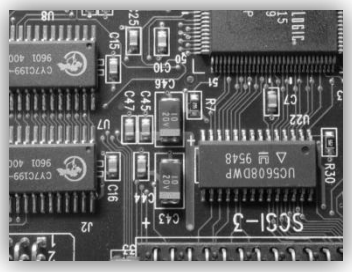
Acme Electronics Overview



Acme Electronics is an electronics contract manufacturer (ECM) that assembles completed circuit boards for other companies. For example, Acme is under contract to Pretty Good PCs to manufacture motherboards for PGPC's products. PGPC designs the circuitry and the board layouts, specifies the components, and establishes the tests that Acme must perform. From PGPC's designs, Acme manufactures the bare circuit boards, solders all the components onto those boards, and tests them for correct operation before shipping them to PGPC. Acme is paid a set price per functioning motherboard, so their profit increases the more they can reduce the cost of manufacture.

One such manufacturing cost is cleaning solder flux from completed circuit boards. When circuit boards are manufactured, a bare board – usually some sort of fiberglass or resin surface – is 'printed' with copper or gold circuit traces in a manner quite similar to ink being applied to the surface of a paper to create a drawing. These traces thus serve as the 'wires' that connect things together according to the circuit design. Electronic components are then soldered to these traces with metallic solder that attaches them electrically to the traces where they are meant to connect. Here is how that is done:

- The bare circuit boards – i.e., the unpopulated boards that are etched with the circuit traces – are manufactured at another Acme Electronics facility and shipped to this plant for component assembly. For quality assurance purposes, each bare board is hand wiped with acetone as it is loaded onto the assembly line to assure that it is clean and free of foreign substances such as buffing compound and etch chemical residues. The facility uses 15,000 lbs of acetone per year in this application.
- A thin layer of solder paste is squeegeed onto the board. The paste has the consistency of peanut butter, and is composed of a viscous carrier of flux which has small balls of solid metallic solder suspended in it.
- A pick-and-place machine precisely places components where they are supposed to go – they stick in place because the solder paste acts as a sort of temporary glue.
- The board, now populated with electronic components, is conveyed through a 'reflow oven', which warms it to a temperature sufficient to melt the solder balls in the paste. The role of the flux is to help the metallic solder flow more easily, and helps the melted solder to adhere to the metallic surfaces of the electronic components and the board traces, so that it is repelled from the non-metallic surface sections of the board.
- The board is then allowed to cool and the flux residues are cleaned off. The final product is a completely assembled circuit board.

Acme cleans off the solder flux using n-propyl bromide (nPB). The reflowed boards are manually sprayed with nPB, allowed to rest a few seconds for the nPB to dissolve the flux, then sent through an enclosed air flow area to blow off the dissolved flux from the circuit boards. The air flow area has a local exhaust system to carry away the evaporated nPB. There is no solvent recovery system in place. The facility uses 45,000 pounds of nPB per year.

The nozzle for spraying the nPB onto the circuit boards has adjustable settings. A college co-op student from Green State University conducted a study of the nPB spraying operation. The student reported that on average there was 20% overspray for the circuit boards. Also, the amount of overspray varied from 5% to 60% depending on which operator was using the sprayer.

Acme's workers in the flux cleaning area have complained of neurologic issues such as dizziness and memory loss since using the nPB flux cleaner. Acme's EHS manager encouraged the switch to nPB nearly 2 years ago, as it was not a Hazardous Air Pollutant, and was allowed under EPA's SNAP program for cleaning and degreasing. He picked up a fact sheet on nPB at the last TUR Planner CE Conference, and was concerned with the health and safety information he read there. Acme is required to complete a TUR plan for nPB for the first time this upcoming year.

1. Based on this process overview, create a process flow diagram for the solder flux cleaning process.