CRITERIA FOR SELECTION OF SMT ASSEMBLY EQUIPMENT

(Part - 03)

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Reflow Oven: A reflow oven is a machine used primarily for reflow soldering of surface mount electronic components to printed circuit boards (PCB). The basic requirement of any reflow oven is to be able to consistently reflow the product at the required speed to meet production needs.

Basically there are three types of reflow process equipment.

1. **Infra red reflow**

   Heating is achieved by use of IR ceramic heating elements. When assemblies are passed through conveyors, the radiating elements heat the components locally and heat is transferred to the solder paste. IR reflow oven is used when component density is uniform distributed throughout the PCB. It is observed that if the component density varies then the heat distribution is not uniform. Normally across the PCA temperature should not exceed 2 degC

2. **Convection reflow oven**

   The PCB is transported through a conveyor system. Oven contains multiple zones, which can be individually controlled for temperature. Generally there are several preheating zones before the reflow zone. The solder paste attains liquidous state in this zone and starts solidifying when exiling this stage. The PCA is cooled in the subsequent stage called cooling zones.

   Full convection reflow is the most popular equipment as it meets the requirement to a great extent. Heating is achieved by using heating elements and distribution of heat is done by using Blower motors installed in the individual zones. Some applications use nitrogen gas as option to carry out reflow in inert gas atmosphere.

3. **Vapour phase oven** (condensation soldering.)

The heating of the PCBs is sourced by thermal energy emitted by the phase transition of a heat transfer liquid condensing on the PCBs. The liquid used is chosen with a desired boiling point in mind to suit the solder alloy to be reflowed.

Some advantages of vapour phase soldering are:

- High energy efficiency due to the high heat transfer coefficient of vapour phase media

- Soldering is oxygen-free. There is no need for any protective gas (e.g. nitrogen) No overheating of assemblies. The maximum temperature assemblies can reach is limited by the boiling point of the medium.

SELECTION OF A REFLOW OVEN WITH REQUIRED LENGTH

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.

An SMT assembler wants to produce PCA of length 20 cms at a rate of 180 PCBs per hour. The recommended exposure in the heating tunnel+ cooling tunnel of the reflow machine is 4 minutes.

What is the required length of the reflow oven to process boards?

Boards per minute = 3 (180/hour) Length per board = 20 cms

Load Factor = 90% Spacing between PCBs = 5 cms

Process Dwell Time = 4 minutes in the heating zone

Calculate Line Speed:

(3 boards/min) x (20 cms/board) / 0.9 = 67.7 cms / min

Line speed = 67.7 cms/minute

Therefore, the reflow oven must have a process speed of at least 68 cms per minute.

To determine overall oven length with process speed equation:

Speed = 68 cms/min travel in the tunnel for a duration of 4 mins.

Oven chamber heated length is 68*4 = 270cmss OR 9 feet in length.

Total length of the oven will be 2.7mtr + Conveyor input/output length = Cooling zone length.

(Reference : Research International Reflow Technology Handbook / Conceptronics)

About the Author:

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