specifying a chain conveyor is the chain type and size, and the number and spacing of strands of chain required. The conveyor frame must be rated in excess of the total static load. The chain type to be used will be a function of the application, environment, conveying speed, and live load.

The number of chain strands and spacing required will depend on the total live load and the product characteristics. By their nature, chain conveyors only support the product at the points of contact of the chain. The bottom of the product needs to be capable of supporting the product over the unsupported length. Once the numbers of strands of chain and chain spacing have been determined, the chain should be sized for the total live load and the concentrated load.
6.6 Additional Specification Details

Conveyor Drive – HP, drive type, location

All powered conveyors will have an electric motor that powers the conveyor. Most models are offered with several drive configurations or mounting options. The conveyor manufacturer will publish maximum load ratings for multiple motor sizes. These ratings will be at a standard speed and horizontal elevation. If your application is at any speed other than the standard speed, you will need to de-rate the load ratings using the following formula:

\[
\text{actual load rating} = \text{std load rating} \times \left( \frac{\text{actual speed}}{\text{std speed}} \right)
\]  

(6.6.1)

The motor selected should have a maximum load rating in excess of the total live load for the conveyor. There is no benefit in over sizing the motor. An oversized motor will operate less efficiently and may allow the conveyor to be overloaded beyond its capacity.

The drive configuration and location should be selected to best fit your application. Accessibility, clearance, safety, and conveyor performance should all be considered. A drive mounted beneath the conveyor is out of the way, but it may not be accessible. A drive mounted above the conveying surface may interfere with product on the conveyor. Overhead conveyors may require that the drive be mounted on the side or above the conveying surface to maintain the underside clearance.

Guardrails

Guardrails are installed on conveyors primarily to keep product from falling off of the conveyor or to locate and orient product on the conveyor. Manufacturers offer a wide variety of standard guard rail designs for their conveyor models, and custom guardrails are also available. Some guardrail types are designed to be adjusted quickly for different product sizes, while others are fixed at one width. Low friction surfaces or skatewheels can also be installed on guardrails to minimize the drag created when a product comes into contact with the guardrail.

Accumulation – Type, zone lengths

Depending on the type of accumulation to be used, you may need to supply additional specification information. Minimum pressure accumulation conveyor is adjusted in the field and does not require any further specification. Zero-pressure accumulation conveyor requires that the sensors and zones be specified in detail. The sensor type may be mechanical switch, retroreflective photoeye, diffuse photoeye, limit switch, or other. The sensor must be compatible with the product to be conveyed. The type, mounting location, and voltage of the sensor should be specified. The accumulation zones may be a constant length over the length of the conveyor, or there may be a mixture of zone lengths. It is also possible that some parts of the conveyor will be zero-pressure.
accumulation, while others are powered roller. A sketch should be provided with each zero-pressure accumulation pressure to show the location of sensors and the length and location of accumulation zones.

Transitions/End Types

The transition from one conveyor to another requires special consideration, especially with small products. Depending on the type of conveyors used, a gap may exist between the two conveyor ends due to the radius of the pulleys or the design of the conveyor. The distance from the point of product contact on one conveyor to the next should be no more than 1/3 of the length of the shortest product (see sketch below).

If,

\[ x = R1 + d + R2 \]  \hspace{1cm} (6.6.1)

then,

\[ L/3 \geq x \]  \hspace{1cm} (6.6.2)

must be true for the product to be able to consistently bridge the gap. If the distance is greater than 1/3 of the shortest product length, devices are available to bridge this gap. Dead plates are flat plates that the product can slide across on across the gap. Dead plates are also available with small gravity rollers or wheels to reduce the friction. Powered and gravity roller ends are also available for many conveyor types.
Supports

The conveyor elevation and method of supporting the conveyor will determine the supports to be specified. Conveyors are typically supported from the floor or are hung from an overhead structure.

Floor supports can either be adjustable in height or have a fixed height. They typically attach to the bottom or side of the conveyor, and a footpad with holes is provided to anchor the conveyor to the floor. Multi-level floor supports are available to support multiple conveyor lines when they are stacked one above the other.

Conveyors that are to be supported from above utilize ceiling hanger supports. Ceiling hanger supports use metal tubes or angles that are placed under the conveyor at select points and held in place with brackets. Two rods that are threaded on the ends are then dropped from the overhead support structure at each support location. The drop rods pass through holes in the support, and a nut holds them in place. Overhead supported conveyors may also need sway bracing to keep the conveyors for moving from side to side.

Finish

Common finishes for conveyors are wet painted, powder coat painted, galvanized, brushed stainless steel, and anodized aluminum. Most manufacturers have a standard paint color, but will accommodate special paint requests for an additional fee.

Special Modifications

Most manufacturers will offer modifications to their standard conveyor designs. If you have special requirements for your application that cannot be met by the standard conveyor designs, you should approach the manufacturer about the modifications they can offer.

7. Lay It All In

By this point, you have selected conveyor models and specified their associated widths, lengths, and all other pertinent details. You should have also performed all necessary calculations, including the maximum incline and decline angle. It is now time to lay the conveyors in on the plant layout.

The conveyors should be laid in on the drawing scaled to the actual conveyor dimensions. You may find that the conveyor lengths need to be modified slightly. The greater care and precision you using in laying in the conveyors, the smoother the actual conveyor installation will go. Each conveyor should be numbered in sequential order starting at the infeed end and working downstream. You should use a numbering system that makes sense to your operation. If your
system includes multiple lines, it is a good idea to use separate layers and colors for each conveyor line on the drawing.

The drive locations should be shown on each conveyor with the motor horsepower. The location of any field devices should also be noted. A top of conveyor elevation should be provided at the infeed and discharge of every conveyor. All conveyor supports should be shown with the support type noted. Overall conveyor dimensions are often helpful. Any other pertinent information that will aid in the installation of the conveyor system should be included.
Figure 7: Final Conveyor Layout Drawing
8. Controls

8.1 Purpose of Controls

All powered conveyors, and even some gravity conveyors, will require electrical controls to control the operation of the system. The control system will control the operation of all electrically powered output devices based on inputs from the system. The control system ultimately dictates how the conveyor system will operate and ensures that it operates in a safe manner.

All control systems, whether relay, PLC or PC based, operate on the same basic premise. Electrical outputs are turned off or on based on the state of electrical inputs. Electrical outputs include motors, solenoid valves, relays, lights, horns, clutches, and brakes. Electrical inputs provide an electrical signal to the control system based on their state. Electrical inputs include pushbuttons, limit switches, proximity switches, photoeyes, bar code scanners and HMI’s. Inputs and outputs can be discrete or analog. Discrete inputs and outputs have only two states, on and off. Analog inputs and outputs have a continuous range rather than two discrete states.

8.2 Relay Based Controls

Relay based control systems use control relays to perform all logic functions and to control devices. Relay control systems have been around for a very long time. Relays have an electrical coil and one or more pairs of contacts. The contacts may be open (normally open) or closed (normally closed) in the deenergized state. Closed contacts allow electrical current to flow through them, while open contacts do not. When the coil is energized, the state of the contacts alternates.

The state of the various system inputs will control the state of the relays in the control system. The relays then set the state of the outputs based on the inputs. Very intricate control schemes can be designed using relays, but they can be very complex and difficult to troubleshoot.

8.3 PLC Based Controls

PLC’s were developed in the 1960’s to replace relay controls. PLC’s are microprocessor-based programmable devices. All inputs and outputs are wired to the PLC Input/Output cards. A program is generated off-line and downloaded to the PLC. The program provides the logic for the system to operate. The PLC will scan the state off all inputs, the logic in the program is then executed based on the state of the inputs, and finally the states of the outputs are set. This process happens many times per second.

PLC’s are industrial hardened devices that have proven their value in industry for years. They are easily reconfigured and expanded, and they can be much simpler to troubleshoot.
than relay based controls. Because they do not use mechanical based relays, they are much more reliable.

As processing power increases and becomes cheaper, PLC’s have become more powerful and affordable. In addition to simple logic, they can perform various mathematical operations and interface with other devices over a variety of networks. A number of software packages exist that allow PLC’s to communicate with plant PC’s. They can be accessed using a modem for remote troubleshooting.

8.4 PC Based Controls

Because of the availability of low-cost computing power, applications have been developed that allow PC’s to act as system controllers. They operate similarly to PLC’s. In fact, many of the applications developed are so-called soft-PLC’s. They use standard or industrial hardened desktop PC’s to provide the control logic. Add-on input and output communication devices are used for the system input and output.

As PC and PLC software and hardware evolve, the line between the two will continue to blur. New systems are coming out that are a hybrid of both systems to take advantage of the best features of each.

8.5 Operator Controls

Operators will control the operation of the package handling conveyor system by controlling inputs to the control system. The operator controls may include pushbuttons, selector switches, keypads, pull-cord switches, and HMI’s (Human Machine Interfaces). Some of the basic functions controlled by operators include: Start, Stop, Emergency Stop, Set Speed, Lane Selection, and Product Set-up. The operator devices may be located only in the main control panel, or may be distributed throughout the conveyor system in operator stations.

9. Summary

As manufacturing and distribution move from a one size fits all mentality to a lean manufacturing model, sophisticated package handling conveyor systems will become increasingly important. This white paper attempted to outline the steps to be taken when specifying a package handling conveyor system. The first step is to gather as much information as is available about the products, processes, goals and future. Next, the processes should be sketched on a plant layout with all critical details noted. Calculations are then performed to ensure that the equipment selected will meet the requirements of the application. The conveyor models are selected, and all pertinent details are specified. The conveyors are then laid over the plant layout to ensure proper fit and clearance. Lastly, the system controls must be specified so that the system will operate as desired. By following these steps, one will ensure that the package handling conveyor system that they specify will perform at a level that meets all of their expectations and goals.
10. References