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1. Introduction

Autopack Co, Ltd. is the designer, manufacturer and sales/after sales service provider of shrink wrapping machines. The company was established in Thailand on 1992 and has been growing since then until today with over 55 employees. Autopack Shrink Wrapping Machines are made to support various production lines. The design is suitable for shrink packing thermal sensitive products such as pharmaceutical, cosmetic, food and beverage products, chemical and printing materials.

Autopack has a vast variety of Shrink Wrapping Machine Models to fulfill demands of the packaging industry. In addition, Autopack also has a flexible approach when it comes to modification or using optional parts as per Customer/User Requirement Specifications. Autopack has two different systems which is the more economical Semi-Automatic System and the faster Fully-Automatic Systems to accommodate different production demands.

Finally, with a team of experienced and dedicated engineers combined with highly skilled labor trained according to Australian and European standards it is levelheaded to say that Autopack has established itself firmly well in the Shrink Wrapping Industry globally.

Fully Automatic Systems

Fully automatic system means the machine has a pneumatically-driven pusher to advance products from the grouping table across the welding bar without the aid of an operator.

The fully automatic system consists of a wrapper unit where the coding starts with Wxx. Following the W is the type of infeed of the wrapper. "L" is side infeed (Right or Left infeed), "I" is for Inline Infeed. Last letter or the third one indicates the machine model. For the tunnel unit, the codes starts with Txx, followed by the tunnel type. "L" is for small size tunnel used for low speed packing of small items, "M" is for medium size tunnel for medium speed packing of small and medium size items, and "H" is for Large size tunnel for high speed or heavy duty packing of small to large size items. For more details please refer to Chapter 2 (P. 11).

A complete naming of a Shrink Wrapping System will contain these codes for example 45SLMH20FP. The first two digits indicates that the width of the welding bar is 45cm as for the last two digits indicates the heat tunnel height is for product with height not more than 235 mm. SLMH indicates

S-shrink system

L-"L" or side infeed

M-multi-lanes

H-high speed or heavy duty

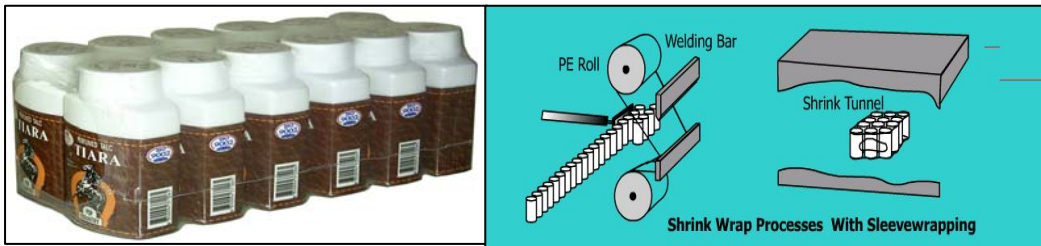
Autopack has two different types of automatic systems which are divided into two sub systems as below:

1. Horizontal Collating.
2. Vertical Collating.

1.1 Horizontal Collating

Horizontal Collating means that products are collated or formed in rows and columns in just one layer before being pushed by pneumatic pusher through the film sleeve, sealed by the welding bar and then onto the heat tunnel. In other words, products are just formed into rows and columns but not stacked. (Picture 1.1)

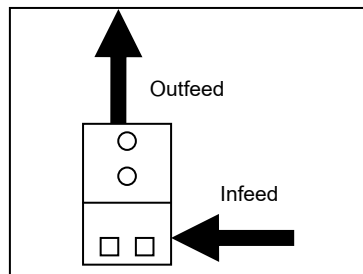
The machine types for horizontal collating are WLM, WLN, WLO, WLH, CMOS, WLU, and WLA. Basically, at the moment it includes all models except the WLV which is the Vertical Collating System and the trays packer (CZH, CUF, and CUH).



Picture 1.1 Product Wrapped by a SLH machine (Integrated Horizontal Collator)

1.1.1 WLH model (Horizontal Collating Side Infeed).

This model suits medium production speed, it has a conveyor that can be connected to either sides of the wrapper (left or right hand side). WLH means the machine is L-shaped infeed with respect to machine direction. Picture 1.4 shows the L shaped conveyors.



Picture 1.1.2 L shaped system with infeed on the right side

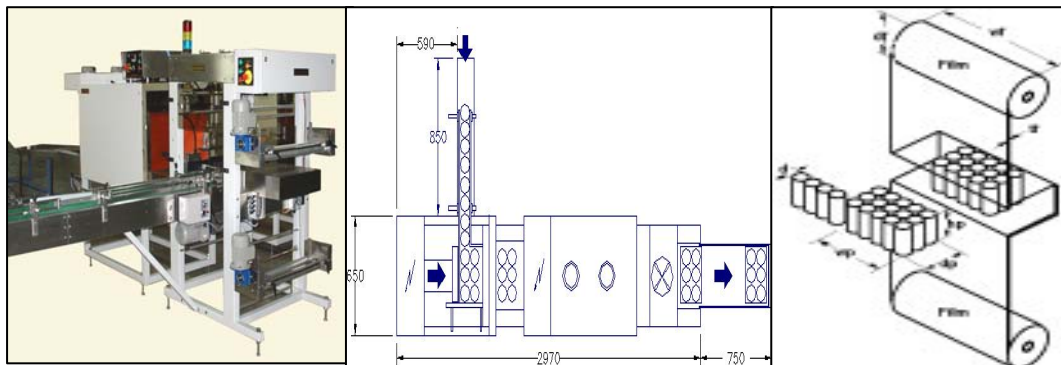
The conveyor carries product containers on a single lane onto the collation table, then these containers accumulate until the first item touches the PSsw (Product Sensing Switches), and then the pusher moves a short distance and come back to receive another row of items. The process repeats until the required number of rows is completed. And as a last step for the pusher, a long stroke pushes the group of items across the welding bar. As the pusher comes back to the collation table, the welding bar cuts the film which results in a seam around the pack.

As the product accumulates on the collation table, the product sensing switch (PSsw) is activated and the following happens:

- a) Product infeed is interrupted by applying product clamp.
- b) Table guide retracts allowing transfer of product forward.

- c) Pusher advances taking one row of product forward.
As the pusher reaches the Short Stroke Switch (SSsw), motion is reversed. This happens as the pusher plate is just above the table guide. When the pusher returns, it activates PRsw which in turn causes:
- d) Release of the product clamp, allowing product to enter table area.
- e) The table guides raises to guide the entering product in straight line. Again accumulated product will touch the PSsw and the short push cycle is repeated.

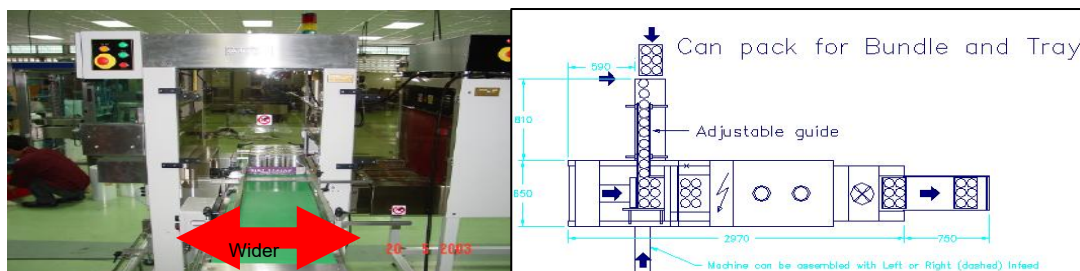
When the final row of product touches the PSsw the pusher will not advance until the welding bar is at its top position and WTsw (Welding Bar Top) is activated. This time the pusher ignores SSsw and transfers the collation on the wrapping and welding position. At that point PFsw (forward end of stroke switch) is actuated. This causes the pack clamp to descend and hold the pack in the position while the pusher starts to retract. The reverse motion of the pusher activates the welding bar down valve. As the pusher reaches the rest position the PRsw (pusher returned) switch is depressed. This starts the collation process again. Picture 1.1.3 shows the machine and Picture 1.1 shows products packed by the machine.



Picture 1.1.3 SLH Machine and Machine Layout

1.1.2 Universal Option or WLU model (Side Infeed).

This model has a wider infeed conveyor, it can assembly all of functions like WLH model but it has a valve and a gate for the collating process. This Machine is also capable of wrapping products on trays, boxes, and other products with rectangular shapes such as juice on tray, water bottle on tray etc. Picture 1.1.4 shows a wider Infeed conveyor on SLU system to accommodate products coming on trays.



Picture 1.1.4 WLU Wrapper With Wider Infeed Conveyor and Layout

1.1.3 Multi lane infeed, Multi packing or WLM model (Side Infeed).

This model has a wide Infeed conveyor with up to 4 sets of guide lanes. An optional Infeed conveyor can be made to split the incoming products into 2 or 3 lanes. Picture 1.7 shows the multilane Infeed packing machine. The product table is fit with multiple table guides and can be adjusted for difference size of product. Or in the operation stages that. The Speed of this machine is up to 50 Ppm because multilane infeed required less movement of pusher to collate products.

When the product accumulates on the collation table, the product sensing switches (PSsw) are activated and sending a signal to the PLC to do the following:

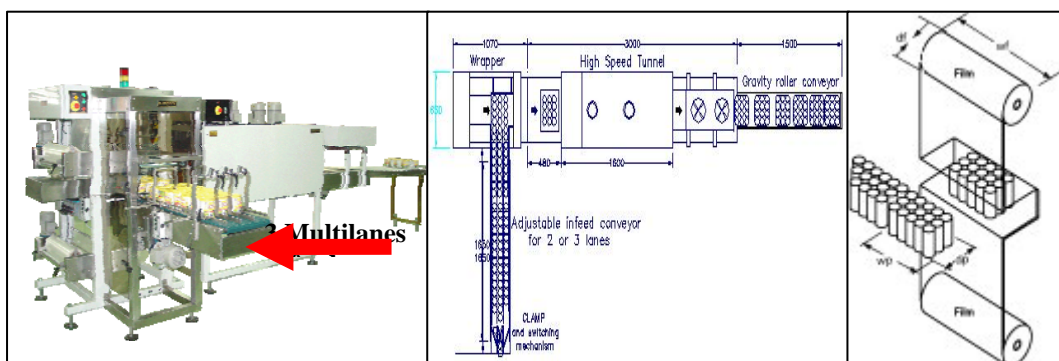
- a) Close the product Infeed clamp.
- b) Lower the table gates.
- c) Advance the pusher forward.

The pusher transfers the group of product to the wrapping and welding position. At that stage PFsw (Forward end of stroke switch) is actuated. This causes the pack clamp to descend and hold the pack in the position while the pusher starts to retract. The reverse motion of the pusher activates the welding bar down valve.

As the pusher reaches the rest position the PRsw (pusher returned) switch is depressed. This causes:

- a) Product clamp to open.
- b) Table gates to rise.

This model is suitable for wrapping products in a high speed or for a continuous production line. Such as drink water, juice, fruit caned and other products with similar shapes.



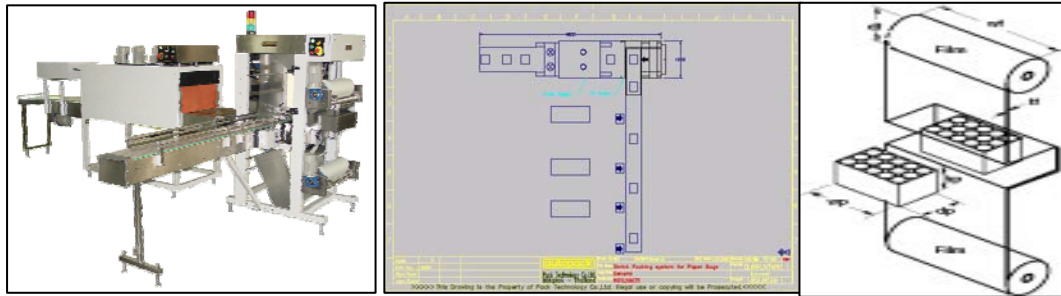
Picture 1.1.5 SLM Machine and Machine Layout

1.1.4 WLN (Side Infeed) and WIT (Inline Infeed) Model (Non-collating Wrapper)

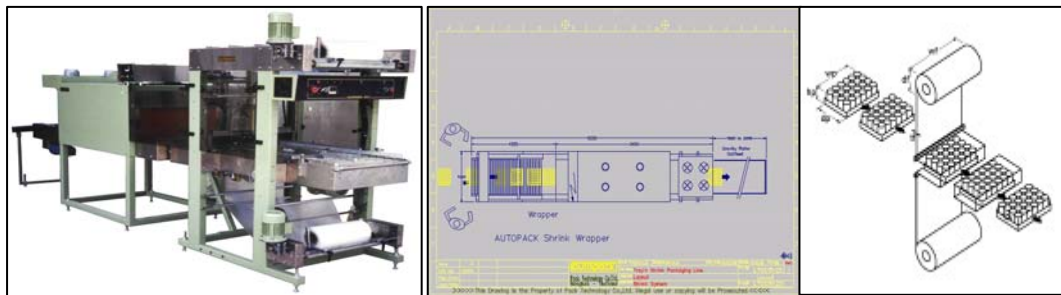
Direct infeed or WLN model is the simplest Automatic model since it does not have a collator; this machine suits items on trays. The difference between WLN and WIN is WLN has the Left or Right

Infeed (Picture 1.1.6) as for WIN the Infeed conveyor is Inline with the machine or direct Infeed (Picture 1.1.7).

This model is specially designed for efficient transfer and wrapping products on tray and rectangular objects that does not require collation. The benefit of the wider conveyor is it can pull the tray directly in front of the pusher. Such as the product is pulled into the machine until the product touch a side lay and the sensor orders the pusher to transfer the group of products through the wrapping and welding bar. This model is suitable for wrapping the UHT containers, sardine on tray, water on tray, bottles and other product which had the same character of product and needs stronger packing.



Picture 1.1.6 WLN Machine with Left Infeed Conveyor



Picture 1.1.7 WIT machine with Inline Infeed Conveyor

1.1.5 CZH model (Tray Packer with Z Infeed).

This machine is specially designed to load products onto a carton tray. CZH Tray Packer is normally combined with an Inline Infeed Wrapper such as WIT where incoming products on trays are sleeve wrapped and then pushed into the shrink tunnel for a complete Shrink Packaging System. Naming tray packers are as follows: “C” is cardboard, “Z” is zig -zag infeed, and “H” is horizontal collation.

Process starts as normal where products are collated and then a pusher will push the products forward onto the tray. The machine uses suction cups to pull a blank from the magazine, formed into a ‘U’ then placed between the fingers on the carrier chains. Next the ‘U’ is advanced to the loading station to merge with the product. The tray of products carried by the chain conveyor will go to the corner flaps step where the cardboard tray is formed into a square tray. Next stage is hot melted glue is applied on to the side flaps to reinforce the cardboard tray. All these steps are accurately control by the PLC program.

This model is suitable for the consumer products that need light and robust packaging. Such as UHT packed drinks, Light canned drinks and other pre- packed liquid products.



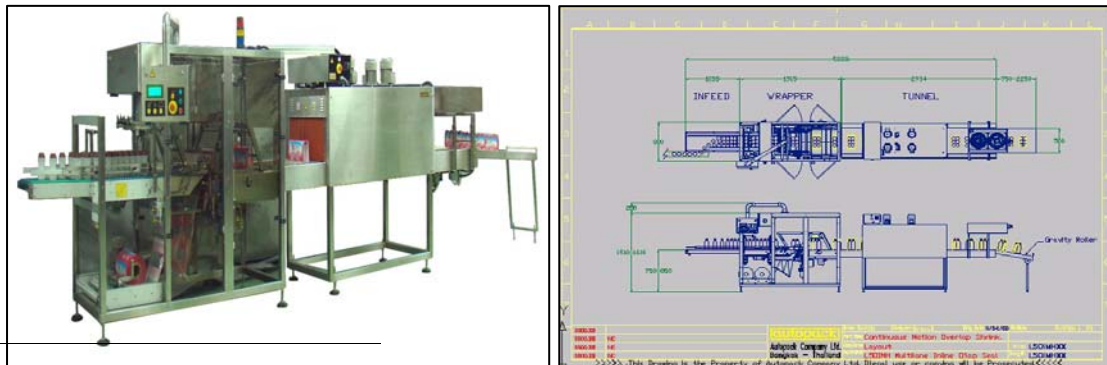
Picture 1.1.8 CZH Machine with Zig Zag Infeed for Tray Packing

1.1.6 CMOS Model (Overlap Shrink Wrapping with Flybars)

CMOS is a Continuous Motion Overlap Seal Shrink Packaging System. This machine can be used for a high speed production line (small product) up to 60 packs/min or medium speed for a bigger size product (1, 5 Liters PET Bottle) up to 40 packs/min. The tandem version of CMOS machine is currently the highest speed sleeve wrapping machine from Autopack with speed up to 80 packs/min which means for an average collation format of 3x2 (6 items per pack) this machine can pack up to 480 items per minutes. Overlap Seal Shrink means that there is no visible seam around the packs, because of the seam is overlapped at the bottom of the pack.

Autopack also made CMOS machine with stacking¹ capability means that Vertical Collation is integrated into the system.

These overlap sealing technique is commonly used for printed film or high speed production line where barcodes and product information are displayed on the film since with this type of shrink sealing there is no seam that will obstruct the barcode scanning.



¹ Important to remember that only nesting cans (where radius of the bottom of the can is smaller than the top) or wrapped paper cans (paper cohesion prevent cans from tumbling) can be stacked.

Picture 1.1.9 CMOS machine

1.1.7 WLP model (for Magazines and Papers Side Infeed)

WLP is a fully automatic sleeve wrap type machine designed for wrapping flat bottom products such as stacks of magazines or paper as well as product collated on tray or pad.

In operation the product is delivered into the machine from side on a conveyor made up of a series of Polycord belts. Once the pack reaches an adjustable stop, it is then lifted off the belts by pneumatically operated bed of rollers. Then a pneumatic pusher transfers the pack behind the welding bar where the wrapping operation is completed.

Once the sleeve is formed the pack is transferred into the shrink tunnel where the shrinking process takes place resulting in a tight pack ready for stacking on the pallet.

1.1.8 WLA model (Tetrapack Aseptic Handling with Lubricated Conveyor with L Infeed).

This model is a machine designed for multi-packing UHT containers. It is suitable for both the Tetra and the "Combibloc" aseptic (sterilization processing) package.

It is designed to operate in conjunction with shrink tunnel to form a complete high performance shrink packaging system for UHT containers.

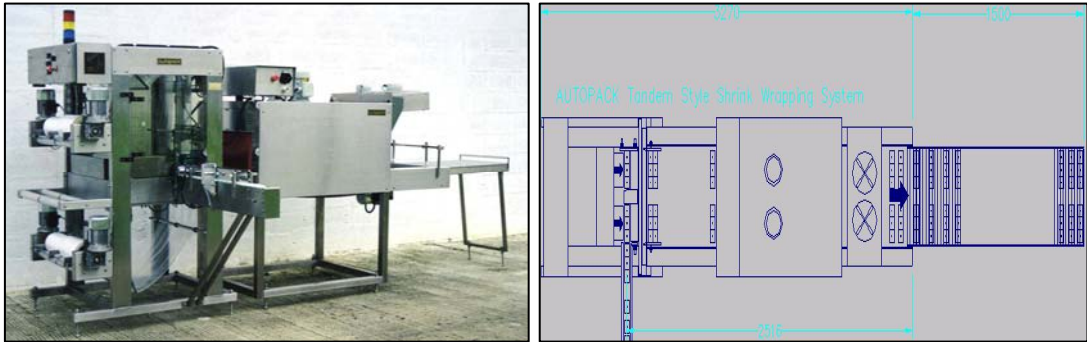
For the operation when after filling and straw application, the UHT containers are transported to the machine on a multi-flex type infeed conveyor (Lubricated Conveyor). As the containers enter the machine they accumulate against the end stop. When back pressure control photocell is covered, the following occurs:

- a) Product Infeed brake is applied to stop in entering the machine during the pusher cycle.
- b) The end stop swings away about 10 mm. to relieve side pressure on the cartons while they are pushed forward.
- c) Pusher starts to move forward.

The pusher takes the row of product just past the retracting table guide and then it returns to its Or position. At the stage the brake is released and the product can enter the machine once again.

When the sensors are triggered, the cycle is repeated, but this time the pusher takes the collation of cartons behind the welding bar, to the wrapping station.

While the pusher returns to form another collation the welding bar descends to form a sleeve around the collation. From here the pack is transferred onto shrink tunnel conveyor which takes the pack through the heating and cooling stages to produce firmly wrapped package.



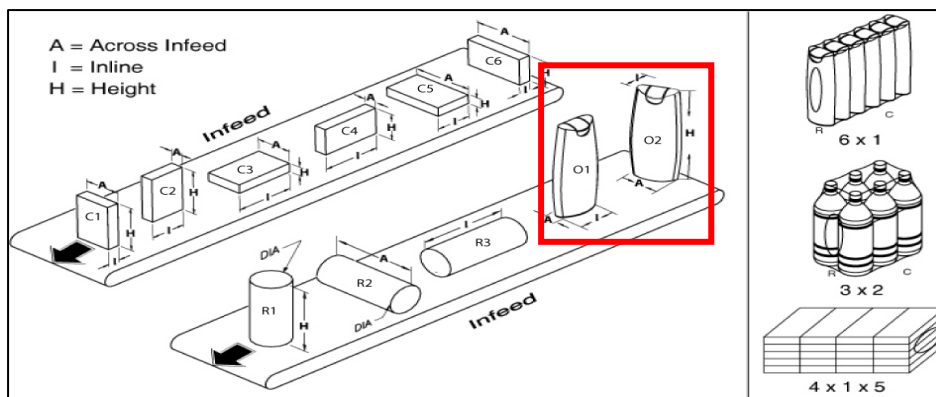
Picture 1.1.10 SLA Machine Picture and Layout for a Tandem SLA

1.1.9 WLO model (Oval Shapes handling with Side Infeed).

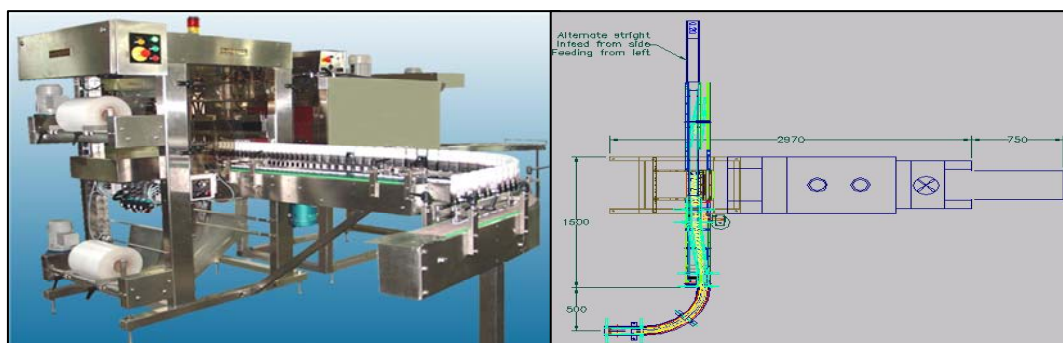
WLO is designed to handle Oval Shaped Bottle such as Shampoo Bottle or Lotion Bottle. Oval Shaped object normally came onto the infeed conveyor in standing position where side of the bottle is leading (Picture 1.1.11 Code O1). This position is not suitable for collation format because when the product is being pushed towards the Welding Bar they will tumble.

Best position for collation is if the bottles are going into the machine in position as in Picture 1.1.11 Code O2, that way when they are being pushed they will move in steadily or stably towards the welding bar.

In order to change the position of the oval bottle, the Infeed conveyor have two separate lane running on different speed that joined together and forming one lane only heading into the collation table as described in Picture 1.1.12 SLO layout.



Picture 1.1.11 Product Orientations on Infeed Conveyor

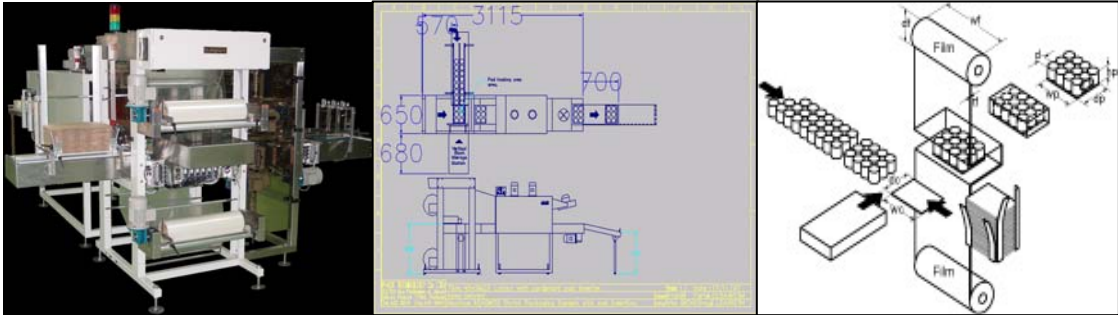


Picture 1.1.12 SLO Machine and Layout

1.1.10 WLC model (Cardboard Pad Inserter with Side Infeed).

This model is a Fully Automatic Shrink Wrapping Machine with Cardboard Pad Inserter.

Operation starts with grouped/collated items arriving onto a cardboard pad in front of a pusher. This cardboard pad is placed by a pusher before groups of items arrived. Once items are in place, the pusher advances the items to the welding position. At this stage the pack is clamped, the welding bar descends to complete the wrap, and the pusher returns to prepare the next collation of product.



Picture 1.1.13 SLC Machine and Layout



Picture 1.2 Product Wrapped by a SLV machine (Integrated Vertical Collator)

1.2 WLV model (Vertical Collating or Stacking with Side Infeed)

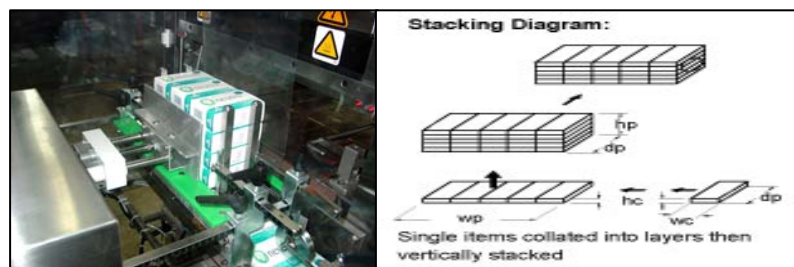
This model is equipped with the vertical-stacking unit located just in front of the pusher. The packing can be done with a number of cartons across the pusher and in rows; and then vertical stacking of the product into a pre-selected number of layers. The machine operates like a horizontal collator but the difference with this model is the lifting capability for stacking products. The first carton activates the lifter and then the layer is elevated to the table level. The lifted cartons are supported by latches which permit the lifter to return. The process will repeat until the desired number of layer has been reached, once this happens the horizontal pusher will push the grouped items across the welding bar where a conveyor further carries them onto the heat tunnel. In summary this process starts with products filling the stacking area which will activate product sensing switches (PSsw) that caused the lifter to elevate the first layer of cartons from the conveyor level to table level.

At this point LTsw sensor is de-activated, sending the lifter down. At the same time, latches keep the lifted layer of cartons at table level. When lifter reaches conveyor level, the cartons enter the collating section again, the PSsw sensors are tripped and then the cycle is repeated.

During the up/down movement of the lifter, products are blocked from entering the stacking section by a lifter plate side extension.

On the final up-stroke the lifter stops in the upper position signaling the pusher to transfer the collated cartons to the wrapping and welding position. As PFsw (Forward End of Stroke Switch) is de-activated, lifter descends, and pusher reverts to start position. The lifter bottom is now loaded with cartons once again which trips PSsw sensors. But the lifter has to wait until the pusher returns, and activates PRsw (Pusher Return Switch).

This machine can collate single or multi stack packing such as pharmaceutical, soaps, toothpaste, cassettes, discs, floor and wall tiles, ice cream tubs etc.

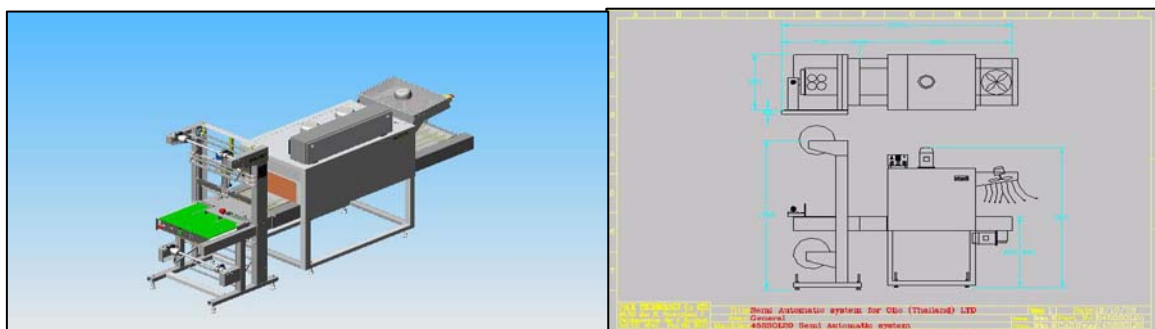


Picture 1.2.1 Vertical Collator in the SLV Machine

1.3 Semi-Automatic System.

The semi-automatic system is designed to be operated with operator assistance or other controlling machine. The collation of product and pushing them toward the welding gate is all done by operator not by the wrapper. This machine is for low speed production line where size and shape of product is various and collation need to be adjusted frequently. This machine is very economical in term of maintenance as it has less automation functions which mean less electrical motors. Price is less expensive because less sensor and PLC is required since collation is all done by an operator.

One of the Optional function for this model is powered pusher where pushing the products is done by the help of a pneumatic pusher on order from the operator not from PLC module. The Advantage is that less energy is needed since the pushing is done by pusher not by an operator and less expensive because this type still does not require PLC and sensors to collate items.



Picture 1.3 SSO Machine and Layout

2. The assembly of shrink tunnel.

The Heat tunnel consists of five main module or units as follow:

- The Inside of the shrink tunnel is designed for installation of 1500w or 1750w heater. The size and quantity depend on the tunnel's dimension. For more effective heating process it has a blower and a squirrel cage design to equally circulate the hot air inside.
- The Outside of the shrink tunnel is insulated to retain the heat inside the tunnel which also saves energy.
- Conveyor spec. Depend on type of products and used character, wire belt mesh type, or heavy duty slat type. This part of the machine is controlled by electric motors for adjustable conveyor speed.
- The control box on the top of the tunnel, consist of a heat control unit and conveyor speed control unit that can be adjusted for a desirable shrink condition.
- The air-cooling unit (at the end of the heat tunnel), is a galvanized steel electric fan. This fan blows air to cool down the film in order to tighten the sleeve wrap. The faster the cooling is the tighter the sleeve wrap going to be.
- ***Type of shrink tunnel.***

The shrink tunnels are comes in three basic models:

__TL__ - Short length tunnel designed for slower pharmaceutical and cosmetic packing lines
Or label shrinking.

__TM__ - Medium to high speed general purpose tunnel suitable for most shrink packaging applications.

__TH__ - Long series, heavy duty tunnels, applicable at all speeds where thicker films and Heavier packs are used.

The first is blanking for two digits mean the width of entrance tunnel.

The second is blanking for two digits mean with height of entrance tunnel.

The shrink tunnels have a number of features which are not normally found on other brand, these are as follow:

- Quiet and low energy consumption operation.
- Small external size compared to product handling capability (Compact design).
- Symmetrical, fixed air flow pattern. (no perplex to adjust)
- Drop down bottom for easy cleaning.
- Cooling station with a roller accumulation conveyor.

Because of its unique airflow, the tunnels can be used with a variety of films and machines such as L-bar sealers, flow wrappers, but the air flow symmetry really excels with sleeve wrapped product, resulting in tight, uniform pack with small holes on either side.

For best results, the shrink tunnels should be matched with the sleeve wrappers or L-bar sealers to from a higher performance shrink packaging system.

Heat Tunnel Glossary

- ***Conveyor system***
Simple relay / contactor circuit with some electric control.
- ***Conveyor drive***
Geared motor with fixed or variable speed depending on application.
- ***Conveyor belt***
Stainless steel mesh for general-purpose tunnels. THH uses heavy duty chain with flat bars for product conveying.
- ***Air circulation***
Two or four centrifugal force impellers are used to provide symmetrical air pattern.
- ***Heating***
Finned type (for long life) air heating elements controlled by PID electronic temperature control unit.
- ***Outfeed accumulation conveyor***
Free running roller type to accumulation conveyor is provided. Other options are also available.
- ***Safety***
The machine is well guarded. Two step bottoms are provided on either side of the tunnel for emergency use.
- ***Temperature / speed setting***
When the tunnel reaches its operating temperature, (approximate 10-15 min.) product can be passed through. It is best to operate at the lowest possible temperature and slow to medium speed.
- In general for 40-50 μ . PE. Films the tunnel temperature is set to 180⁰-200⁰ Celsius with speed setting range from 3.5-6.0 in scale.
- For 70-80 μ . PE. Films The tunnel temperature may be set at 20⁰-250⁰ Celsius with speed Setting range from 2.5-5.0 in scale.
- For PVC. Films the temperature may be as low as 120⁰C and the speed up to 7 but again it is best to set the temperature as low as possible and lower the tunnel's conveyor speed.

Appendix A

By semi automatic system

This system divided by width and height of entrance shrink tunnel, including the size of product that suitable for each model in the example below.

- Model 45 SSS 20 : is for product that had 20-165 mm. of diameter, with height not over 225 mm. and packing speed is approximately 18 packs per minute.
- Model 45 SSS 30 : is for product that had 20-240 mm. of diameter, with height not over 325mm. and packing speed is approximately 18 packs per minute.
- Model 60 SSS 30 : is for product that had 20-240 mm. of diameter, with height not over 325mm. and packing speed is approximately 18 packs per minute.
- Model 60 SSS 40 is for product that had 20-240 mm. of diameter, with height not over 400mm. and packing speed is approximately 18 packs per minute.
- Model 80 SSS 30 is for product that had 25-340 mm. of diameter, with height not over 325mm. and packing speed is approximately 14 packs per minute.
- Model 80 SSS 40 is for product that had 25-340 mm. of diameter, with height not over 400mm. and packing speed is approximately 12 packs per minute.

By fully automatic system

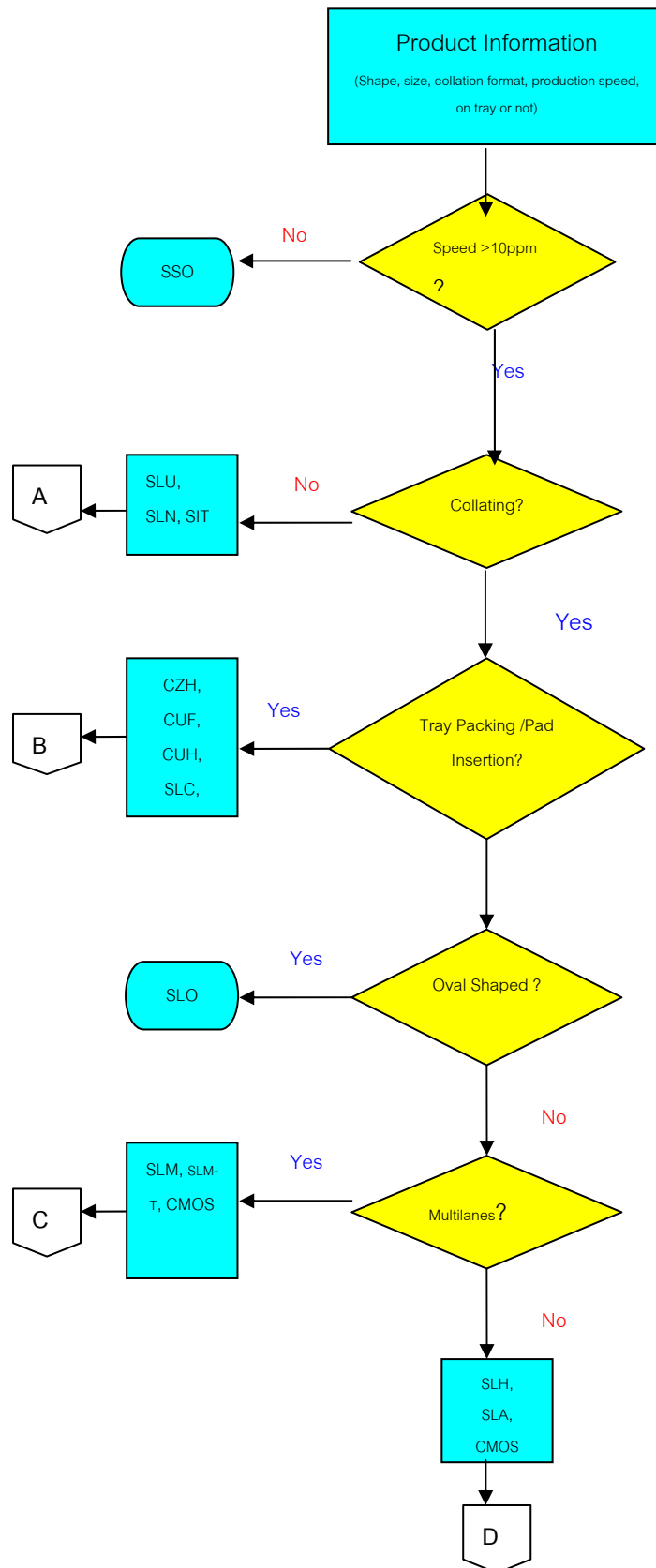
This system divided likely the semi automatic system by width and height of entrance shrink tunnel, including the size of product but it had faster in packing process than, that suitable for each model in the example below.

- Model 45 ASS 20 : is for product that had 20-100 mm. of diameter, with height not over 220mm and packing speed is approximately 28 packs per minute.
- Model 60 ASS 30 : is for product that had 20-100 mm. of diameter, with height not over 325mm. and packing speed is approximately 25 packs per minute.
- Model 60 ASS 40 : is for product that had 20-100 mm. of diameter, with height not over 400mm. and packing speed is approximately 13 packs per minute.
- Model 80 ASS 30 : is for product that had 50-130 mm. of diameter, with height not over 325mm. and packing speed is approximately 20 packs per minute.
- Model 80 ASS 40 : is for product that had 50-130 mm. of diameter, with height not over 400mm. and packing speed is approximately 20 packs per minute.

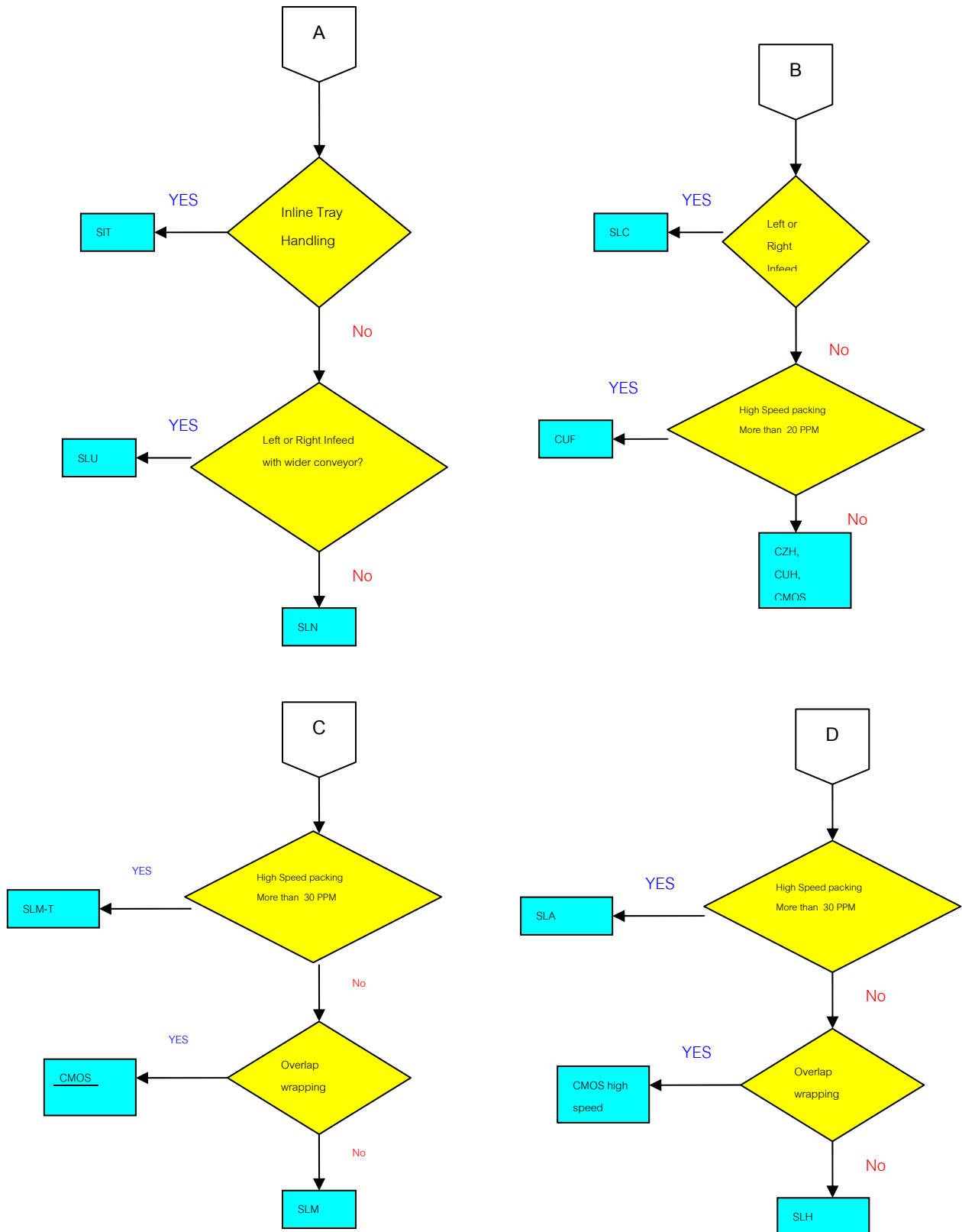
Machine Safety Features.

- The welding bar had a dual safety system to protect the product and the machine operator.
- Emergency stop switches installed in many different positions for an easy and quick Shut Down of the machine.
- Safety guards made from acrylic clear views with interlocking system are installed to cover Infeed conveyor and Collation table (include Welding bar). If anyone opens these covers machine will shutdown and will not be able to start.
- If the machine detects any fault or emergency situation in the system such as product jam or running out of Shrink Film, the suitable color of the emergency light flashes and the alarm will sound immediately.
- The temperature level in the tunnel is controlled precisely by a Precision Controller. In addition the temperature is displayed by a LCD screen on the top of the heat tunnel for surveillance purpose.
- Autopack also design Heat Tunnel with Reduced Explosion Risk for products containing flammable gas and other explosive chemicals.

Appendix B



Appendix C



Appendix D

* Autopack Machines Features					
System	Packing Speeds (Packs Per Minute) Depends on Collation format	Interface	Operation Mode	Advantages	Wrapper model
SSO	12 PPM (depends on operator's skill)	No	Semi automatic (operator push)	When size and collation changes many times per day	WSO
SLO	12-22PPM	LCD	Full Automatic	Special for Oval Bottle handling Quick adjustable lower tunnel temperature	WLO
SLU	12-28 PPM	LCD	Full Automatic	Wider Tray, Line Communication	WLU
SIT	18 PPM	No	Full Automatic	Trays and rigid stacked items wrapping w/ Inline Infeed Low maintenance	WIT
SLN	12-28 PPM	No	Full Automatic	Trays and rigid stacked items wrapping w/ Side line Infeed Low temperature tunnel for cosmetic and pharmaceutical products	WLN
SLC	12-25 PPM	LCD	Full Automatic w/ cardboard inserter	Line Communication, Quick adjustment, power film drive, film perforation	WLC
SLH	12-28 PPM	LCD	Full Automatic w/ Integral Horizon Collator	Medium speed collation, Line communication, film perforation	WLH
SLA	12- 28 PPM	No	Full Automatic w/ Aseptic container Collator	Aseptic Container Handling	WLA
SLM	30 PPM	LCD	Full Automatic w/ multilane collator	Multilane packing	WLM
SLM-T	50 PPM	LCD	Tandem Full Automatic w/ multilane collator	Line Communication, Quick adjustment, power film drive, film perforation, High Speed	WLM-T
Tandem CMOS	75- 80 ppm So far this is the fastest machine we have	LCD	Tandem Full Automatic Overlap Wrapping w/ Integral Horizon Collator	Overlap Wrapping, Printed Film, Line Communication,	72SIMH35
CMOS	50 -55 PPM	LCD	Full Automatic Overlap Wrapping w/ Integral Horizon Collator	Overlap Wrapping, Printed Film, Line Communication,	50SIMH25, 70SIMH35
CZH	20 PPM	LCD	Full Automatic Tray Erecting, Gluing, Collator and Loading	Nordson Hot Melt Gluing, Integrated Controls, printed and perforated film	CZH
CUF	25 PPM	LCD	Full Automatic Tray Erecting, Gluing, Collator and Loading	Nordson Hot Melt Gluing, Integrated Controls, printed and perforated film, Finger Collator U shape Infeed	CUF
CUH	20 PPM	LCD	Full Automatic Tray Erecting, Gluing, Collator and Loading	Nordson Hot Melt Gluing, Integrated Controls, printed and perforated film, wider tray U shape	CUH