

Section 7:

Choosing Your Reflow Oven

What Size Oven do I Need?

The basic requirement of any reflow oven is to be able to consistently reflow the product at the required speed to meet production needs.

Selecting a reflow oven requires that the profile process band has been defined and the oven can successfully heat within the band. Production throughput rates can be met providing the oven has been sized correctly.

Size The Oven Properly

The oven must be sized to handle the production rate of the pick-and-place equipment. The calculation is shown below:

Line speed (minimum) =

$$\frac{\text{Boards per minute} \times \text{Length per board}}{\text{Load Factor}}$$

(See Figure 3-5 for description of Load Factor.)

Operating the oven conveyor speed greater than the line speed ensures that no product jams will occur on the onload area of the reflow oven.



In order for the oven to be properly sized, the process speed defined below must be greater than the minimum calculated line speed. This will ensure that bottlenecks will not occur at the reflow oven. The process speed should be determined through testing or by the following equation:

Process speed =

$$\frac{\text{Oven chamber heated length}}{\text{Process dwell time}}$$

Example of Oven Sizing Calculation

An SMT assembler wants to produce 8-inch boards at a rate of 180 per hour. The solder paste manufacturer recommends a 4 minute, three step profile. How long an oven do I need to process boards at this throughput?

Boards per minute = 3 (180/hour)
 Length per board = 8 inches
 Load Factor = 90%
 (2-inch space between boards)
 Process Dwell Time = 4 minutes

Calculate Line Speed:

$$\frac{(3 \text{ boards/min}) \times (8 \text{ inches/board})}{0.9}$$

Line speed = 26.67 or 27 inches/minute

Therefore, the reflow oven must have a process speed of at least 27 inches per minute.

Determine oven chamber heated length with process speed equation:

$$27 \text{ in/min} = \frac{\text{Oven chamber heated length}}{4 \text{ minutes}}$$

Oven heated length = 108 inches (9 feet)

To meet process requirements of this example, the reflow oven needs at least 9 feet of heated length so that an 8-inch board can be processed at 27 inches/min conveyor speed for a 4-minute profile.

Note that the overall length of the oven will exceed 9 feet including the cooling section and conveyor loading sections. The calculation is for HEATED LENGTH – NOT OVERALL OVEN LENGTH needed.

Comparing Reflow Ovens

When selecting reflow equipment, it is important to take into consideration all aspects that may affect the process and production. Try to avoid becoming too focused on one issue, such as populated uniformity, as it may not lead you to the optimum decision. The recommended steps in the selection process are described in the following paragraphs.

Thermal Performance

Oven thermal performance is defined by the sum of the temperature non-uniformities caused by mass differential, oven uniformity, and oven repeatability under production loading conditions. A set of tests must be conducted with the desired product on the oven in question.

Throughput

Oven throughput (in boards per unit time) is defined by the following equation:

Throughput =

$$\frac{\text{Conveyor Speed} \times \text{Load Factor}}{\text{Length per board}}$$

Note that in the previous example, the throughput in boards per minute was a given.

Process Gas

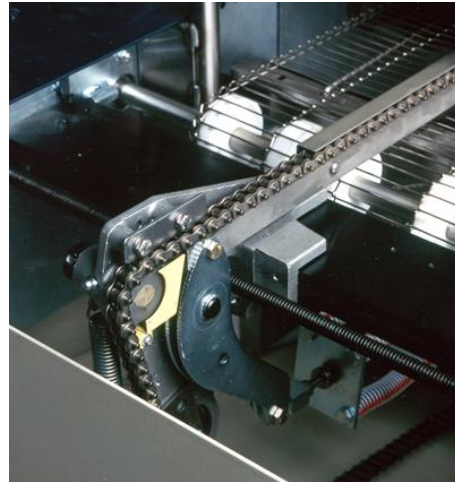
If a nitrogen atmosphere is required for solderability or no-clean processing, one needs to consider the purity required and the gas consumption.

Be careful how the purity is measured, such that it is not measured at the gas inlet. Measure purity in an area representative of what the board will see on the conveyor, not the nitrogen inlet in the oven. Purity in reflow is the most critical area since solder is liquidus.

Conveyor Design

One needs to define whether a mesh conveyor or an edge-type conveyor is required. Typically edge conveyors are used for in-line processing or if double-sided assembly is required.

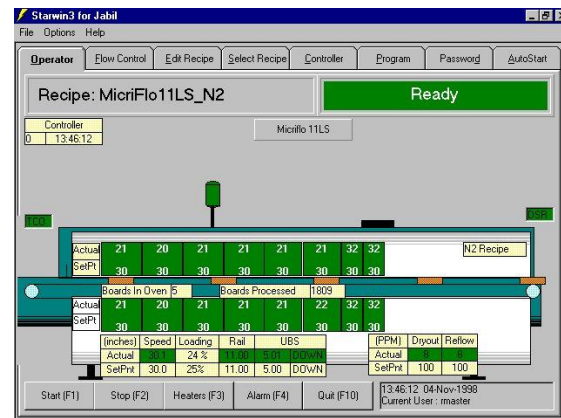
The most important issue with edge conveyors is the ability for the conveyor to remain straight to avoid dropping boards. Find out how parallel the edge conveyors will be during heating conditions – avoid simply taking measurements in a cold oven only.



Research International's patented tensioned rail stays parallel over any temperature range.

Software

The best technically designed oven in the world may be no better than the worst if the software is difficult to operate. When comparing software, keep the user in mind. Consider file access and edit security. Ask questions about networking machines to a host.



Research International StarWin 3.0 Software

**Reliability/Serviceability/
Documentation**

Once a machine is placed into service, it is critical that it remains operational. Evaluate the product design from a structural as well as a functional standpoint.

Is the oven designed to withstand the rigors of production? Review the product manuals, drawings, and spare parts lists. Find out where the nearest servicing center is located. Is training available?

Maintenance Downtime

Maintenance downtime is perhaps the most overlooked aspect of equipment selection. The key to meeting throughput requirements is a continuously operating reflow oven. Flux cleaning downtime and frequent scheduled maintenance will reduce the number of hours available to solder boards. Compare maintenance requirements carefully before selecting an oven.