

Determining The Cost Of Wave Soldering Defects At Your Facility

There are numerous increases to production costs and very serious financial losses caused directly by wave solder failures such as bridges and insufficients.

SCRAPPING: How many boards are scrapped per week or per month? What are the direct materials costs of the boards scrapped? For example, a plant that scraps 11 boards per week with a direct materials cost of \$49.00 per board, is losing at least \$539.00 per week due to scrapping alone, or more than \$28,028.00 annually.

TOUCH-UP: How many boards are handled per week for the purpose of touch-up? Better yet, combine that with how many joints are touched up, on average per board. For example, if a plant assembles 2000 printed circuit boards per week and 5% are touched up, that means 100 boards are at issue weekly. If there is an average of three joints in need of touch-up on each of these boards, that means that 300 joints are touched up weekly. Using the convention that the direct direct cost of touch-up per joint is \$4.00, the plant is losing \$1,200.00 per week due to touch-up alone, or about \$60,000.00 annually.

TOUCH-UP STAFF: A much better approach to assessing the cost of wave solder failures is to estimate the total cost to the plant of touch-up staff. For example, if a plant has three wave machines running every shift two shifts per day five days per week, and one touch-up person is assigned to each machine per shift, that means there are six full-time employees (three per shift) just for this purpose. While salary ranges do vary, this plant pays its touch-up people an average annual salary of \$15,000.00 (about \$7.25 per hour). That's a total of \$90,000.00 for all six of the touch-up staff. If a full 25% of their time is spent on activity that is actually desirable, like hand soldering, then 75% of their time is spent performing touch-up. 75% of \$90,000.00 is \$67,500.00 annually as the direct cost of performing the touch-up function at this plant. *It's very important to note that the real cost of touch-up is much, much higher, as this calculation does not include the cost to the plant of benefits like health care, disability insurance and retirement plans, nor the large costs to the facility for payroll taxes, social security, workman's compensation and the like. It does not even include the cost of floor space, or the purchase of workdesks, training costs, the investment in hand soldering equipment and the consumables that go along with it, or management energy and time.*

REWORK: On a per joint, per chip and per board basis, rework is far more expensive than even touch-up. If the sample plant discussed here performs rework on only 1% of its boards, that means that 20 boards per week (2000 boards x 1%) are experiencing rework, or 1000 boards annually. Using the convention that the direct cost of rework per joint is \$12.00, the plant is losing \$240.00 per week due to rework alone, or about \$12,000.00 annually.

MORE COSTS: The weakness in all of these calculations of financial loss is that they do not even begin to take into account the true cost of wave solder defects. This includes the reduction in throughput, management and engineering time fighting wave solder problems, downtime, the aggravation and staff distraction that entails, and the cost of ineffective or partial attempts to improve the wave solder process. Further, joints that have gone through touch-up and rework are weaker than joints that are wave soldered properly in the first place, thus being prone to fail sooner in the field.

FUTILITY OF INSPECTION: One of the most obvious points is that at normal levels of solder joint inspection the inspector is at best sampling the quality of the joints on each board and, from the external appearance of the joints, assessing the chances that a satisfactory result has been achieved on all of them. This assessment of each and every joint is obviously ridiculous; all defects can never be identified before boards leave the plant. Therefore, the responsibility for high quality PCBs lies with the assembly process, not with inspection.

FIELD FAILURES: This combined triple threat of touch-up, rework and inspection by sampling leads to failure at test and - most damaging of all - product failures in the field. As an OEM you're servicing an internal customer. As a contract manufacturer you're competing to retain customers and competing to attract new ones. The damage and the cost of quality problems and field failures are incalculable to your relationship with your customers, job security and position in the marketplace.

Ralph Woodgate puts it this way in the accompanying article: "When all factors are put together and the calculation correctly done, even a very tiny increase in yield will result in important cost savings. Wave solder defects are very, very expensive. Anything that will reduce the number of defects will show a cost savings."