**TOPTIER**

# Palletizer
# Row Forming
# Technologies
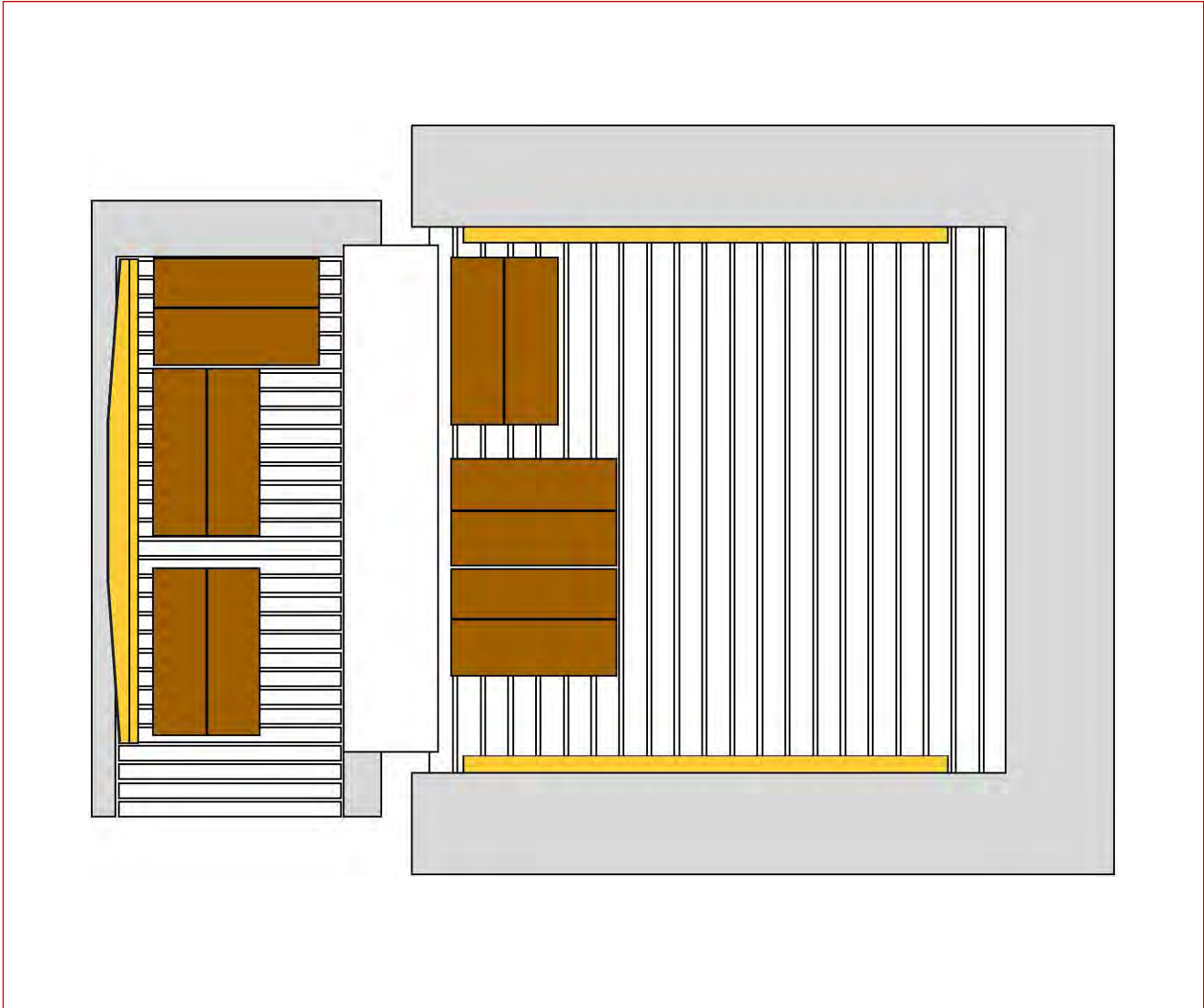
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## Summary

Conventional palletizers create layers by depositing a series of rows onto the layer conditioning area. Creating gaps between products in a row is an essential component of proper layer construction. Three methods are available for achieving product gapping: row stops, electronic gapping, and positive indexing.

## Overview

Low and moderate speed conventional palletizers create space between products when building rows for non-column stacked loads. The spacing of products is referred to as row gapping. The three methods for creating gaps are hard automation row stops, electronic gapping, and positive indexing row building. This discussion provides an overview of row gapping as well as a review of the three methods and the advantages and disadvantages of each.

The palletizer constructs a series of rows that are pushed onto a layer assembly deck until a layer is completed. When one row is pushed into the next row products must be in alignment so that the orientation of a product of a previously pushed row is not altered during the row push process.

## Row Gapping Example

The following example consists of a seven case layer pattern that will be interlocked when stacked. Each layer requires three rows to construct and requires row gapping.

- For layer A, a gap is required between products [1,4,5] and products [2,6]. The gap is shown in blue. The differently orientated products could catch a corner and spin one of the products causing a malformed layer and machine stoppage. The gap between the products changes when building A and B layers.

- Product 4 has a single product in row 2 which must be pushed so that it aligns with product 1 in layer A and product 3 in layer B.

- Proper construction of the example pattern requires two distinct gap positions. More complex patterns require additional gapping. Multiple gap positions are be required when a palletizer must accommodate multiple patterns due to packaging size or product variations.
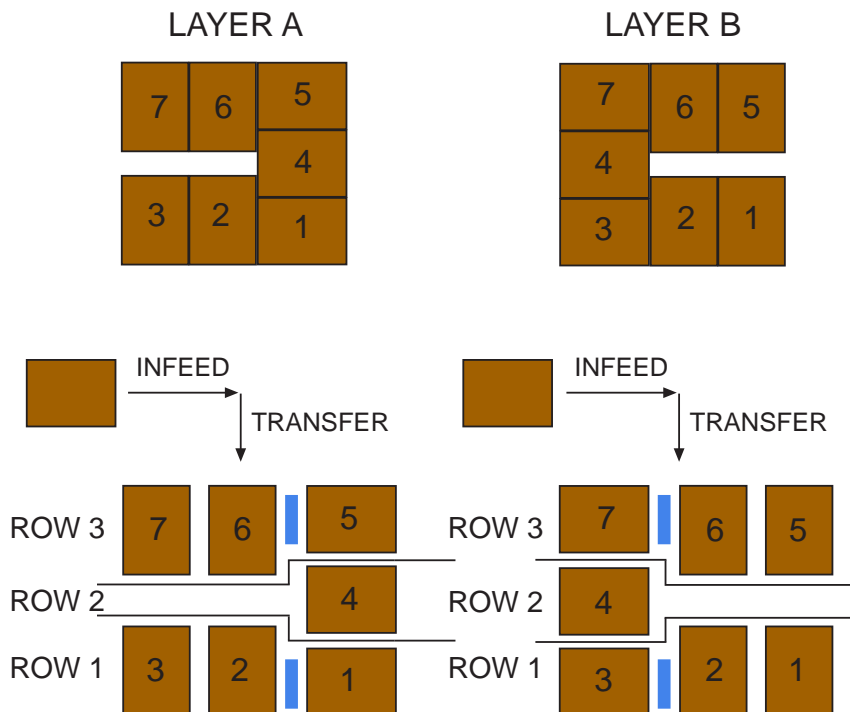
## Row Stops used for Gapping

The most common method of row gapping is the use of blade stops that extend from a retracted position below the conveying surface. Blade stops create a physical barrier to arrest the product at the required position as it travels on the row build conveyor. Although effective, the technology is essentially hard automation as moving the stops is time consuming. There are other disadvantages as outlined below:

- Product entering a row build section of a palletizer is often traveling in excess of 100 FPM. The velocity of the product when it collides with the fixed stop can be stressful to the product or can tip a tall product.

- Stops are a high maintenance device due to constant impacts especially when heavy products are handled.

- Extension of the stop to intercept the desired product requires multiple position sensors or use of timers. Sensors are viable if relatively few patterns are handled by the palletizer. Otherwise, timers are used to extend the stop based on the timed transition of the prior product to pass over the stop location and initiate extension of the stop before the product arrives. Tuning such timers can be a challenge due to numerous minor variations in product travel consistency.

- Multiple stops are required when multiple patterns are handled. Proper location is sometimes compromised by conveyor roller centers and space constraints of the physical size of the stop.

Row stops are relatively simple and inexpensive if only a few stops are required for the application. They square and register the product against the stop. Row stops perform well if timing issues prove reliable; as rates increase, timing can become problematic.

Row stops are generally a pneumatic device. In order to satisfy safety requirements, all retained energy must be purged during an e-stop – including air pressure used to extend row stops. When an e-stop occurs during row build the row stops retract. Re-start can be an issue if stopped products have migrated forward when air pressure is restored and the palletizer returns to automatic operation.

## Electronic Row Gapping

As PLC scan rates improved and VFD motor control technology proved to be cost effective, electronic row gapping has become more prevalent for row gapping. Electronic gapping uses a signal from a sensor immediately prior to the row build conveyor that when activated by a product in transit causes the row build conveyor to index under VFD motor control. The row conveyor is cycled to receive the product and can run for additional time to create a gap prior to next product entrance.

Electronic gapping provides excellent flexibility because each pattern can have unique row build conveyor index values for each product in a pattern. The pattern program contains a time value for each product whether straight or turned, consistent with the product dimension. A gap time value is then added. The case dimension index value and gap timer index value control the VFD row build conveyor run time to create desired row construction with gaps. Acceleration and declaration curves are kept constant and VFD technology combined with high PLC scan rates provides reliable row build conveyor indexing. The system is effective provided rates are not extreme and products are suitable for reliable indexing. Indexing products onto the row build conveyor is much gentler on products by eliminating high speed collisions against a row stop or prior product.

A fundamental requirement of electronic gapping is the product be suitable for electronic gapping. The system depends on the coefficient of friction between the row build conveyor and the product to be suitable for indexing without significant slippage. Inadequate grip between the product and the conveying surface can prevent reliable index spacing if the product is light, has a slick bottom, or is inconsistent when conveying. In these circumstances, rows are not reliable and pattern assembly can be compromised.

A second issue with electronic gapping can occur when product is not fully turned 90 degrees. In this case, the effective length of the product is longer than the row build conveyor indexing anticipates. Hard automation row stops generally square products not fully turned – a capability not available with electronic gapping. In most instances inadequately turned products will be straightened by the prior or subsequent product or by the row pusher. However, improper gapping due to improper turning may result in a faulty layer.

Electronic gapping is well proven and reliable, but like hard automation row stops there are compromises and incidents of malformed layers remains problematic.
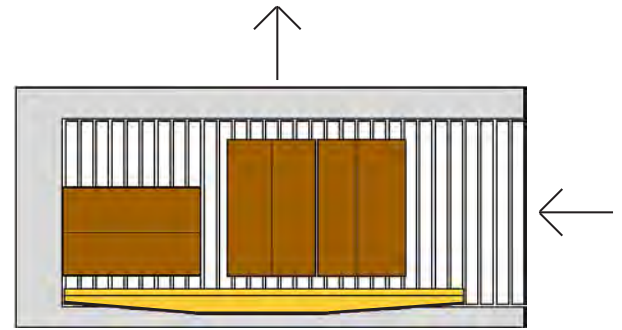
## Positive Indexing Gapping

**Positive indexing overcomes the challenges of prior row gapping methods. PerfectPattern® patented technology was introduced by TopTier in 2013 and includes a quality check system that prevents malformed layers before they occur.**



SENSOR      FLIGHT BAR

**Positive indexing combines known product dimensions with a flight bar squaring solution. Product dimensions are integrated in load build programming, and initiate several palletizer operational parameters through positioning feedback drives. Product dimension data is relevant for positive index row building technology.**

**Electronic positioning control is achieved using positioning feedback drives. Known product dimensions allow desired row build gapping to be a simple millimeter value input into the pattern menu. The simple value entry for gapping is combined with simple mechanical systems to achieve perfect rows that are confirmed to be accurate as they are built. When reliable rows are built, layer assembly becomes 100% reliable. Two systems working in a coordinated manner using pattern product data dimensions provide a significant improvement in row building and gapping.**

**The first system is the flight bar system located downstream of the product turner. The simple device is a pusher bar that engages each product from the rear after it passes the turner. The flight bar is driven by a positioning drive so the location of the flight bar is always known to the controller. The bar engages an already moving product so there is nominal collision. The flight bar pushes the product over a skid plate so that the product fully registers square against the flight bar due to the friction of the skid plate against the product bottom.**

**The controller knows the desired product orientation for the pattern and the product size from the pattern menu. When the product breaks a sensor at the end of the flight bar system the controller compares the flight bar position to expectations based on product size, providing verification of each product entering the row build conveyor. If the product is orientated incorrectly or if squaring against the flight bar could not overcome an improperly tuned case, the system stops for operator intervention and before a time consuming defective layer build can occur.**
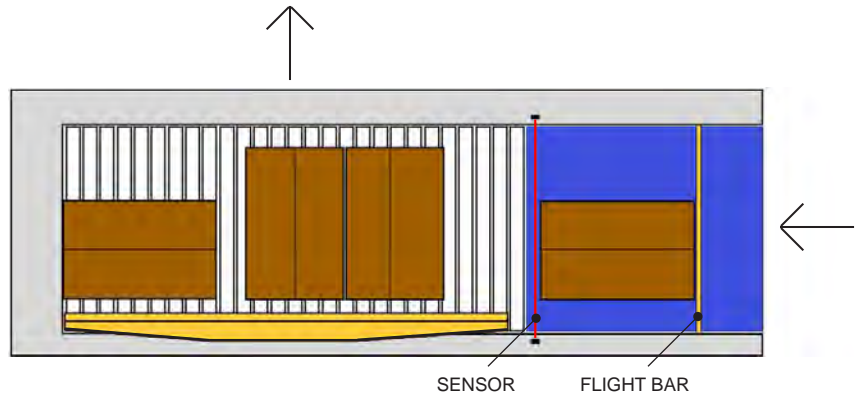
Properly orientated products that have been verified by quality control are transferred by the flight bar to the row build conveyor that employs positioning feedback control. The row build conveyor indexes the row based on the product size plus a gap if required for the pattern. After the last product in a row is transferred by the flight bar the entire row is indexed an additional distance prior to transfer to the layer assembly area.

Perfect Pattern overcomes the challenges and deficiencies of prior row build and gapping technology.

- Timers and timer tuning are eliminated. All inputs are distance values that are reliably achieved using positioning drives.

- Products are correctly oriented. The flight bar pusher squares each product and positively positions the product on the row build conveyor.

- Product orientation is verified. Product dimensions derived from the pattern menu provide data to measure the actual product size prior to row build entrance. Only proper orientated products become part of a row.

- Row building is gentle to products. The flight bar engages the rear of a moving product so there is nominal impact. Products on the row build conveyor are indexed with a small gap or they gently touch.

- Gap programming is simple. All needed gaps for any pattern are created using a simple millimeter value entered in the pattern menu.

- Operations are reliable. Electronic positioning is exact and not influenced by machine wear or environmental considerations.

## Conclusion

Blade stops rely on timers, lack flexibility, and subject product to harsh treatment. Electronic gapping is subject to potential failure when product is not properly oriented. Perfect Pattern is an important advance in achieving continuous error-free palletizing operations. Gaping instructions are easy to program and the system applies to any palletizable product.

## About TopTier

TopTier palletizers are mission-critical components of automated end-of-line packaging operations for food, beverage, and consumer packaged goods manufacturers. TopTier is the leader in innovation and value – providing palletizing solutions with speed, flexibility, and dependability for 24/7 operations. TopTier installs single palletizers or systems integrated with existing conveyor and other material handling equipment. New patented technologies from TopTier make palletizing reliable, easy, safe, and energy efficient.

TopTier is the leading palletizer manufacturer in the US, with sales throughout North America and select countries worldwide. TopTier manufactures palletizers exclusively and serves an elite list of both Fortune 1000 and mid-size companies. TopTier palletizers are engineered and built in a vertically integrated manufacturing facility located in Portland OR, USA. TopTier is a member of the Packaging Machinery Manufacturers Institute (PMMI) and the Material Handling Industry of America (MHIA).

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