White Paper Case Packing

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10/30/17

Case packing is the process by which packages or products are loaded into cases, boxes or trays. These are usually corrugated board but may also be fluted plastic, heavy non-fluted board or other materials. In some instances, such as milk in bottles and cartons, specialized metal or plastic returnable crates are used. For simplicity, this white paper will use the word “case” generically to cover all variations. With minor variations, case packing is the same regardless of whether it is an RSC case, a tray, a crate or some other box.

Case packing seems like a natural for using operators instead of machines. It is simple work so unskilled, relatively low cost, labor can be used and automation dollars can be saved for other things. In reality, there is no such thing as low cost labor. Compensation is high and rising and qualified employees keep getting harder and harder to find. Case packing is also repetitive, often heavy, work with a lot of ergonomically hazardous lifting and bending. This can add to workers compensation claims.

Automated case packing is relatively simple and generally very easy to justify.

The term “case packing” is frequently used to describe the complete process of getting the package into the case. In reality, there are at least 3 discrete operations:

Case erection

Case packing

Case sealing

There can also be placement of internal partitions, slip sheets if more than a single layer of product is packaged, leaflet and instruction insertion.

The entire process may be done on a single machine or multiple machines. This white paper will focus only on the case packing, regardless of where erection and sealing is done.

There are three major methods of automatic case packing: Side loading, vertical placing and vertical drop packing. Some may consider wraparound case forming to be case packing as well. It is beyond the scope of this paper and will be covered in a future paper on caser erection/forming. Each method has a number of variations depending on machine design as well as package and product requirements. The techniques discussed here also apply generally to tray packing. The method chosen will depend largely on the nature of product to be packed.

Side loading

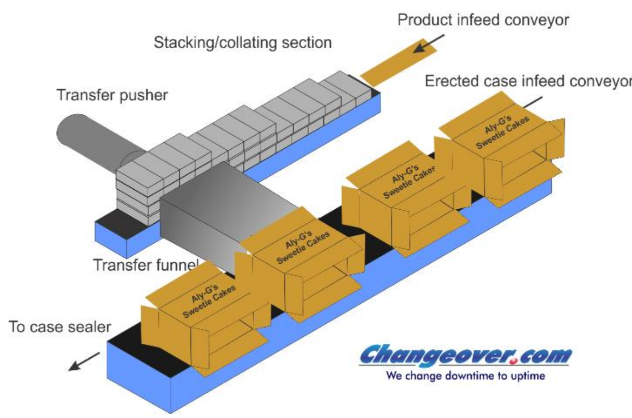
Side loading, sometimes called end or horizontal loading, case packers insert the product horizontally. They are useful where the product shape conforms closely to the shape of the case. Cartons packed in a 2 X 6 pattern into a close fitting case will have little clearance around or between the cartons to allow air to escape as they go in. It is similar to pushing a piston into a cylinder. An air cushion forms and insertion is difficult and slow.

Horizontal packers are also useful where it may be difficult to stage the product vertically in the appropriate pattern. Examples of this include caulking tubes or stacks of plastic cups.

The formed case arrives at the case packing station in either vertical or horizontal orientation usually, though not necessarily, with the long dimension parallel to flow. If vertical, the case needs to be turned on its side for loading. The open end of the case is aligned with the loading station and flaps are moved out of the way. The packer may use a funnel or other device to assure that the flaps do not interfere with loading. When the cartons closely conform to the dimensions of the case, it may be desirable to leave the bottom case flaps unsealed until after loading.

While the case is being positioned, individual packages enter the loading station via a conveyor and are collated into the final pack pattern. Collation usually involves stacking rows of product. If 12 silicone tubes are to be loaded in a 3 X 4 pattern, it will be necessary to include a device to collect 4 tubes, lower them, place 4 more tubes on top of them, lower them and then place the final 4 tubes on top. Only when this complete pattern is ready, can a pusher arm push all 12 into the case. If 24 tubes were to be packed in 2 layers, the first collated group of 12 will be pushed forward to allow space to collect the 2nd group of 24 tubes. Once the 2nd group is collated behind the first group, a pusher arm pushes all 24 tubes into the case.

The collation above described tubes being brought in, lowered and more tubes placed on top. This is called “downstacking”. Other products may be more easily collated by “upstacking”. Upstacking, to use the caulking tubes again, would bring a group of 4 tubes to the collating station, lift them up and then bring another row of 4 tubes underneath them. Rows of tubes would be formed and lifted 4 times until all 12 are collated. They would be pushed forward, a second group collated behind them and both groups pushed into the case.



Side load case packer schematic

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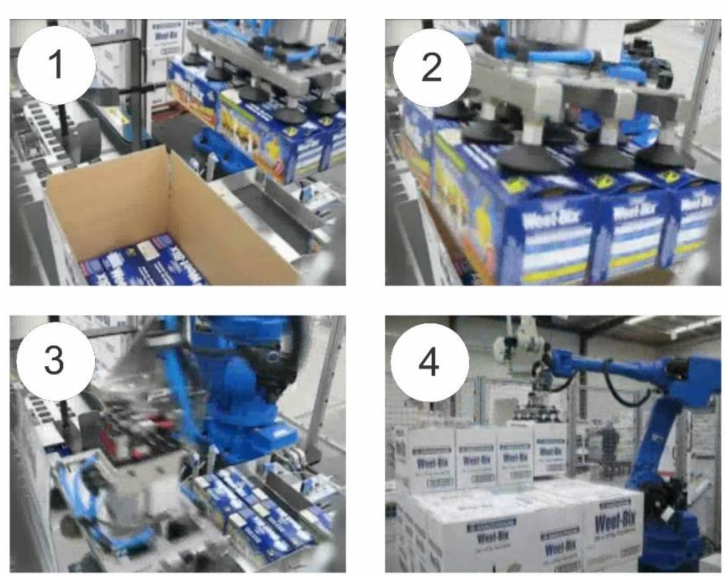
Once loading is complete, the funnel is removed, the case is turned upright, and conveyed to the case sealer. The case packer will require a station to close, and perhaps seal, the flaps prior to turning the case upright.

Vertical placing

Some products do not lend themselves to either side loading or drop packing. For these products vertical placing using “pick and place” or robotic systems may be the only viable automatic alternative. Consider an example of thermoformed cups of soup packed in a 6 X 4 X 4 pattern. Their irregular, tapered, shape makes them difficult to collate and push sideways into a case. Vertical placing may be the best option.

Vertical placing can be accomplished using pick and place mechanisms or robots. A pick and place is a mechanism with a limited range of motion and adaptability, generally built “one-off” for a specific machine and product. In the case of the cups above, it would move up and down as well as side to side, perpendicular to the conveyor, in a straight line. The distances traveled by the pick and place are often adjustable but the motion itself is generally designed in and relatively non-adjustable. Robots are much more flexible. Robots can perform virtually any motion within a relatively large envelope. As their motions are controlled by software they are an excellent choice when multiple functions or frequent changes to the movement are required. They have the disadvantage of being rather expensive as well as technically complex. In recent years robot prices have plummeted and they have become much simpler to program and maintain. This allows them to supplant old style pick and place systems for many applications.

Robots can be highly useful where multiple complex operations are required. A single robot, depending on the speed and distances, might be able to perform the case loading functions on 2 parallel packaging lines, alternating between them. In the sequence of video screenshots below the robot (1) picks up a staged group of cartons (2) tilts them to push the flaps out of the way during loading, (3) after loading multiple layers, pushes the trailing minor flap closed as it goes into the sealer and finally (4) places the case on a pallet. Combining multiple functions into a single machine conserves space and money.

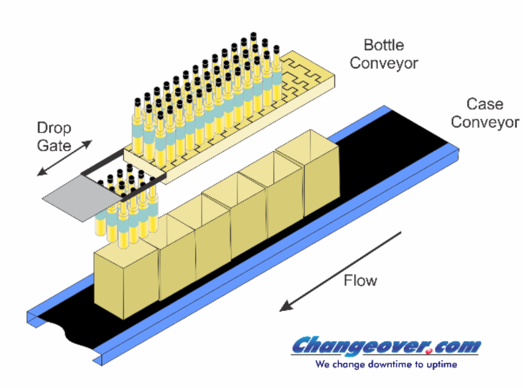


In a vertical placing system the product is must first be collated and isolated in a staging area. A 4 X 3 pattern for vertical pickoff can be collated by dividing the flow of products into 3 lanes, then using hold-backs to release backpressure on the last 4 products in each lane. The robot arm, with 12 grippers or suctions cups, picks up the entire pattern and places it in the case

Drop packing

Drop packing is useful for products such as bottles. As their name implies, they drop groups of product into the case. The dropping motion is not as violent as it looks but may not be suitable for use with fragile products. Drop packers will work only with products that can fall freely into the case. Attempting to use a drop packer with square containers such as cartons may not work because as they drop they will form a pneumatic cushion. Some or all of the packages may not fall all the way to the bottom. If all the packages do not fall together, others will get out of position causing jams. Drop packers are commonly used for loading a single layer of products but some products, like cans, can be drop packed in multiple layers.

The typical drop packer consists of a collating and staging station above a case positioning system. This station is similar to that described for vertical placing except that instead of being lifted off the station, the product will be dropped down through a gate under the collated products that is opened on a signal.



While the bottles are staging, an empty case is positioned under the staging area or drop grid. This case is often raised so as to minimize the vertical drop from staging to the case bottom. Some designs lower the case as the bottles drop reducing the shock. Once case and bottles are in position, the gate is opened and all products drop simultaneously into the case. Fingers between each bottle help guide them into position as they fall.

When packing multiple layers, the process is the same except that an empty case is only indexed into the packer every 2 (or more) drop cycles.

A large part of the cycle time is consumed by staging the product and the cases rather than the actual drop. When higher speeds are required, double case backing can be used. Instead of a 6 X 4 pattern, a 12 X 4 pattern would be used in the staging area. Instead of a single case, 2 cases are staged underneath. Otherwise it is very similar to the drop packer described above.

Drop packers can run at high speeds, in excess of 1500 bottles per minute in a beverage plant. That translates into more than 62 cases (24 count) per minute.

Downpacking

A hybrid method of packing combines both drop packing and vertical placing. The product is collated over a bottom gate as in a drop packer. Prior to opening the gate, grippers grasp each product. The gate opens but instead of the product falling into the case by gravity, they are lowered into the case. This loading is gentler for fragile products and more positive for light products such as empty plastic bottles. As there is only one downward vertical movement, the method is also considerably faster than the vertical loading described above. The simpler motion, purely vertical, also makes for a simpler, less expensive machine.

As robots become more capable and less expensive (Epson recently introduced a SCARA robot for under $8,000 complete and ready to run) they will continue to replace dedicated case packing machines. Robots are limited in speed so they will never be the one size fits all solution some people are expecting.

One thing is clear, no matter how simple case packing seems, it is too hard to do manually. It must be automated.