

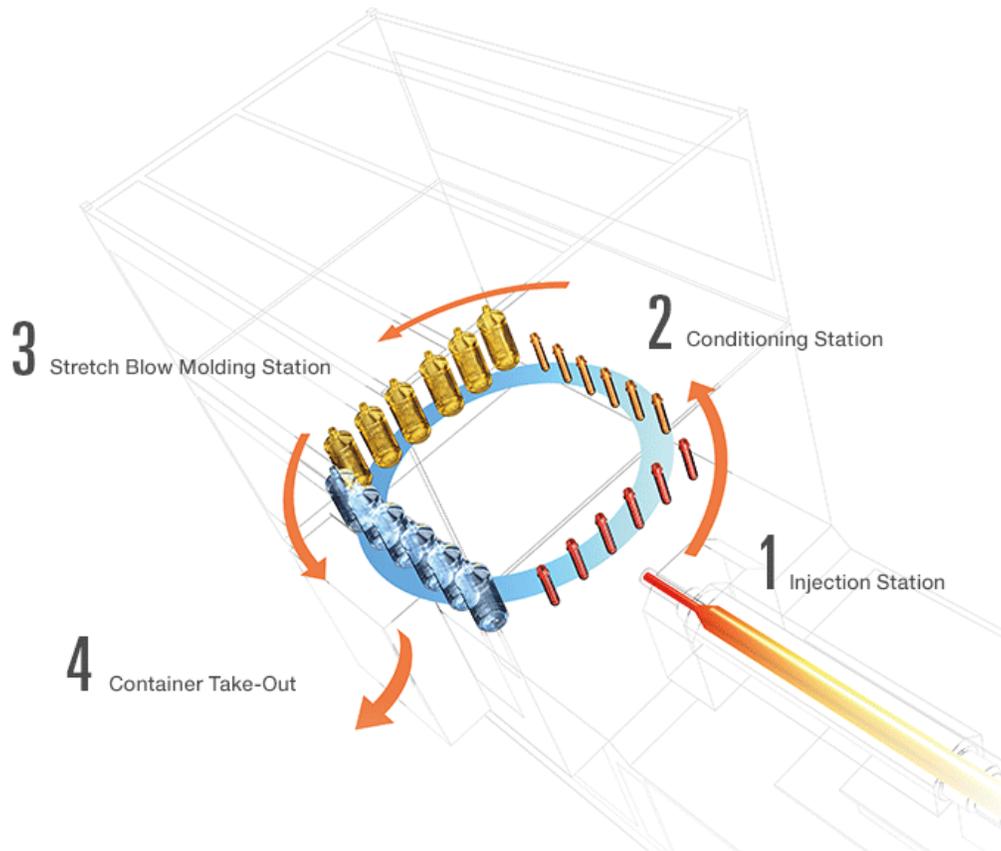
Leak Testing Injection Stretch Blow Molded (ISBM) Bottles a.k.a. PET Bottles made on One-Stage or One-Step Machines

Injection Stretch Blow Molding Process (Nissei ASB definitions in quotes, from <http://nissei-asbus.com/faqs>)

"There are two basic molding methods, 1-step and 2-step. In 2-step molding, two separate machines are used, one for injection molding the preform, the second for stretch-blow molding it into the final container shape. In 1-step machines, the entire process from raw material to finished container is conducted within one machine, making it especially suitable for molding non-standard shapes (custom molding), including jars, flat oval, flask shapes etc. Its greatest merit is the reduction in space, product handling and energy, and far higher visual quality than can be achieved by the 2-step system."

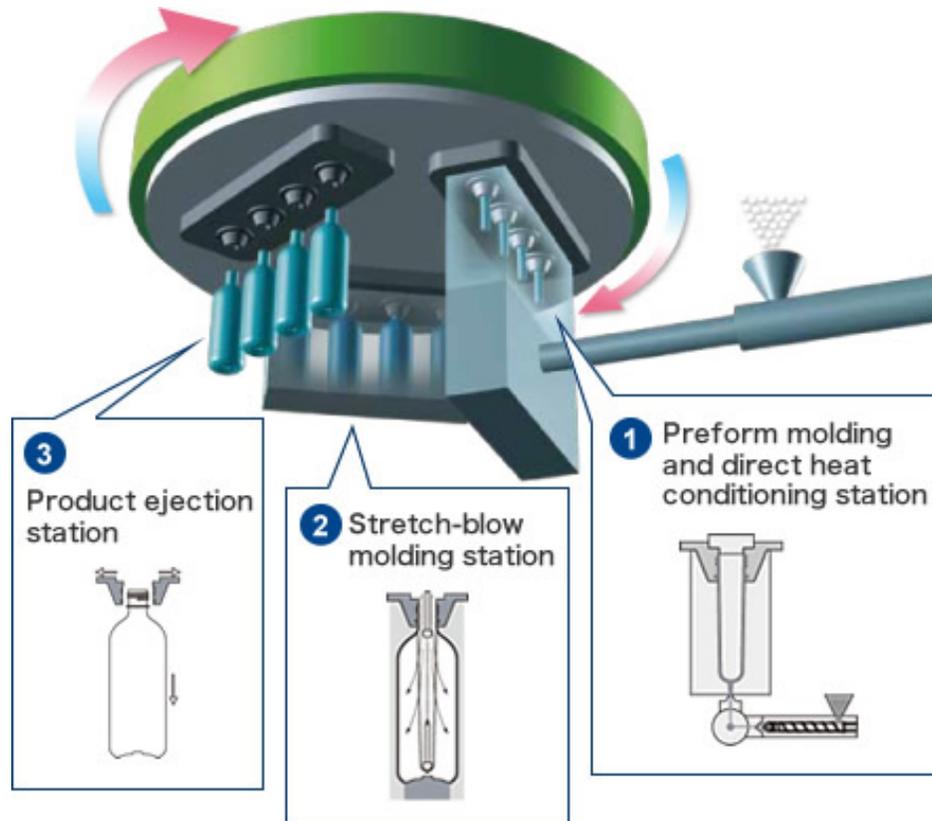
The most common plastic material type used on One Stage machines is PET. "PET is the abbreviation for a PolyEthylene Terephthalate, more commonly known as Polyester in the fiber industry..." "When molded into a container, it produces outstanding strength, toughness and transparency."

Within 1-step machines, there are two common platforms. "4-station" machines (e.g. Nissei ASB Company or SIPA) injection mold the preform in the 1st station, reheat the preforms in the 2nd station, stretch blow the bottles in the 3rd station, and eject the bottles in the 4th station. "3-station" machines (e.g. Aoki Technical Laboratory, Inc.) eliminate the reheat stage, instead using latent heat in the preform.



4-Station Machine Example

<http://www.nisseiasb.co.jp/en/solutions/molding-process/1step/>



3-Station Machine Example

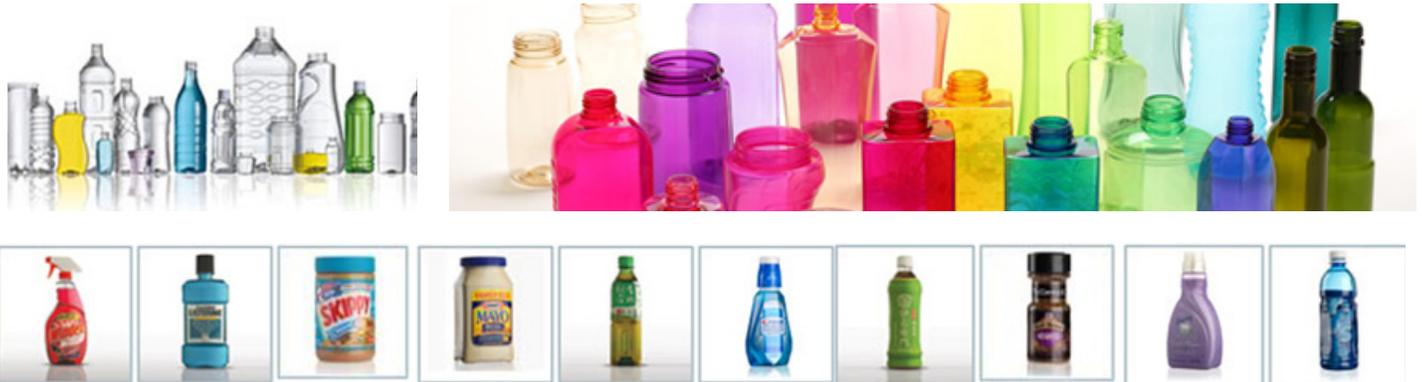
<http://www.aokitech.co.jp/english/technology/>

Common Machinery Types

Nissei ASB, Aoki, SIPA



Common Bottle Types



Common Leak Tester Machine Types & Uses

ALPS machinery recommendations are based on a review of the following information:

- 1) Testing Speeds – Typically the blow molder output plus 10% surge capacity to allow for efficient flow of bottles on the production line. This needs to be defined for the range of container types.
- 2) Bottle Drawings – Bottle dimensions and shapes. To review sizing requirements and handling characteristics.
- 3) Hole Size Sensitivity – Longer leak test durations (i.e. more test time) equate to smaller hole size sensitivities. If the customer does not have a specification, ALPS can provide guidance on the sensitivity alternatives. The typical sensitivity range for ALPS equipment is between .004" (0.1mm) to 0.020" (0.5mm) diameter holes, depending mainly on the container volume, shape and test time.

Common Leak Tester Machine Types & Uses ALPS SC Linear Indexing Conveyor Leak Tester

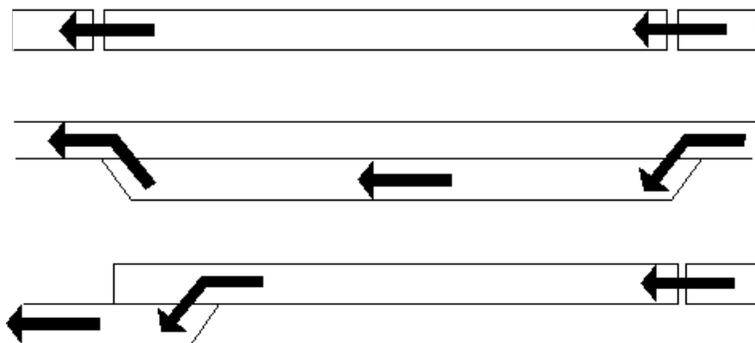


The ALPS **SC Linear** is a versatile machine that covers the majority of applications for 1-step PET production lines. The machine includes a stepper-motor-driven conveyor with optional vacuum underneath the bottles to improve speed and stability.

The **SC Linear** machine operation is very simple. A single sensor is used to detect bottle presence. Upon detection of a bottle, the conveyor is stopped, a probe is extended to seal on the container and perform the leak test, and non-conforming containers are immediately ejected by means of a cylinder or air jet.

The **SC Linear** incorporates a color touch-screen interface, including Guided Setup features to teach the mechanical and leak test setup to a novice operator. The standard machine includes a “Self Test” orifice that enables proof of performance with the touch of a button (or it can be automated).

Integration of the **SC Linear** into the production line requires the setup of bottle transfers to and from the leak tester conveyor (examples shown in image below). The transfers can either be “End Transfers”, with the conveyors mounted end-to-end, or “Side Transfers”, with the conveyors mounted in parallel for bottles to be transferred across the sides.



End Transfers require installation of a Deadplate (fixed element) between the curved conveyor ends. Bottles are pushed across this transfer by the upstream conveyor and the backpressure from the backlog of bottles. End Transfers are sufficient if the bottles are stable and able to backlog without handling issues.

For smaller or less stable containers, Side Transfers are recommended to minimize the dead space on which the bottles must travel. Side Transfers are also the easiest way to integrate the machine into an existing conveyor line. The **SC Linear** conveyor has a flush side frame to eliminate the need for a Deadplate if the adjoining conveyor also has a flush side frame. Care must be taken with the customer conveyor interface, and set up of the transfers, for the leak tester to operate efficiently. A “Prime Sensor” option is available to maintain a minimum backlog of containers across the upstream transfer.

ALPS RS Linear or RS-S Linear moving head leak testers = Premium for Hard-to-Handle Bottles **U.S. Patent #7,266,993**



RS-S Linear



RS Linear

The **RS Linear** family of units should be considered for specific Injection Stretch Blow Molded (ISBM) applications where bottle transfers to a separate conveyor, or a backlog of containers, proves difficult. The **RS Linear** uses a servo-driven linear slide to follow and test each bottle over an existing conveyor. An Encoder Wheel is provided to monitor the customer's conveyor speed and automatically match the slide speed.

Examples application include very small bottles (e.g. vials or eye dropper bottles, etc.), bottles with high height-to-footprint ratios (3:1 or 4:1 and higher), and hard-to-handle bottle shapes (e.g. reverse tapers, severe ovals, triangular shapes).

The **RS Linear** unit incorporates a floor-standing frame, and should be considered for applications with minimal conveyor height adjustments and where portability of the machine is important. The **RS-S Linear** is a compact machine version that is designed to mount directly to a customer conveyor. Its main advantage is applications where there are regular conveyor height adjustments.

Very important to note is for **RS Linear** machines, the conveyor speed and not the blow molder output, determine the necessary testing rate. The conveyor speed must be defined for each application to gauge the **RS Linear** capabilities for both speed and hole size sensitivity.

The **RS Linear** incorporates the same basic control system as the **SC Linear**, including a color touch screen HMI with Guided Setup capability.

ALPS Speed-Glider multi-station moving head leak testers = Higher Speeds



The **Speed-Glider** family of machines are applicable for higher speed, or higher sensitivity, applications where single-station machines are not fast or sensitive enough. The **Speed-Glider** uses a Timing Screw for each bottle, to space the bottles for leak testing and to provide positive bottle handling. The machine incorporates a single servo-driven slide to match the slide speed to the timing screw.

Speed-Gliders are available in configurations including 2, 3, 4, 5, 6, 7 and 8 stations for speeds from 30 up to 500 Bottles-Per-Minute. Typically the conveyor underneath the leak tester is synchronized to the machine, by means of a 4-20mA signal, to match the conveyor speed to the slide speed and ensure the most efficient performance.

Key Reasons for Leak Testing PET Bottles

Leak testing of 1-step PET bottles has evolved to become a best practice by providing the following benefits:

- 1) A **Functional Test** that verifies that each bottle will seal and hold pressure
- 2) Detection of the Most Critical Defects using the most straightforward method
- 3) Protection from random quality issues through 100% inspection. Sampling will not guarantee detection.
- 4) Monitoring the blow molding process. Typically the leak tester is positioned as the first machine after the blow molder, to detect and alert operators quickly to initiate corrective action.
- 5) Protection of inventory and prevention of costly returns

A main complementary technology, or in some cases a competing technology based on customer budgets, is Vision inspection of bottles. Vision technology has its own value to consider in providing visual checks of each container, but Vision is not a reliable approach for leak testing plastic bottles because leaks are not consistent in their location and appearance. Leak Testing offers a more straightforward technology, typically at a lower capital and operating cost, at 1-step PET production rates.

Common Defect Types in PET Bottles

- **Sealing Related Defects (Short Shots, Nicks, Cocked Necks, etc.)**

The ALPS leak test provides a functional test of every seal surface, by sealing and pressure checking every container. ALPS specifically uses the lowest test pressure in the industry, to enable low sealing forces and the ability to tune the Seal Surface inspection. Alternate probe seals (softer or harder) and probe designs (fixed, tilting, etc.) can be provided to ensure the integrity of the most critical sealing-related defects for a given container.

- **Holes (Gate Leaks, Gate Cracks, Contamination Defects, Misformed Bottles)**

Pressure-based leak testing will detect leakage regardless of its location or appearance. The most common weak points for small leaks in a PET container is the Gate, which is the injection point on the bottom of the container. Leaks can occur anywhere in the bottle if there are material issues (e.g. contamination from recycled material) or process issues affecting the proper formation of the bottle.

- **Height and Topload**

Auxiliary inspections can be added to ALPS leak testers to detect tall and short containers, and to verify that the container does not deform at a specific sealing force (topload).