**6 MONTHS INDUSTRIAL TRAINING**

**AT**

**“LUMINOUS POWER TECHNOLOGIES”**

**ABSTRACT**

The report presents that how the electronic components are inserted on a PCB. In an electronic industry, the heart of the industry is “**Auto Insertion”** department. Thousands of the components are inserted in this department on the bare PCB with the help of machines. This can’t be possible manually.

All the machines are programmed according to the BOM which contains the details of the components for the model of the inverter which is to be prepared. The BOM is issued by the “**Research n Development**” department. Then, the process starts.

It will lead to increase in production and also offers a better quality which really matters.

Training in this department is really beneficial:

* To expose student to engineering experience and knowledge this is required in industry.
* To get a feel of work environment.
* To expose the student to future employers.
* With all the experience and knowledge acquired, the student will able to choose appropriate work upon graduation.

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| **CHAPTER 1** | |
| **Subject** | **Page no.** |
| * **Company Profile** * **Company Departments** * **Training Department** * **AI Department** | * **1,2** * **3,4,5** * **6** * **7** |
| **CHAPTER 2** | |
| * **Quality** * **5S Methodology** * **Kaizen System** | * **8,9** * **10,11** * **12** |
| **CHAPTER 3** | |
| * **Machines Used in AI** * **Jumper Machine** * **Axial Machine** * **Radial Machine** * **SMT** * **Reflow Oven** * **Visual Inspection** * **AOM** | * **13** * **14,15** * **16,17,18** * **19** * **20,21** * **22** * **23,24,25** * **26** |
| **CHAPTER 4** | |
| * **Magazine** * **Quality Check** * **Rework of PCBs** | * **27** * **28** * **29,30** |
| **CHAPTER 5** | |
| * **Manual Insertion** * **Manual Soldering** * **Wave Soldering Machine** * **Testing** | * **31,32** * **33,34,35** * **36,37,38,39** * **40** |
| **CHAPTER 6** | |
| * **Final Assembly** * **Skills Acquired during the Training** | * **41,42** * **43** |
| **Bibliography** | |
| **Special Thanks** | |

**CHAPTER 1**

* **COMPANY PROFILE**
* **COMPANY DEPARTMENTS**
* **TRAINING DEPARTMENT**

**COMPANY PROFILE**



* Luminous Power Technologies (P) Limited is a leading global company delivering high quality power products for home and commercial applications. The company’s portfolio also includes products and services in telecom infrastructure & renewable energy systems like solar, wind and hybrid solutions. Company’s Vision is to be a global leader in the field of Packaged Energy, Power Products, and Distributed Power Generation and Environment friendly new technologies. Luminous has been consistently winning awards & accolades for market leadership and excellent reliability of its products in domestic as well as international arena. Luminous is the proud recipient of Frost & Sullivan Industry Technological Leadership Award for market penetration in DC-AC Inverters in Non Renewable Energy markets in Asia Pacific.From supply of power to one room apartments to large multistoried buildings, Luminous Inverters are available for every application- Solar Power Inverters, wind power to utility grid.

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| * Luminous Batteries are separately designed for each specific application in Inverters, Solar Power and Renewable Energy, UPS, Telecom and Other Industrial Applications. | | | |
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| http://www.luminousindia.com/domestic/images/spacer.gif |  | http://www.luminousindia.com/domestic/images/spacer.gif | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | .   |  |  | | --- | --- | | Enterprise Business Group (EBG) of Luminous Power Technologies is focused to provide end-to-end solutions in enterprise-wide power & connectivity solutions to corporate offices, Telecommunication Service Providers, Data centers, Health care centers and Process Industries. | | | http://www.luminousindia.com/domestic/images/spacer.gif |  | | http://www.luminousindia.com/domestic/images/spacer.gif   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | http://t3.gstatic.com/images?q=tbn:ANd9GcSbzo_dtAuE198HV0892Z7S_dZseX48xMZgHC6jDmnQWKvFrr88UQ  The Reverse Osmosis water purification process utilizes a semi-permeable membrane to remove dissolved impurities. This process produces clear, fresh and pleasant tasting water even from brackish or contaminated water from various sources like wells, rivers or municipal supplies.  http://www.luminousindia.com/domestic/images/app.jpg   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Packaged Backup Power products   |  |  | | --- | --- | | Packaged Backup Power products | Luminous offers Packaged Backup Power products that match the characteristics of Batteries for providing the best performance. These products offer much higher energy efficiency and are very convenient to use.  P-2 | | http://www.luminousindia.com/domestic/images/spacer.gif | | | | |  |  | |  | | |  |  | | | | http://www.luminousindia.com/domestic/images/spacer.gif | . | | | |   **COMPANY DEPARTMENTS**   * R&D (Research and Development) * A.I. (Auto Insertion) * M.I. (Manual Insertion) * FA (Final Assembly) * **Research and development**, often called [R&D](http://www.wisegeek.com/what-is-rd.htm), is a phrase that means different things in different applications. In the world of business, research and development is the phase in a product's life that might be considered the product's 'conception'. That is, basic science must exist to support the product's viability, and if the science is lacking, it must be discovered - this is considered the **research**phase. If the science exists, then turning it into a useful product is the **development** phase. Further terminology refinements might call it **engineering**to refine production so that the product can be made for a cost that appeals to consumers. * **Auto Insertion** is an advanced process, invented as an alternative to the manual insertion process. Due to its high productivity and quality outputs, AI machines are suitable for mass production. * **Manual Insertion** is the department where large components are inserted by hands which can’t be inserted through machines such as heat sinks, relays, inductors etc. Soldering is used in this department. Problems of dry solder are main and after whole component insertion, testing is done. * **Final Assembly** department is responsible for performing a variety of general and specialized assembly tasks.  Work cells are customized based upon the unique assembly requirements of each product family. Each work cell is stocked with the necessary inventory, tools, and work instructions to efficiently build products with a minimal amount of overhead.   P-3  Research and Development department develop a PCB design and decide the components whether to be changed or not. Then, PCB is checked by increasing or decreasing the temperature and humidity. 256 parameters regarding load and voltage are studied here in this department.  After this, a **BOM** is prepared.  **BOM (Bill of Materials)**  It is composed of:   * Reference Number * Component Name * Component Value * Location name * Package name   **.**  The BOM is handed over to the **AI** (Auto Insertion) department.  **In AI department**,  After getting the **BOM**, all the machines are programmed according to respected BOM.  Means the machine should know where or at which location the component to be placed.  Then, PCB starts from **Jumper machine** and in series passed out from all the machines.  First of all,   * Jumper insertion is there. After this PCB is passed through **Axial machine**, the machine inserts axial components like resistors. * With Axial insertion, PCB is passed on to **Radial machine** for insertion of radial components like capacitors. Then, chip placing is required. * Before chip components placing, PCB is passed through the machine which pastes the glue on the locations where SMT components to be placed. * Now with glue pasted, PCBs are passed through **SMT machine** for chip placing. It is further passed through **Reflow Oven** to dry the glue. * Second last stage is of Visual Inspection. Many problems occur like Shifting, missing etc. * Final stage is visual inspection by machine. The **AOM** machine checks the problems further which are not inspected manually. Then after **Quality** check PCBs are handed over to **MI** (Manual Insertion) department.   P-4   |  |  | | --- | --- | |  | [http://www.becs.com/becs/Portals/0/Images/CB6.jpg](http://www.becs.com/becs/Portals/0/Images/2CB6.jpg)Completed circuit boards must pass through an exhaustive semi-automatic functional test. Trained technicians utilize custom test fixtures and software to verify proper circuit board operation and assure the quality of our products and process. |      After auto insertion, in MI all the large components like inductor, heat sink are inserted manually. Proper soldering of all the components is done and at the final stage testing is there. Some parameters out of 256 parameters are checked here.  AC voltage (240-250) V  Frequency Output (49-51) Hz  Checked on regulated or unregulated mode depending on the VA ratings like 600 VA, 800 VA etc.  600 VA means 600\*0.8= 480W inverter  At 220 Vac, Charging current is (11-13) mA  Overloaded cutoff range: (275-290) V  After proper Testing, the PCBs are handed to FA (Final Assembly) department.The Final Assembly department is responsible for performing a variety of general and specialized assembly tasks.  P-5  **TRAINING DEPARTMENT**  **AUTO INSERTION:**  In this Dept. Electronic components are inserted by machines on bare PCBs. Components may be axial, radial or SMTs. The components are inserted in a series with the machines. Electronic Components are: Resistors, Diodes, Zener Diodes, ELCOs, Ceramic Capacitors and Transistors etc.  **Mainly of two types:**   * PTH (Through Hole) * SMD (Surface Mount Device)   **PROCESS**  **Bare PCBs**  **Jumper Insertion**  **Radial Insertion**  **Axial Insertion**  **AOM**  **Chip Placement**  **Finish**  **Axial Insertion includes:**   * Sequencer * VCD   **Chip Placement includes:**   * Glue/ Solder Paste (HDPG1/ Screen Printer) * Chip Placer (MV2F, MV2V) * Reflow Oven   P-6   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | http://www.mitsutoyo-malaysia.com/Pictures/EMS/smt2.jpg  **AUTO INSERTION**  **Machines used in Auto Insertion Department:**   * JV To insert Jumper wire * VCD To insert Axial components like resistors, diodes, Zener diodes etc. * RH6 For Radial components such as ELCO, ceramic capacitor, transistor etc. * MV2F/MV2V Chip resistance, capacitance, diode, ICs etc. * Reflow oven Curving the SMT components * AOM Visual inspection by machine | http://www.mitsutoyo-malaysia.com/Pictures/MsSpacer.gif | |  | |   Auto Insertion is an advanced process, invented as an alternative to the manual insertion process. Due to its high productivity and quality outputs, AI machines are suitable for mass production. AI operation consists of three types of processes namely Jumper Wire, Radial and Axial. It produces a total rate of 10.0 million insertions per month. |  | |  |  |   The vision are to enhance shareholder's value, provide quality service to our customers & to be one of the preferred Manufacturing Service Providers http://www.mitsutoyo-malaysia.com/Pictures/EMS/vision2.jpgTo realize this vision, the sole purpose in every action at work is set to:   * To be committed to comply with ISO9001:2000 quality requirements and continually improve effectiveness of the systems * Committed towards ISO14001:2004 environmental friendly policy * To meet customers total satisfaction at competitive cost price.   P-7  **CHAPTER 2**   * **QUALITY** * **HOW TO ACHIEVE QUALITY** * **5S METHODOLOGY** * **KAIZEN SYSTEM**   **QUALITY**  Quality is a perceptual, conditional and somewhat subjective attribute and may be understood differently by different people. Consumers may focus on the **specification quality** of a product/service, or how it compares to competitors in the marketplace. Producers might measure the **conformance quality**, or degree to which the product/service was [produced correctly](http://en.wikipedia.org/wiki/Conformance_testing).  Many different techniques and concepts have evolved to improve product or [service quality](http://en.wikipedia.org/wiki/Service_quality). There are two common quality-related functions within a business. One is [**quality assurance**](http://en.wikipedia.org/wiki/Quality_assurance) which is the prevention of defects, such as by the deployment of a [quality management system](http://en.wikipedia.org/wiki/Quality_management_system) and preventative activities like [failure mode and effects analysis (FMEA)](http://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis). The other is [**quality control**](http://en.wikipedia.org/wiki/Quality_control)which is the detection of defects, most commonly associated with testing which takes place within a quality management system typically referred to as verification and validation.  The dimensions of quality refer to the attributes that quality achieves in [operations management](http://en.wikipedia.org/wiki/Operations_management).  Quality supports [**dependability**](http://en.wikipedia.org/wiki/Dependability)   * Dependability supports [speed](http://en.wikipedia.org/wiki/Speed). * Speed supports flexibility. * Flexibility supports [cost](http://en.wikipedia.org/wiki/Cost).   In the manufacturing industry it is commonly stated that “Quality drives productivity.” Improved productivity is a source of greater [revenues](http://en.wikipedia.org/wiki/Revenue), employment opportunities and technological advances. However, this has not been the case historically, and in the early 19th century it was recognized that some markets, such as those in Asia, preferred cheaper products to those of quality. Most discussions of quality refer to a finished part, wherever it is in the process. Inspection, which is what, quality insurance usually means, is historical, since the work is done. The best way to think about quality is in process control. If the process is under control, inspection is not necessary.  P-8 | http://www.luminousindia.com/domestic/images/spacer.gif |
| http://www.luminousindia.com/domestic/images/spacer.gif | | | |  |
|  | **QUALITY**  **The degree of excellence of something.**  **Quality is essentially about learning what you are doing well and doing it better. It also means finding out what you may need to change to make sure you meet the needs of your service users. Quality is about:**   * knowing what you want to do and how you want to do it * learning from what you do * using what you learn to develop your organization and its services * seeking to achieve continuous improvement   satisfying your stakeholders those different people and groups with an interest in your organization.  http://1.bp.blogspot.com/-xLZA8NuspB8/TdEr93BoljI/AAAAAAAABMk/YMR2NumVlW0/s1600/quality.jpg  P-9  Quality is a perceptual, conditional and somewhat subjective attribute and may be understood differently by different people. Consumers may focus on the **specification quality** of a product/service, or how it compares to competitors in the marketplace. Producers might measure the **conformance quality**, or degree to which the product/service was [produced correctly](http://en.wikipedia.org/wiki/Conformance_testing). The common element of the business definitions is that the quality of a product or service refers to the perception of the degree to which the product or service meets the customer's expectations. Quality has no specific meaning unless related to a specific function and/or object. Quality is a perceptual, conditional and somewhat subjective attribute.  Numerous definitions and methodologies have been created to assist in managing the quality-affecting aspects of business operations. Many different techniques and concepts have evolved to improve product or [service quality](http://en.wikipedia.org/wiki/Service_quality). There are two common quality-related functions within a business. One is [quality assurance](http://en.wikipedia.org/wiki/Quality_assurance) which is the *prevention* of defects, such as by the deployment of a [quality management system](http://en.wikipedia.org/wiki/Quality_management_system) and preventative activities like [failure mode and effects analysis (FMEA)](http://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis). The other is [quality control](http://en.wikipedia.org/wiki/Quality_control) which is the *detection* of defects, most commonly associated with testing which takes place within a quality management system typically referred to as verification and validation. | | | |
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**How to Achieve Quality?**

**Quality** of a product or service refers to the perception of the degree to which the product or service meets the customer's expectations. Quality has no specific meaning unless related to a specific function and/or object. Quality is a perceptual, conditional and somewhat subjective attribute.

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* **5S Methodology**

**5S**

There are 5 primary phases of 5S: sorting, straightening, systematic cleaning, standardizing, and sustaining. Additionally, there are three other phases sometimes included; safety, security, and satisfaction.

**Sorting (*Seiri*)**

Eliminate all unnecessary tools, parts, and instructions. Go through all tools, materials, and so forth in the plant and work area. Keep only essential items and eliminate what is not required, prioritizing things as per requirements and keeping them in easily-accessible places. Everything else is stored or discarded.

**Straightening or setting in order / stabilize (*Seiton*)**

There should be a place for everything and everything should be in its place. The place for each item should be clearly labeled or demarcated. Items should be arranged in a manner that promotes efficient work flow, with equipment used most often being the most easily accessible. Workers should not have to bend repetitively to access materials.

P-10

**Sweeping or shining or cleanliness / systematic cleaning (*Seiso*)**

Keep the workplace tidy and organized. At the end of each shift, clean the work area and be sure everything is restored to its place. This makes it easy to know what goes where and ensures that everything is where it belongs. A key point is that maintaining cleanliness should be part of the daily work – not an occasional activity initiated when things get too messy.

**Standardizing (*Seiketsu*)**

Work practices should be consistent and standardized. All work stations for a particular job should be identical. All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station. Everyone should know exactly what his or her responsibilities are for adhering to the first 3 S's.

**Sustaining the discipline or self-discipline (*Shitsuke*)**

Maintain and review standards. Once the previous 4 S's have been established, they become the new way to operate. Maintain focus on this new way and do not allow a gradual decline back to the old ways. While thinking about the new way, also be thinking about yet better ways. When an issue arises such as a suggested improvement, a new way of working, a new tool or a new output requirement, review the first 4 S's and make changes as appropriate.

program such as new equipment, new products or new work rules, it is essential to make changes in the standards and provide training. Companies embracing 5S often use posters and signs as a way of educating employees and maintaining standards.

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P-11

**KAIZEN SYSTEM**

Kaizen methodology includes making changes and monitoring results, then adjusting. Large-scale pre-planning and extensive project scheduling are replaced by smaller experiments, which can be rapidly adapted as new improvements are suggested. In modern usage, a focused kaizen that is designed to address a particular issue over the course of a week is referred to as a "kaizen blitz" or "kaizen event". These are limited in scope, and issues that arise from them are typically used.

 Kaizen is a daily process, the purpose of which goes beyond simple productivity improvement. It is also a process that, when done correctly, humanizes the workplace, eliminates overly hard work ("[**muri**](http://en.wikipedia.org/wiki/Muri_(Japanese_term))**"**), and teaches people how to perform experiments on their work using the [scientific method](http://en.wikipedia.org/wiki/Scientific_method) and how to learn to spot and eliminate waste in business processes. In all, the process suggests a humanized approach to workers and to increasing productivity: "The idea is to nurture the company's human resources as much as it is to praise and encourage participation in kaizen activities." Successful implementation requires "the participation of workers in the improvement."

While kaizen usually delivers small improvements, the culture of continual aligned small improvements and standardization yields large results in the form of compound productivity improvement. This philosophy differs from the **"**[**command and control**](http://en.wikipedia.org/wiki/Command_and_control_(management))**"** improvement programs of the mid-twentieth century.

P-12

**CHAPTER 3**

* **MACHINES IN AI DEPARTMENT**
* **JUMPER MACHINE**
* **AXIAL MACHINE**
* **RADIAL MACHINE**
* **SURFACE MOUNT TECHNOLOGY**
* **REFLOW OVEN**
* **VISUAL INSPECTION**
* **AOM**

**AUTO INSERTION**

In this department, components are inserted by machines. AI machines are suitable for mass production. AI operation consists of three types of processes namely Jumper Wire, Radial and Axial.

**Features & Benefits of the machines in AI**

**Sequencer Machine**

* Demonstrated reliability at 200 parts per million or better.
* Reaches sequencing speeds of up to 25,000 components per hour.
* Available from 20 to 200 stations in 20-station increments, providing the flexibility to expand.
* Low part sensing on each module alerts operator before parts are depleted, allowing replenishment without interrupting machine operation.
* Bulk tape reels are located outside the machine and tape hubs are independent of each other for improved accessibility.
* Optional component verifier reduces the possibility of inserting defective, reversed polarity, or out of sequence components.
* Part presence sensing ensures the availability of every component in the correct sequence.
* New jumper wire dispensing system provides fast, reliable, and accurate wire feed.
* New dispensing heads are easy to operate, greatly extend life of wearable parts, and a low for quick change- over with minimal scrap.

**Dual Head 8 Axial line**

**Features & Benefits:**

* Insertion cycle rates up to 40,000 components per hour-fastest in the industry!.
* Up to 40% throughput increase, resulting from servo positioning system speed­up and servo- driven heads and clinches.
* The industry leader in lowest cost per insertion
* High-performance servo system provides dynamic motion control, yielding precise component insertion and clinching.

P-13



**JUMPER MACHINE**

A 0.08 s/piece insertion speed combined with variable insertion pitches and transfer speeds of 2 seconds enable the Panasert JV model jumper wire insertion machine to deliver high productivity.

This machine is used to insert jumper wire. It is the only wire of zero resistance and is used to pass current from one point to another. It also provides mechanical strength to PCB.

It works in two respective modes:

* Auto mode
* Semi auto mode

The machine consists of three major parts:

* Head
* Anvil
* Table

The table is movable and head is fixed. Head is having Jumper wire. An anvil cut the wire according to width required. PCB is placed on the table. PCB has two fudicial points. As machine senses these points, it starts working.

In Auto mode, insertion and movement is automatic. But in Semi auto, only movement is there, insertion will start by pressing the button.

**Operating AC voltage 100V**

**Air Pressure required 5 kg/sqcm**

The width of the jumper, the location where jumper wire is to be located all depends on the programming of the machine means how the machine is programmed. The location is defined by considering the x y axes. Z axes determine the width of the jumper wire.

P-14

In Jumper machine, **Panasert Technology**, Model **JV2**

PCB is considered as a main block. Various keys are used to program the machine.

* **Shift+N** gives the block number
* **Shift+NShift+T**

If T=1 X axis

If T=2 Y axis

**Shift +G**  is set to 0 as it refers to origin.

**Slash (/) +**it may be set to 0,1,2,3

**Shift+M** if it sets to 1 then it refer to Insertion command.

**For coordinates X, Y, W**

* **Shift+X** for X axis may be positive or negative.
* **Shift+Y** for Y axis may be positive or negative.
* **Shift+W** for width of Jumper wire.

P-15

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**SEQUENCER**

Consist of second generation axial sequencer and axial insertion machine. Sequence the components from tape on the chain conveyor as programmed and feed insertion machine directly, no need make into tape again. The insertion head is steady, the rotary table is movable, include vertical or horizontal direction, ensure precisely insert components in PCB. Application software is designed by our company; control all the operation through one computer.

**FEATURES**

* Insertion rate 26000Cpts / H
* Insert direction Parallel 0°, 90°, 180°, 270°.
* Components span Two-Hole Distance 5.0mm-20mm (Insert jumper wire can reach 5mm- 30mm)
* PCB Size (Min)50 mm x50mm(Max)450mm x 450mm  
   PCB thickness 0.79mm-2.36mm
* Components available Capacitors, transistors, diodes, resistors, fuse and so on, must be Tape packed electronic components.
* Clinch Length 1.2-2.2MM (adjustable)
* Clinch degree 0-35° (adjustable)
* Machine Size (L×W×H) Main machine 1730mm×1580mm×1600mm
* Machine Weight: main machine 700kg
* Power supply 220V, AC(single phase) 50/60HZ, 1.5KVA
* Air pressure  0.6-0.8 kg/cu-cm
* Machine noise 65 dB
* Driving system AC Servo AC motors
* Control System English version interface (WINDOWS system control platform)LCD monitor
* PCB transfer mode Manual / automatic optional

P-16

**VCD Machine**



**VCD** is used for Axial Insertion. The process is **Board Stuffing.**

This is the process by which leaded through-hole components (mainly resistors, diodes and inductors) are automatically inserted into the holes of conventional printed circuit boards and mechanically fixed in place by the under board clinching of each component's leads. This is **'board stuffing’.**

One type of axial insertion machine is known as a VCD or **Vertical Centered Distance** machine. VCD's are available in two main forms, **Stand Alone** or **Combi-Machine**.

The **Stand Alone** machine requires to be fed with pre-sequenced components on a reel produced by a machine called a **Sequencer.** The Sequencer machine is set up with reels of all of the unique components required to be inserted into the PCB. Some Sequencers can have in excess of 100 component stations and are modular in format so additional stations can be added or reduced as required.

User programmable software determines when each component head 'fires'. As each head fires, it cuts off the desired number of components from the component reels in the required sequence and individual components drop into a **conveyor** which travels along the length of the sequencer machine. At the end of the conveyor, the components are then re-taped in the pre-determined sequence determine by the software by being sandwiched between adhesive tape to form a **'bandolier'.** It is this bandolier or reel which is then fitted to the VCD machine for insertion. Each reel will contain a pre-determined number of sequences.

**For example** one reel may have 40 sequences on it which will be the exact quantity to populate 40 PCBs.

P-17

The VCD machine is set up by loading the correct tool plate (which supports and houses the PCB through the insertion process), the sequenced reel and the correct software. Upon activation of the VCD machine, a mechanism cuts the component leads from the tape, forms the leads at a right angle to the component body, and then inserts the leads of each component into its correct position in the PCB. A cut 'n' clinch mechanism cuts and forms the leads protruding through the solder side of the PCB to mechanically fix the component in place.

In VCD machine, the components are mechanically fixed but not soldered at this stage, so electrical connection is not achieved by this process.

The **combi-axial** insertion machine combines the capabilities of both the sequence machine and the VCD.VCD machines can typically handle axial components with 5mm-20mm pitch but need to be set up individually to handle one component pitch size at a time. The machine inserts 8000 components per hour so as to increase productivity.

For **programming** the machine, Windows 98 and MS DOS are required.

* **SET C** command is used to determine the count of PCBs
* **DI 17** command is used to determine the line number.
* **CH V**  command is used to change line number.

To change the coordinates;

* **A line-no 5+ 8- 2+** where first digit determines x axis, second determines y axis and third determines z axis.

P-18



**RADIAL MACHINE (RH6)**

In an automatic electronic component insertion machine for inserting electronic components into the inserting holes in a printed-circuit board, inserting operations for any shaped electronic components among taped axial electronic components, taped radial components and stick-packed electronic components can be conducted with a single electronic components insertion machine.

For insertion of radial components, **RH6** model is used. The machine consists of movable heads. Each head has four nozzles. In case of Jumper machine, table on which PCB is placed is movable but in radial machine, table is fixed. Two photo emissive sensors are embedded in the machine. These sense the fudicial points of PCB. After sensing, the machine starts working, after component insertion, PCB is passed on to the SMT machine by means of a conveyor.

The programming of radial machine is same as that of variable centered distance machine.

Radial machine provides 100 panels per hour, 32 components per panel are there in our company, and where one panel consists of two PCBs means speed of component insertion is 0.8 per second.

For **programming** the machine, Windows 98 and MS DOS are required.

* **SET C** command is used to determine the count of PCBs
* **DI 17** command is used to determine the line number.
* **CH V** command is used to change line number.

To change the coordinates;

* **A line-no 5+ 8- 2+** where first digit determines x axis, second determines y axis and third determines z axis.

P-19

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**GLUE DISPENSER**

As the market advances, maximizing performance and increasing reliability will be under the spotlight. The pressure to decrease size and weight, at reduced costs, is on the increasing trend. To remain competitive, it is essential for manufacturers to take advantage of the new advances in technology. There is therefore an increasing demand from the providers for screen printers and glue dispensers with a higher throughput and faster cycle times.

Before SMT, the PCB is passed through Glue Dispenser. It pastes the glue on the respective locations where SMT components are to be placed. To make the PCB dry, after SMT it is passed through reflow oven.

A monitor is provided. The machine is programmed according to the BOM of the model running.

The locations where machine pastes glue, on these respective locations, SMT machine places components over there. The machine is attached to surface mount technology by means of a conveyor. The conveyor belt is movable.

The main model used is Panasonic HDPG1.

Chip placers are also used after it. Chip placers used are MV2F, MV2V.

P-20

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**SMT (Surface Mount Technology)**

**Surface mount technology** (**SMT**) is a method for constructing [electronic](http://en.wikipedia.org/wiki/Electronics) circuits in which the components (SMC or Surface Mounted Components) are mounted directly onto the surface of [printed circuit boards](http://en.wikipedia.org/wiki/Printed_circuit_board) (PCBs). Electronic devices so made are called **surface mountdevices**or **SMD**s. In the industry it has largely replaced the [**through-hole technology**](http://en.wikipedia.org/wiki/Through-hole_technology) construction method of fitting components with wire leads into holes in the circuit board.

An SMT component is usually smaller than its through-hole counterpart because it has either smaller leads or no leads at all. It may have short [pins](http://en.wikipedia.org/wiki/Lead_(electronics)) or leads of various styles, flat contacts.

**The main advantages of SMT over the older through-hole technique are:**

* Smaller components. Smallest is currently 0.4 x 0.2 mm. Much higher number of components and many more connections per component.
* Fewer holes need to be drilled through abrasive boards.
* Simpler automated assembly.
* Small errors in component placement are corrected automatically. Components can be placed on both sides of the circuit board.
* Better mechanical performance under shake and vibration conditions.
* SMT parts generally cost less than through-hole parts.
* Faster assembly. Some placement machines are capable of placing more than 136,000 components per hour.

P-21

**Reflow Oven**



A **reflow oven** is a machine used primarily for [reflow soldering](http://en.wikipedia.org/wiki/Reflow_soldering) of [surface mount](http://en.wikipedia.org/wiki/Surface_mount) electronic components to [printed circuit boards](http://en.wikipedia.org/wiki/Printed_circuit_board) (PCB).

**Types of Reflow Ovens**

* **Infrared and convection ovens**

The oven contains multiple zones, which can be individually controlled for temperature. Generally there are several heating zones followed by one or more cooling zones. The PCB moves through the oven on a [**conveyor belt**](http://en.wikipedia.org/wiki/Conveyor_belt)**,** and is therefore subjected to a controlled time-temperature profile.

The [heat](http://en.wikipedia.org/wiki/Heat) source is normally from ceramic infrared heaters, which transfers the heat to the assemblies by means of [radiation](http://en.wikipedia.org/wiki/Radiation). Ovens which also use fans to force heated air towards the assemblies (which are usually used in combination with ceramic infrared [heaters](http://en.wikipedia.org/wiki/Heaters)) are called **infrared convection ovens.**

Some ovens are designed to reflow PCBs in an oxygen-free atmosphere. [Nitrogen](http://en.wikipedia.org/wiki/Nitrogen) (N2) is a common gas used for this purpose. This minimizes [oxidation](http://en.wikipedia.org/wiki/Oxidation) of the surfaces to be soldered.

* **Vapor phase oven**

The heating of the PCBs is sourced by thermal energy emitted by the [phase change](http://en.wikipedia.org/wiki/Phase_change) of a [heat transfer](http://en.wikipedia.org/wiki/Heat_transfer) liquid condensing on the PCBs. The liquid used is chosen with a desired [boiling point](http://en.wikipedia.org/wiki/Boiling_point) in mind to suit the solder alloy to be reflowed.

Some advantages of vapor phase soldering are:

* High energy efficiency due to the high heat transfer coefficient of vapor phase media
* Soldering is oxygen-free. There is no need for any protective gas (e.g. [nitrogen](http://en.wikipedia.org/wiki/Nitrogen))
* No overheating of assemblies. The maximum temperature assemblies can reach is limited by the [boiling point](http://en.wikipedia.org/wiki/Boiling_point) of the medium.

P-22

**VISUAL INSPECTION**

**Visual inspection** is a common method of [**quality control**](http://en.wikipedia.org/wiki/Quality_control)**,**[**data acquisition**](http://en.wikipedia.org/wiki/Data_acquisition)**, and**[**data analysis**](http://en.wikipedia.org/wiki/Data_analysis). Visual Inspection, used in maintenance of facilities, mean inspection of equipment and structures using either or all of human senses such as vision, hearing, touches and smell. Visual Inspection typically means inspection using raw human senses and/or any non-specialized inspection equipment. Inspections requiring Ultrasonic, X-Ray equipment, Infra-red, etc. are not typically considered as Visual Inspection as these Inspection methodologies require specialized equipment and training.

A study of the visual inspection of small integrated circuits or PCBs found that the modal duration of eye fixations of trained inspectors was about 200 msec. The most accurate inspectors made the fewest eye fixations and were the fastest.

**The problems are:**

* Shifting of components from pads.
* Lifting of components
* Extra glue on pads
* Missing components
* Wrong value components

If any of the above problems occur, PCB is then given for rework. If not, it is passed over to AOM machine.

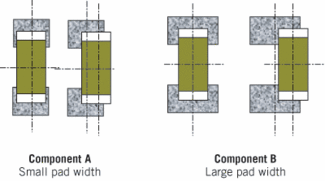
P-23

**PROBLEMS IN VISUAL INSPECTION**

**SHIFTING:**

There are number of factors that can cause components to shift during reflow:

* Physical contact with curtains or hardware
* Excessive vibration or rapid speed changes in the conveyor system
* Poor solder placement - either the wrong location (off the pads) or the incorrect amount.
* Convection rate too high at the beginning of the profile - before the surface tension of the solder can hold the component or while the flux is changing state
* Heating ramp rate too high causing the flux to rapidly outgas and move the component.
* Small components placed next to large ones where the heated gas is directed from the side of big component toward the smaller ones.

**Shifting of Capacitor from its pad.**

**LIFTING:**

In this case, the component is lifted from its pad. Due to this, no soldering will be there.

**Lifting of a capacitor**

P-24

**MISSING:**

It is a huge problem regarding component insertion. If a component is missed, it will not give the proper output.



In the above case, two components are not there.

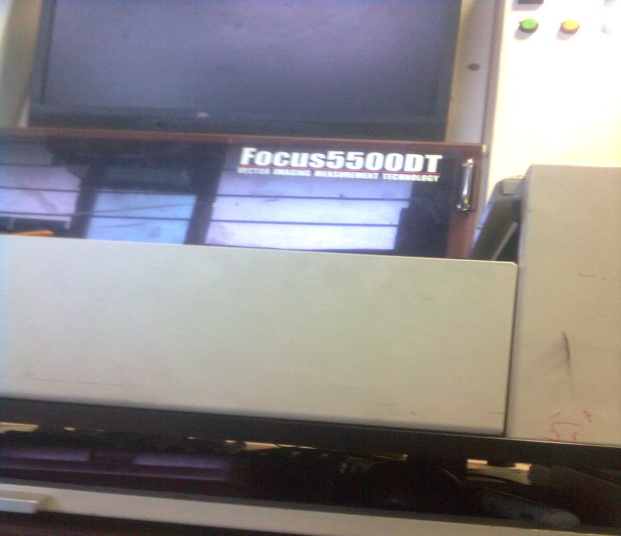
**EXCESSIVE GLUE PROBLEMS**

If the glue remained on the electrolytic pads then soldering can’t be done.

**WRONG VALUE COMPONENTS**

It is also a major problem. It is not visible by naked eye. Hence, inspected by AOM.

P-25

 Automatic optical measurements machine is used to visualize the PCB. It displays the images of components with pads on PCB so that a person can identify the problem.

**AOM (Automatic Optical Measurements)**

Firstly, the PCB is placed on the adjustable conveyor. With the help of conveyor, PCB moves inside the machine. The machine senses the fudicial points of PCB and scans every component on PCB, The camera scans the PCB and results are shown on the screen of monitor.

A simple description of the model is inserted into the machine’s memory by means of a program.

During scanning, machine compares the scanned results with the defined description in memory.

Thus find out errors.

Manual visualization is not so precise. Hence, it is introduced.

PCBs are grouped into a Magazine in the industry.

Magazine may be of 50 cards or 100 cards means 25 or 50 panels respectively.

**For model 160 VA,**

10% of the PCBs are handed over for AOM.

**For model 172-05,**

20% of the PCBs are handed over for AOM.

It uses the metrology approach to measure the component position and evaluate the solder rather than comparing the inspected image with Golden sample based on pattern matching technology. AOM’s multiple image analysis method, allows high quality image analysis and high productivity by following IPC-A-610D standards.

P-26

**CHAPTER 4**

* **MAGAZINE**
* **QUALITY CHECK**
* **REWORK OF PCBs**

**MAGAZINE**

A magazine is used to handle the PCBs. These are available in mainly two forms:

* Magazine of 25 panels (50 cards)
* Magazine of 50 panels (100 cards)



Since the manufactured cards are very delicate, these may break. It will lead to loss in production and quality decreases. So, the cards are handled by the magazines for the safety. Magazines are passed on from machine to machine. A WIP sticker is taped on the head of the magazine.

Where, WIP determines the work in progress.

Operator who operates the machine signed on the sticker and then the magazine is passed on to another machine. In this way, the online process starts. Size of the magazine is adjustable and is automatically adjusted according to the size of the card. Because the size of the PCB varies with the model designed.

After whole component insertion, the magazine is offered to quality department. If there is a problem, then the magazine is provided for Rework.

P-27

**QUALITY CHECK**



After whole component insertion, Magazines are offered for quality check.

For a magazine of 50 panels or 100 cards, 5 to 10 cards are checked by Quality In-charge.

For a magazine of 25 panels or 50 cards, 2 to 5 cards are checked by Quality In-charge.

If any one of the card is faulty, the whole magazine is gone for the rework.

The whole magazine is forwarded to MI department with a WIP sticker

Quality is important because it ensures the viability of a business.  
  
Without quality, a business may survive, but won't/can't reach its optimal earning potential.  
  
When I'm referring to quality, I'm not focused solely on quality of product or service. I'm referring to the quality of the business practices and processes. The lack of quality is costly through waste (redundancies, errors, scrap, time, etc.).

Magazine is handed over from:

**AI DEPARTMENT MI DEPARTMENT**

P-28

**PCBs REWORK**

During the rework, there are certain precautions**.**

**Electrostatic Discharge (ESD)**   
Certain components used in electronic assemblies are sensitive to static electricity and can be damaged by its discharge. Static charges are created when non-conductive materials are separated, such as when plastic bags are picked up or opened, when friction occurs between articles of synthetic clothing, when plastic tapes are dispensed and many other causes.

Destructive static charges are induced on nearby conductors, such as human skin, and delivered in the form of sparks passing between conductors, such as when the surface of printed board assembly is touched by a person having a static charge potential. If touched at the right solder joint or conductive pattern, the circuit board assembly can be damaged as the discharge passes through the conductive pattern to a static sensitive component. It is important to note that usually the static damage level for components cannot be felt by humans. (Less than 3,000 volts.)

|  |  |  |
| --- | --- | --- |
| |  | | --- | | http://www.circuitrework.com/web/uploads/1/2-1-2_001.gif | | *Handle components by edges to prevent contaminating leads with skin* | |

**Electrical Overstress (EOS)**   
Electrical overstress damage can be caused by generation of unwanted energy; such as spikes, occurring within soldering irons, solder extractors, testing instruments and other electrically operated equipment. This equipment must be designed as to prevent unwanted electrical discharges.

**ESD/EOS Safe Work Areas**   
The purpose of an ESD/EOS safe work area is to prevent damage to sensitive components from spikes and static discharges. These areas must be designed and maintained to prevent ESD/EOS damage.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P-29  **Handling and Storage Methods**  Circuit board assemblies must always be handled at properly designated work areas.  Designated work areas must be checked periodically to ensure their continued safety from ESD. Areas of main concern include:   * 1. Proper grounding methods.   2. Static dissipation of work surfaces.   3. Static dissipation of floor surfaces.   4. Operation of ion blowers and ion air guns.  |  |  |  | | --- | --- | --- | | |  | | --- | | http://www.circuitrework.com/web/uploads/1/2-1-1_001.jpg | | *Always handle circuit boards by the edges.* | |  1. Designated work areas must be kept free of static generating materials such as Styrofoam, vinyl, plastic, fabrics or any other static generating materials. 2. Work areas must be kept clean and neat. To prevent contamination of circuit board assemblies, there must be no eating or smoking in the work area. 3. When not being worked on, sensitive components and circuit boards must be enclosed in shielded bags or boxes. There are three types of ESD protective enclosure materials including:   Static Shielding - Prevents static electricity from passing through the package.   Antistatic - Provides antistatic cushioning for electronic assemblies.   P-30 |  |

**CHAPTER 5**

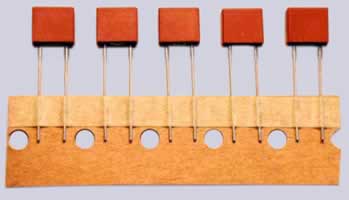
* **MANUAL INSERTION**
* **MANUAL SOLDERING**
* **WAVE SOLDERING MACHINE**
* **TESTING**

**MANUAL INSERTION**

For through-hole components, such as leaded resistors or the larger values of tantalum capacitors, whether insertion machines are used or the task is undertaken manually, the process is to take the component from its packaging, preform the lead wires if necessary, and insert the component in the correct position:

* Axial components are first cut from the guide tape, and the leads preformed prior to placement into the board, Figure 1.
* Radial components are taped at right-angles to the guide tape and must be cut from the tape before insertion.

**DIN IEC 286 Part 2 packing for axial components**

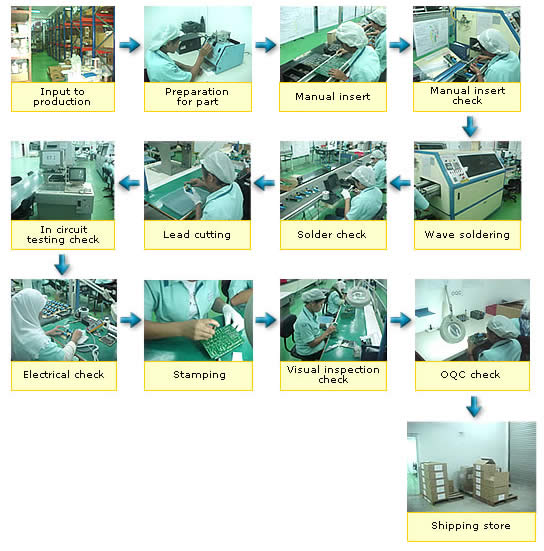


The components which cannot be inserted by machines are inserted manually.

**Manual Insertion** is the department where large components are inserted by hands which can’t be inserted through machines such as heat sinks, relays, inductors etc. Soldering is used in this department. Problems of dry solder are main and after whole component insertion, testing is done.

P-31

#### Manual Insertion PCB Assembly

P-32

**MANUAL SOLDERING PROCESS**

**Soldering** is a process in which two or more [metal](http://en.wikipedia.org/wiki/Metal) items are joined together by melting and flowing a filler metal into the joint, the filler metal having a lower [melting point](http://en.wikipedia.org/wiki/Melting_point) than the work piece. Soldering differs from [welding](http://en.wikipedia.org/wiki/Welding) in that the work pieces are not melted. There are three forms of soldering, each requiring higher temperatures and each producing an increasingly stronger joint strength: [soft soldering](http://en.wikipedia.org/w/index.php?title=Soft_soldering&action=edit&redlink=1) which originally used a tin-lead [alloy](http://en.wikipedia.org/wiki/Alloy) as the filler metal, [silver soldering](http://en.wikipedia.org/wiki/Silver_soldering) which uses an alloy containing [silver](http://en.wikipedia.org/wiki/Silver) and [brazing](http://en.wikipedia.org/wiki/Brazing) which uses a [brass](http://en.wikipedia.org/wiki/Brass) alloy for the filler. The alloy of the filler metal for each type of soldering can be adjusted to modify the melting temperature of the filler. Soldering appears to be a **hot glue** process, but it differs from gluing significantly in that the filler metals alloy with the work piece at the junction to form a gas and liquid tight bond.

**Soft soldering** is characterized by having a melting point of the filler metal below approximately 400 °C (752 °F), whereas **silver soldering** and **brazing** use higher temperatures, typically requiring a flame or carbon arc torch to achieve the melting of the filler. Soft solder filler metals are typically alloys (often containing [lead](http://en.wikipedia.org/wiki/Lead)) that have [liquidus](http://en.wikipedia.org/wiki/Liquidus) temperatures below 350°C.

In the soldering process, heat is applied to the parts to be joined, causing the solder to melt and to bond to the work pieces in an alloying process called [wetting](http://en.wikipedia.org/wiki/Wetting). In stranded wire, the solder is drawn up into the wire by [capillary action](http://en.wikipedia.org/wiki/Capillary_action) in a process called **wicking**. Capillary action also takes place when the work pieces are very close together or touching. The joint strength is dependent on the filler metal used, where soft solder is the weakest and the brass alloy used for brazing is the strongest. Soldering, which uses metal to join metal in a molecular bond has electrical conductivity and is water and gas-tight.

Soldering filler materials are available in many different [alloys](http://en.wikipedia.org/wiki/Alloy) for differing applications. In electronics assembly, the [eutectic](http://en.wikipedia.org/wiki/Eutectic) alloy of 63% tin and 37% lead (or 60/40, which is almost identical in performance to the eutectic) has been the alloy of choice. Other alloys are used for plumbing, mechanical assembly, and other applications.

P-33

Common solder alloys are mixtures of tin and lead, respectively:

* 63/37: melts at 183 °C (361 °F) (eutectic: the only mixture that melts at a point, instead of over a range)
* 60/40: melts between 183–190 °C (361–374 °F)
* 50/50: melts between 185–215 °C (365–419 °F)

The purpose of [flux](http://en.wikipedia.org/wiki/Flux_(metallurgy)) is to facilitate the soldering process. The obstacle to a successful solder joint is an impurity at the site of the union, e.g. dirt, oils or [oxidation](http://en.wikipedia.org/wiki/Oxidation). The impurities can be removed by mechanical cleaning or by chemical means, but the elevated temperatures required to melt the filler metal (the solder) encourages the work piece (and the solder) to re-oxidize. This effect is accelerated as the soldering temperatures increase and can completely prevent the solder from joining to the work piece. One of the earliest forms of flux was [charcoal](http://en.wikipedia.org/wiki/Charcoal), which acts as a [reducing agent](http://en.wikipedia.org/wiki/Reducing_agent) and helps prevent oxidation during the soldering process. Some fluxes go beyond the simple prevention of oxidation and also provide some form of chemical cleaning (corrosion).

For many years, the most common type of flux used in electronics (soft soldering) was [rosin](http://en.wikipedia.org/wiki/Rosin)-based, using the rosin from selected pine trees. It was ideal in that it was non-corrosive and non-conductive at normal temperatures but became mildly reactive (corrosive) at the elevated soldering temperatures. Plumbing and automotive applications, among others, typically use an acid-based ([muriatic acid](http://en.wikipedia.org/wiki/Muriatic_acid)) flux which provides cleaning of the joint. These fluxes cannot be used in electronics because they are conductive and because they will eventually dissolve the small diameter wires. Many fluxes also act as a [wetting agent](http://en.wikipedia.org/wiki/Wetting_agent) in the soldering process, reducing the [surface tension](http://en.wikipedia.org/wiki/Surface_tension) of the molten solder and causing it to flow and wet the work pieces more easily.

Currently, mass-production printed circuit boards (PCBs) are mostly [wave soldered](http://en.wikipedia.org/wiki/Wave_soldering) or [reflow soldered](http://en.wikipedia.org/wiki/Reflow_soldering), though hand soldering of production electronics is also still standard practice for many tasks. In wave soldering, parts are temporarily adhered to the PCB with small dabs of adhesive, and then the assembly is passed over flowing solder in a bulk container. Reflow soldering is a process in which a [solder paste](http://en.wikipedia.org/wiki/Solder_paste), a mixture of prealloyed solder powder and a flux-vehicle that has a peanut butter-like consistency is used to stick the components to their attachment pads, after which the assembly is heated by an infrared lamp; a hot air pencil; or, more commonly, by passing it through a carefully controlled oven.

P-34

Since different components can be best assembled by different techniques, it is common to use two or more processes for a given PCB. For example, [surface mounted](http://en.wikipedia.org/wiki/Surface-mount_technology) parts may be reflow soldered first, with a wave soldering process for the [through-hole](http://en.wikipedia.org/wiki/Through-hole_technology) mounted components coming next, and bulkier parts hand-soldered last.

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**Desoldering and resoldering**

Used solder contains some of the dissolved base metals and is unsuitable for reuse in making new joints. Once the solder's capacity for the base metal has been achieved it will no longer properly bond with the base metal, usually resulting in a brittle cold solder joint with a crystalline appearance.

It is good practice to remove solder from a joint prior to resoldering [desoldering braids](http://en.wikipedia.org/wiki/Desoldering_braid) or vacuum desoldering equipment ([solder suckers](http://en.wikipedia.org/wiki/Solder_sucker)) can be used. Desoldering wicks contain plenty of flux that will lift the contamination from the copper trace and any device leads that are present. This will leave a bright, shiny, clean junction to be resoldered.

The lower melting point of solder means it can be melted away from the base metal, leaving it mostly intact, though the outer layer will be "tinned" with solder. Flux will remain which can easily be removed by abrasive or chemical processes. This tinned layer will allow solder to flow into a new joint, resulting in a new joint, as well as making the new solder flow very quickly and easily.

P-35

**SOLDERING MACHINE**

**Wave soldering** is a large-scale [soldering](http://en.wikipedia.org/wiki/Soldering) process by which [electronic components](http://en.wikipedia.org/wiki/Electronic_component) are soldered to a [printed circuit board](http://en.wikipedia.org/wiki/Printed_circuit_board) (PCB) to form an electronic assembly. The name is derived from the use of waves of molten solder to attach metal components to the PCB. The process uses a tank to hold a quantity of molten solder; the components are inserted into or placed on the PCB and the loaded PCB is passed across a pumped wave or [waterfall](http://en.wiktionary.org/wiki/cascade) of solder. The solder wets the exposed metallic areas of the board (those not protected with [solder mask](http://en.wikipedia.org/wiki/Solder_mask), a protective coating that prevents the solder from bridging between connections), creating a reliable mechanical and electrical connection. The process is much faster and can create a higher quality product than manual soldering of components.

Wave soldering is used for both [through-hole](http://en.wikipedia.org/wiki/Through-hole_technology) printed circuit assemblies, and [surface mount](http://en.wikipedia.org/wiki/Surface-mount_technology). In the latter case, the components are glued by the [placement equipment](http://en.wikipedia.org/wiki/SMT_placement_equipment) onto the printed circuit board surface before being run through the molten solder wave.

through-hole components have been largely replaced by [**surface mount**](http://en.wikipedia.org/wiki/Surface_mount)**components,** wave soldering has been supplanted byre flow methods in many large-scale electronics applications. However, there is still significant wave soldering where SMT is not suitable (e.g. large power devices and high pin count connectors), or where simple through-hole technology prevails (certain [major appliances](http://en.wikipedia.org/wiki/Major_appliance)).

P-36There are many types of wave solder machines; however the basic components and principles of these machines are the same. A standard wave solder machine consists of three zones: the preheating zone, the fluxing zone, and the soldering zone. An additional fourth zone, cleaning, is used depending on the type of [flux](http://en.wikipedia.org/wiki/Flux_(metallurgy)) applied. The basic equipment used during the process is a conveyor that moves the PCB through the different zones, a pan of solder used in the soldering process, a pump that produces the actual wave, the sprayer for the flux and the preheating pad. The solder is usually a mixture of metals. A typical solder has the chemical makeup of 50% tin, 49.5% lead, and 0.5% antimony. There are three types of waves: normal wave, a medium speed, long leads used for horizontal soldering; cascade wave, high speed, short leads, used for inclined soldering; and flat wave with extenders; medium to high speeds, long leads that is used for horizontal soldering.

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Wave solders process

[](http://en.wikipedia.org/wiki/File:Wavesolderingmachine.jpg)

[http://bits.wikimedia.org/skins-1.17/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Wavesolderingmachine.jpg)P-37

## Process Characteristics

The following are characteristics of the wave soldering process:

* The solder connection is very reliable and also a clean connection
* The process is automated
* The process reuses the flux and solder that is left over
* It does require inspection, some touch ups, and also testing
* The productivity and efficiency is increased

### Defects

Cracks in the solder can occur and are usually caused by stress on the solder and can cause a loss of conductivity. Cavities, pores in the solder, can be caused by contaminated surfaces, insufficient flux, and insufficient preheating. Cavities can reduce strength and conductivity. Improper solder temperature or conveyor speed can cause an undesired thickness. If the solder is too thin, then it is susceptible to stress and may not support the required load. If it is too thick, then unwanted shorts and bridging can occur. Poor conduction in the solder can be caused by contaminated solder and can cause the product to be dysfunctional.

### Excess heat

Excess heat can cause the circuit board to delaminate, become brittle, and become warped. Excess heat can also damage components that are sensitive to heat.

P-38

## Finish and Quality

Quality depends on proper temperatures when heating and on properly treated surfaces.

|  |  |  |
| --- | --- | --- |
| **Defect** | **Possible causes** | **Effects** |
| Cracks | Mechanical Stress | Loss of Conductivity |
| Cavities | Contaminated surface  Lack of flux Insufficient preheating | Reduction in strength  Poor conductivity |
| Wrong solder thickness | Wrong solder temperature  Wrong conveyor speed | Susceptible to stress  Too thin for current load Undesired bridging between paths |
| Poor Conductor | Contaminated solder | Product Failures |

P-39

**TESTING**

The name for the manufacturing department where the product is assembled.

A schedule of end items to finish the product for specific customers' orders in a make-to-order or assemble-to-order environment. It is also referred to as the finishing schedule because it may involve operations other than just the final assembly; also, it may not involve assembly, but simply final mixing, cutting, packaging, etc. The FAS is prepared after receipt of a customer order as constrained by the availability of material and capacity, and it schedules the operations required to complete the product from the level where it is stocked (or master scheduled) to the end-item level.

**FABRICATION**

Manufacturing operations for making components, as opposed to assembly operations.

**FABRICATION LEVEL**

The lowest production level. The only components at this level are parts (as opposed to assemblies or subassemblies). These parts are either procured from outside sources or fabricated within the manufacturing organization.

**FABRICATION ORDER**

A manufacturing order to a component-making department authorizing it to produce component parts. See: batch card, manufacturing order.

**FABRICATOR**

A manufacturer that turns the product of a converter into a larger variety of products. For example, a fabricator may turn steel rods into nuts, bolts, and twist drills, or may turn paper into bags and boxes.

P-40

**CHAPTER 6**

* **FINAL ASSEMBLY**
* **SKILLS ACQUIRED DURING THE TRAINING**

|  |  |
| --- | --- |
| **Assembly Conveyors** | http://www.indiamart.com/aravali-engineers/ts/zero.gif |
| These are used in various sectors for packaging, processing and other applications. The range of assembly conveyors includes testing conveyor, manual conveyor, work tables are appreciated widely for remarkable features such as improved motion control, automatic controls, speed expertise and efficiency.   * Socking and testing of equipment can be done online on slow moving conveyors. * Power source is supplied to the equipment on the moving conveyor with the help of specially designed power collectors * Provides a convenient system of testing/socking without any need for manual intervention | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | |  | | --- | | PCB Insertion/Testing Conveyor | | | ASSEMBLY CONVEYOR | | |  | | --- | | **PCB Insertion/Testing Conveyor** |   **Application:**  For socking/testing of PCBs/Television sets & other electronic / electrical equipment’s. |
| **P-41**  **Manual Conveyor** |

**Application:**  
  
Manual conveying/sliding of any product/pallet.  
  
**Description**:

* Conveyors fitted with durable and jam free rollers
* Provide cost effective and efficient medium of conveying products from one work station to another
* Products can be pushed, with slightest effort, from one work station to the other
* Multi directional Ball castor tables can be used for turnings or sorting
* Available in complete Aluminum section construction
* Available with rollers for manually conveying pallets
* Also available with channel for manual sliding of PCBs
* No power required
* Low cost alternative to powered assembly conveyors

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | |  | | --- | | Manual Conveyor | | | MANUAL CONVEYOR | | |  | | --- | |  |   P-42 |

**SKILLS WHICH ARE GAINFUL IN MY FUTURE EMPLOYMENT**

* I am exposed to engineering experience and knowledge which is required in industry.
* I got a feel of work environment during my training period.
* The Training is extremely helpful to expose the students to future employers.
* I have got the Decision making Capability which is necessarily required in the industries

With all the experience and knowledge acquired, the student will able to choose appropriate work upon graduation.

P-43

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