

# CRITICAL FACTORS IN SELECTING AN EMS COMPANY FOR AEROSPACE PRODUCTS

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Electronic manufacturing services (EMS) companies are an integral part of the supply chain. Especially for high-reliability products, they are relied upon for their expertise, precision, and quality processes. For aerospace applications, where requirements are stringent and device failure is not an option, choosing an EMS partner can be critical. This paper explains how knowledge of an EMS company's certifications and processes, along with facilities, service, and support, can lead to success when selecting an EMS company for your aerospace or high reliability products.

## CERTIFICATIONS

For manufacturing aerospace products, the first thing to check is quality certifications. Having received a quality certification tells you a lot about a company.

The certification required for aerospace quality manufacturing is AS9100. It has recently been revised to AS9100:2016 (Rev D). AS9100:2016 (Rev D) standardizes quality management system requirements for organizations that design and manufacture products for the aerospace industry, including parts, components, and assemblies. The standard is prepared by the International Aerospace Quality Group (IAQG), with representatives from aviation, space, and defense companies in the Americas, Asia/Pacific, and Europe. The Society of Aerospace Engineers (SAE) maintains a database of companies with AS9100:2016 (Rev D) certification.

AS9100:2016 (Rev D) includes new requirements above and beyond those specified in the previous revision AS9100 (Rev C). They address risk-based

thinking, make it more explicit, and build it into the whole management system. It ensures that risk is considered from the beginning and throughout the manufacturing process, and makes prevention part of strategic and operational planning. AS9100:2016 (Rev D) provides a framework to enable organizations to adapt to their changing environments or circumstances, involves organizational knowledge, product safety, counterfeit parts prevention, awareness by employees of their contribution, and consideration of human factors in the root cause analysis for nonconformities. Obsolescence must also be considered in the planning process.

According to Douglas Sutherland, President & CEO of NeXsys Group Inc., a professional services company that assists companies in achieving AS9100 and ISO certifications, “This certification doesn’t just indicate that a company has a quality management system. It involves so much more. It involves top management’s commitment and leadership to define their strategic business vision as it is influenced by those applicable interested party’s requirements. Achieving certification shows that a company is dedicated to carrying out an efficient and productive business process management system. Especially for an EMS company, it demonstrates that they have a design and development process for how to build something and a methodology to weed out and mitigate potential problems or failures.”

“For an EMS company, achieving AS9100:2016 (Rev D) certification demonstrates that they have a design and development process for how to build something and a methodology to weed out and mitigate potential problems or failures.”

~ Douglas Sutherland  
President & CEO  
NeXsys Group Inc.

## PROCESSES

For aerospace products, device failure is a major concern; however, processes can be put in place to mitigate failure. Two areas where device failure can be stemmed are cleaning and soldering.

## *Cleanliness of printed circuit boards*

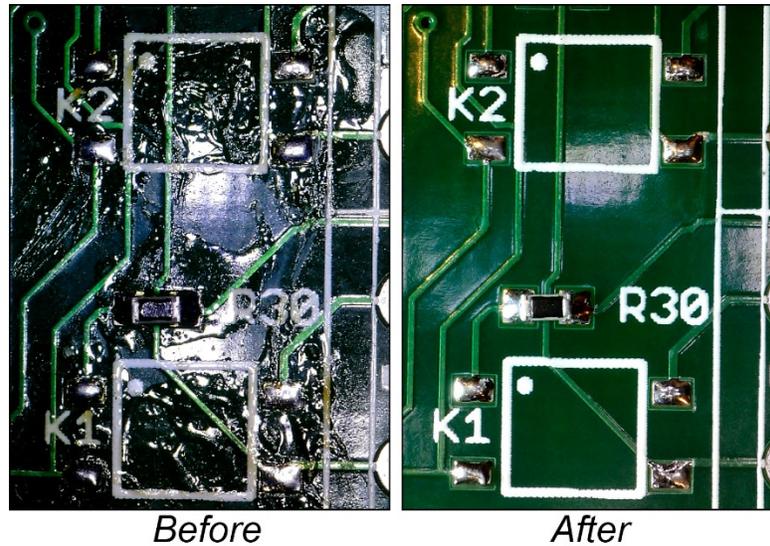
Washing a printed circuit board after the soldering process typically produces a board that sparkles and looks ready for its journey to the end user.

However, areas that are not visible contain the details that spoil this sparkling clean picture. For example, a board with hidden residual flux contamination may pass QC and operate properly, but in its operating environment, there may be high humidity and temperature swings that generate condensation that causes residual flux to grow. This can eventually cause leakage paths that ultimately cause failures. High impedance, high power, analog, power on board circuits in today's micropower electronics are even easier to disrupt with stray voltage sources.

IPC, the global trade association serving the printed board and electronics assembly industries, has a task group devoted to addressing the cleanliness levels of unpopulated (bare) printed circuit boards, and has established a base standard for cleanliness. The standard has acceptable contamination levels based on the end application. High reliability boards, such as those used in military/aerospace applications, require more stringent levels of purity than do circuit boards for general electronics use. The IPC-TM-650 standard sets an acceptable range of 65-2 micrograms/in<sup>2</sup> of sodium chloride (NaCl) for general applications, but 10-2 micrograms/in<sup>2</sup> for military applications. Is this standard enough to prevent failures and can present cleaning methods truly clean the boards that are being produced today?

Digicom Electronics, an EMS company based in the California Bay Area, spent two years researching cleaning methods, processes, and equipment. They found that it's not enough to put the boards through a wash cycle. As a result, they implemented a highly efficient, in-line cleaning system aimed at mitigating failures caused by contaminated PCBs. This innovative process uses a special combination of chemicals, temperature, wash cycles, timing, and equipment that results in printed circuit boards with superior quality and cleanliness. Deionized water from polishing tanks is used and recycled. Filters catch the solids while powerful blowers ensure that harsh chemicals are isolated and confined in a dedicated wash area. A refractometer checks

the stability of the tank to make sure it's not compromised. The process is completely “green”. All drained solids are environmentally friendly.



**Figure 1:** PCB before and after cleaning with Digicom’s process

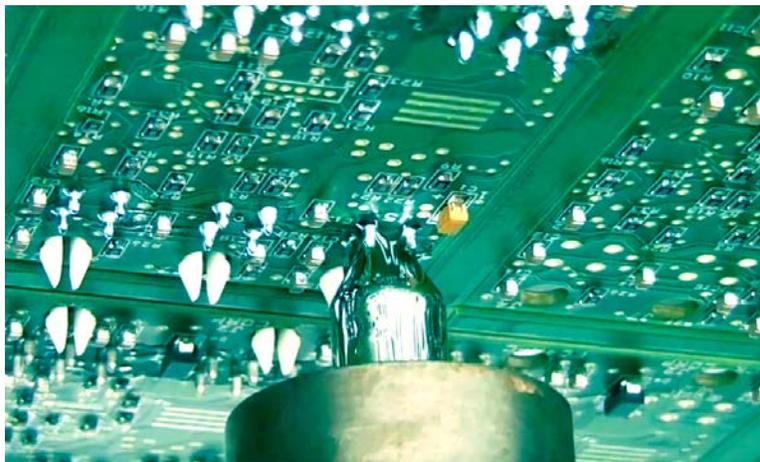
### *Nitrogen and soldering*

Many major failures result from a weakness in the solder joint that connects the wire bond to the printed circuit board (PCB) or the solder connecting the device or package to the board. Using nitrogen is not an absolute requirement; however, nitrogen can help to strengthen the bond and improve solder adhesion in the soldering process.

Nitrogen improves soldering quality by reducing oxide formation and creating a higher surface tension across the solder surface. The wetted surface area can increase by 20% to 30%, resulting in increased solder-joint strength. Higher surface tension minimizes solder balling when using fine pitch solder paste, and a larger surface tension can hold larger and heavier components on the bottom side of a PCB when performing double reflow. Less oxidation improves the wetting on NiAu and bare copper solder leads. Nitrogen also improves the visual appearance of the solder joint surface, leaving it smoother and shinier, especially for lead-free assemblies, so inspection and rework are simplified.

In reflow soldering, flux activity, residues, and cleanliness are significant. According to data cited by TEquipment.net, longitudinal studies provide enough reliable data to confirm that all these factors are improved by using nitrogen. Rework defects were monitored over a two-year period, one year prior to a switch to nitrogen reflow and one year after the switch was completed. With the introduction of nitrogen being the only significant change, the proportion of defective joints fell from 82 to 37 dpm, a decrease of nearly half. Other operations have shown improvements in first pass yield from five to seven percent, which translates into a reduction in defect levels of 50 to 60 percent.

Solder is used in hand soldering, reflow, and selective soldering. Many manufacturers of reflow and selective soldering equipment incorporate the capability of adding nitrogen to these processes. In actuality, only a small percentage of manufacturers use this feature. Nitrogen equipment has to be rented or leased and nitrogen-containing cylinders have to be stored. The nitrogen has to be delivered in a very cold, compressed form, which is not suitable if you're trying to maintain hot-zone stability in the reflow oven. Then there is the added expense.



**Figure 2:** Selective soldering process

Digicom embraced the challenge of adding nitrogen to its soldering processes, including hand soldering, and decided to generate its own nitrogen. After it's generated, the nitrogen is piped directly to machine inputs and work areas at

a prescribed volume and pressure to achieve optimized saturation of the inert gas and to eliminate oxidation at critical moments of the soldering operation. Using nitrogen can make the difference in quality in aerospace products, as EMS companies must seek every way possible to eliminate failures of the devices they manufacture.

## FACILITIES

You can tell a lot about a company when you walk through the door, see the equipment, and talk to the people. If you're thinking of using an EMS company, contact the company and arrange a visit. Once there, some things to look for are:

- Equipment being used
- When the equipment was updated
- Attention given to electrostatic discharge (ESD) control
- Tracking systems that are in place
- Types and frequency of inspection and test
- How inventory is handled
- Cleanliness
- Green practices
- Length of service of employees
- Location



**Figure 3:** EMS manufacturing floor

Precision, reliability, throughput, and yield are all affected by the equipment being employed.

## SERVICE AND SUPPORT

One differentiator that is sometimes difficult to discern initially is the degree and type of service and support you will receive. Who will your point of contact be, manage and supervise the manufacturing and work, be

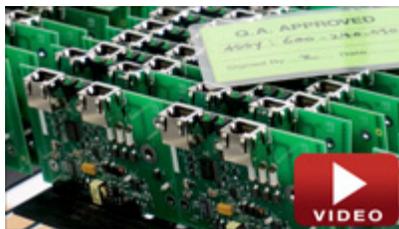
responsible if changes need to be made or problems arise, and how will they deal with any problems? How much actual engineering support and troubleshooting will be done to make sure your design will be manufactured accurately? The EMS should have the expertise to analyze your design for manufacturability and potential problems, evaluate the bill of materials, and optimize the manufacturing process to find ways to produce the product more cost effectively.



**Figure 4:** Assembled ROACH (reconfigured, open architecture, computing hardware) systems make observation and analysis of deep space and our universe possible.

## ... AND FINALLY

Look at the track record and metrics of the EMS company, such as years in business, types of products being manufactured, business from repeat customers and referrals, and on-time delivery. Use due diligence in choosing an EMS company, and the rewards can be great.



Learn more about aerospace device manufacturing by visiting [www.DIGICOM.org](http://www.DIGICOM.org).

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