

# OEM Guideline to Selecting PCB Suppliers

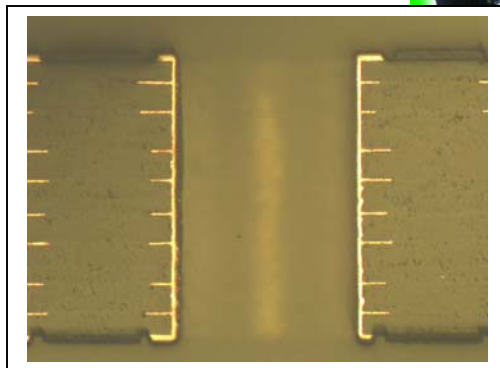
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## Abstract

Many large Original Equipment Manufacturers (OEMs) have a detailed procedure and a significant capital investment in place for the selection of printed circuit board suppliers. This approval process typically involves one or more site audits (which, as we know, now involves a significant amount of overseas travel) and non-destructive and destructive qualification testing by a third party laboratory.

This is all well and good if your company has what seems like unlimited funding to carry out this process, but where does this leave the small OEM? This paper is intended to assist smaller OEM's get the most for their money and purchase a quality product. I was recently in a meeting with a new IPC member who was also new to the electronics industry, and he made the following statement regarding qualifying their suppliers, "We go to the PCB supplier's facility for a tour, they take us to lunch, and they are approved." He also asked in this same meeting, where in IPC can I go for help to better understand what I should do, and we did not have a good answer to his question.

Within the past year and a half a blue ribbon committee has been started to assess the feasibility of IPC having a printed circuit board (PCB) Qualified Suppliers List similar to that of the military for MIL-PRF-31032, MIL-PRF-55110, and MIL-P-50884. This will most likely take a few years before we see this listing on IPC's website. This paper will provide some basic guidelines in assessing your supplier's board at a cost that is reasonable to your company.



## **Introduction**

*Hypothetical Case Study:* A military/commercial ODM (Original Design Manufacturer) has been supplying Class 3 product to its customers. Its product is incorporated into the guidance system of a commercial airplane. The ODM believes that it has the quality of its circuit boards under control by specifying IPC-6012, Class 3 on its drawings. The OEM begins to report failures of the unit, luckily without the loss of lives. The OEM experiences downtime and flight delays. The OEM is holding the ODM responsible. The ODM receives the failed unit for a complete root cause failure analysis. The analysis of this lot of assemblies and other lots from the same supplier show plating cracks attributed to a copper ductility issue. The ODM visits the PCB manufacturing facility for the first time to review these findings and to audit their facility and discovers that the manufacturer states that they build to IPC-6012, Class 3, but that they have done none of the qualification, conformance or acceptance testing to verify that their product indeed meets the Class 3 requirements. Of course the ODM can hold the PCB manufacturer responsible, but not before enduring numerous court battles and the loss of their largest client's confidence in them.

Could this happen to you?

Do you have an Approved PCB Supplier List?

How did you qualify those suppliers?

As can be ascertained by the hypothetical case study above, responsibility for purchasing Printed Circuit Boards for assembly and incorporation into an end product, must not be taken lightly.

## **The Military's Qualified Products List**

The military was the first to develop a Qualified Product List (QPL) for printed circuit boards, and much can be learned about developing an Approved Supplier List by reviewing the military process of maintaining a QPL. MIL-P-55110 governed rigid boards and MIL-P-50884, flexible circuits. In the past, the Department of Defense (DoD) was on the forefront of advancing technology. Currently, the commercial industry has taken the lead and the military is benefiting from these advances. The military has now moved to maintaining a QML or Qualified Manufacturers List. What is the difference between a QPL and a QML? The QPL was geared towards qualifying specific products, based on material type and design complexity. The current QML system is based upon military certification of a supplier's process. PCB manufacturers who have a greater understanding of their processes, a mature quality system and a Technical Review Board (TRB) follow the MIL-PRF-31032 document. The PRF stands for performance. MIL-PRF-31032 allows the manufacturer greater flexibility to advance to more complex technology levels without having to wait for new specification revisions to be released.

## **IPC Marks the Beginning of Commercial PCB Standards**

"In the fall of 1957, six printed circuit board manufacturers came together to create the Institute for Printed Circuits. What did they have in common? A desire to promote the new technology of printed wiring boards and the need for industry standards to create common ground between themselves and their customers. From that day, IPC was dedicated to removing supply chain obstacles, creating industry standards, and supporting the advancement of the industry." (Excerpt from *IPC Review*, Vol. 48, No. 1: January 2007, page 12)



**IPC Founding Members (Courtesy of IPC)**

Engineers in the field fifty years ago were in it from the beginning. They have seen printed circuit board (PCB) products evolve over the years. This group of individuals has knowledge that our new engineers lack - where the PCB came from. Having an historical perspective allows one to understand the PCB board process and what attributes are acceptable and which are not. Due to the shift of founding members out of the industry and into retirement, less experienced engineers are given the position of Supply Chain Manager and are given the responsibility of generating and maintaining an Approved Supplier List. Often individuals that are promoted to this position within a small Original Equipment Manufacturer (OEM), lack the knowledge of how a printed circuit board is made because their company specializes in assembly processes, not board design. Recently a new IPC member, who was also new to the electronics industry, made the following statement regarding qualifying their suppliers, "We go to the PCB supplier's facility for a tour, they take us to lunch, and they are approved." The usefulness of a tour of a potential PCB shop should not be discounted, but there are often serious quality issues that cannot be uncovered by a tour alone.

### **Steps In Qualifying Your Printed Circuit Board Supplier (See Figure 1)**

Assessing a potential circuit board supplier can be very simple to very complex based on the resources available to the company. This guideline is aimed at smaller ODM's and OEM's. A few inexpensive microsections would add significantly to the "tour" approach of qualifying circuit board suppliers. Below, you will find an outline of steps that may be taken to generate a list of potential suppliers and how to go about qualifying your supplier. It is not necessary to complete all of the steps to gain confidence in the supplier, but completing as many as funding allows is key. The steps are as follows:

1. Determine how many suppliers are needed
2. Determine if the location of the suppliers is important
3. Determine which suppliers are capable of building the product required
4. Request references and obtain recommendations from colleagues in the industry
5. Provide a few designs for quote
6. Narrow the list based on information gathered
7. Audit the facilities
8. Test suppliers' products
9. Add passing suppliers to the Approved Supplier List

### **Determine How Many Suppliers are Needed**

The trend today is limiting the number of companies on the Approved Supplier List. The purchase of printed circuit boards is no exception. Narrowing the list to a few technically strong, reasonably priced suppliers gives the purchaser greater power to get what they want because they will be major customer. Providing a recommendation for the exact number with which to

start is not possible because this number will vary based on the range in products that are required for purchase. One word of caution: do not sole-source if at all possible. The uncertainty in the electronics industry, particularly in PCB production, can put you at risk of losing a single supplier of a high-demand part number (P/N). If your target is to have at least two suppliers for each P/N then starting with at least three or four for consideration is probably a good idea.

The initial list of names may be gathered from an internet search and/or attending an IPC or similar industry trade show. Trade shows are the best way to make an initial contact and have face-to-face discussions, although the initial contact is often with a sales representative, technical support staff are often available to visit your facility following the trade show. As most people are well aware, the trade show allows you to meet with several potential suppliers in one convenient location.

Furthermore, DSCC (Defense Supply Center Columbus) QPL and QML lists are publicly accessible. Considering a PCB supplier that is on one of these lists allows you the benefit of knowing that they have quality processes in place and have been held accountable to the government with regards to product quality. Finally, printed circuit board suppliers who are contributing members to the IPC-6012 rigid board and/or IPC-6013 flex circuit technical committees are also more likely to be up-to-date on the latest industry technology and requirements.

### **Determine if Location of the Suppliers is Important**

Are there any restrictions placed by your end customers regarding overseas production. This restriction is most common in the defense industry. Purchase orders and drawings must be carefully evaluated to determine if this restriction applies. Can your company afford overseas travel to visit/audit your supplier? Is your company willing to deal with communication difficulties and a twelve-hour time difference? Assessing cost versus projected obstacles is typically the means used to make this decision. Having a sales representative or technical liaison present in the overseas country can alleviate unforeseen issues tremendously. If having US suppliers is critical to your company, is the location within the US important. If you are located on the west coast, is it important that you be able to drive to or take a short flight to visit a supplier to discuss a problem immediately?

### **Determine Which Suppliers are Capable of Building the Product You Require**

To begin, website advertising of capability level may be useful. Isolate from your search above, those suppliers that are capable of meeting the layer count that you require. Determine which suppliers specialize in the materials you are required to use. For example, shops dealing with high-speed materials can be very specialized. Do you need to purchase rigid boards or flexible boards or both? Are you dealing with High Density Interconnect (HDI) designs? Do you require a manufacturer capable of building a high current board? Is there a particular company that specializes in circuit boards for the industry you serve (Ex. Implantable medical devices, medical equipment, military, telecommunications, Class 2 commercial products such as cell phones or televisions, or Class 3 high reliability products, such as airplane controls or automotive safety devices)? Make a checklist of the capabilities required before starting a search, and you will be certain not to waste time completing the steps below.

When narrowing the search for suppliers, also consider national and international accreditations and customer certifications. If a circuit board supplier is the Approved Supplier List of a large OEM who performs detailed quality audits and qualification testing, you may be able to skip this step yourself.

### **Request References and Obtain Recommendations from Colleagues in the Industry**

New personnel taking on the responsibilities of Supply Chain Manager often do not have the knowledge to know where to start in choosing the "best" suppliers. The gentleman that was mentioned above that entered an IPC meeting with the question of how to qualify his circuit board supplier had definitely come to the right place and he did the right thing by asking the experts. Technical conferences such as these are the best place to make contacts and ask questions regarding how to determine which suppliers are best. Also, look to those who are more experienced within your company. You may not be aware of the fact that the Project Manager down the hall used to fill your exact position within another company. With all of the new technology appearing daily, we often forget that those with years of experience can offer the greatest input with regards to assessing quality and long-time reliability of potential PCB suppliers.

It is also useful to contact the potential suppliers and ask for a list of references and take the time to actually contact these references. Ask about product quality. Ask if they have received any defective product and if so, what percentage. Determine if the technology level is similar to your company's requirements for comparison purposes. Ask about on-time delivery. What percentage is typical? Ask about the company's initiative to take responsibility when there is an issue and

willingness to work as a team to resolve such issues. If the reference is not a competitor, he may be willing to offer additional information regarding other potential suppliers. It never hurts to ask.

### **Provide a Few Designs for Quote**

Provide each potential supplier within the same technology range with the same part numbers for quoting. Price is typically the deciding factor, but quality and delivery are also key. You often get what you pay for; so do not eliminate suppliers solely on cost until completing the audit and board quality assessment if you can afford to visit the supplier.

### **Narrow the List Based on Information Gathered**

Narrowing the list is a bit subjective based on the weight that you place on the information gathered thus far. Make a list comparing each supplier with regards to the following attributes:

1. Location
2. Number of Part Numbers Supplier is Capable of Producing
3. Quality Credentials
4. References and Recommendations
5. Cost

### **Audit the Facilities**

When fiscally possible, choose one or two individuals from your facility who are experts in the area of printed circuit board manufacturing processes, lean manufacturing and quality audits to travel to the potential suppliers to perform audits. This will help to narrow the search for the best suppliers meeting your capability requirements.

### **Test Suppliers' Products**

As resources permit, have a third party lab or your internal lab perform qualification testing on the suppliers' products. This can be your actual product build or another similar build that the manufacturer is producing for another client. A full qualification will provide you with the most information, but even a few thermal stress microsections performed at a minimal cost can provide a wealth of information. Ongoing verification of supplier quality can be accomplished through acceptance testing and periodic conformance. IPC-6012 and IPC-6013 are good guidelines for vendor certification.

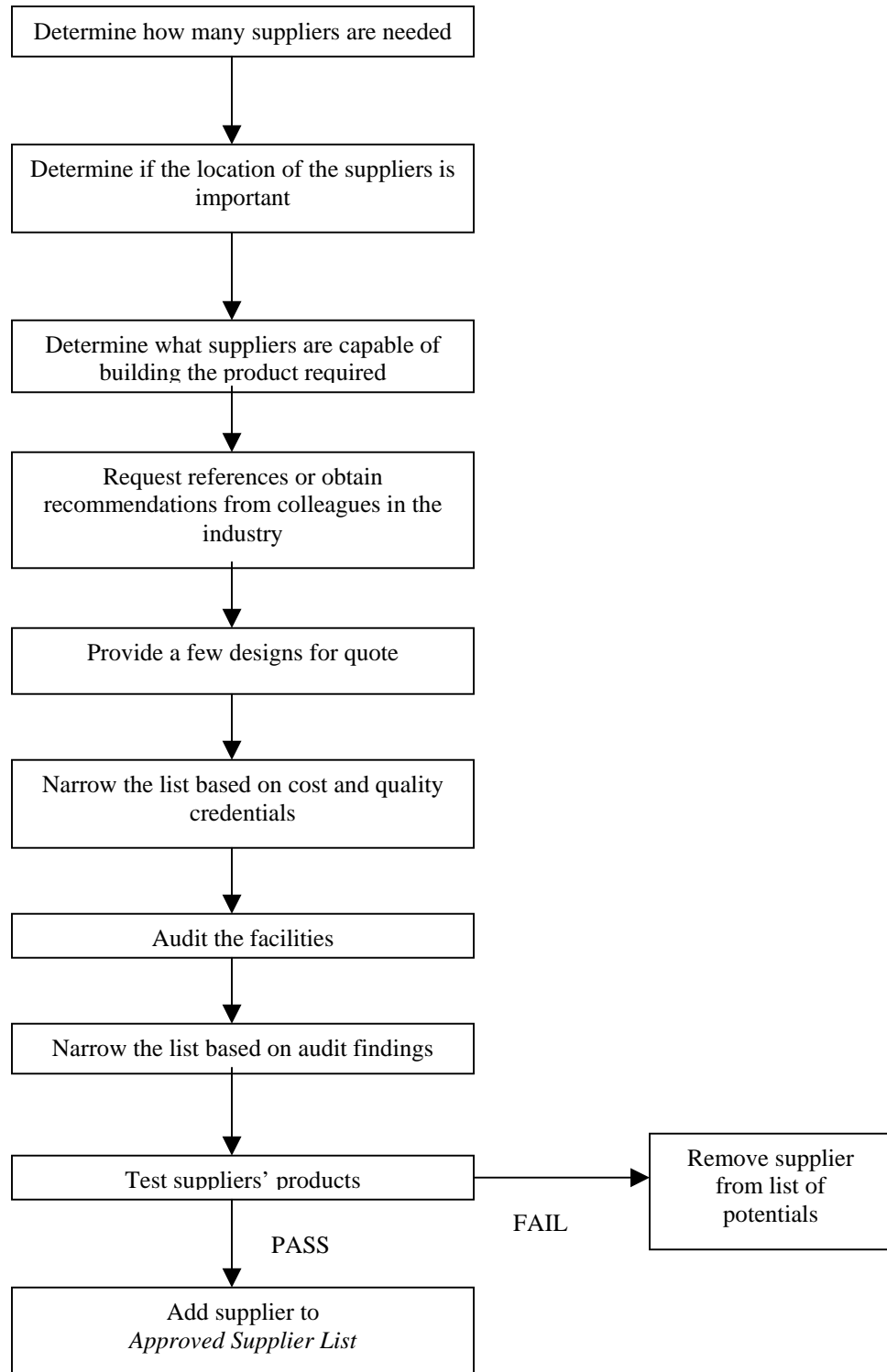
### **Add the Passing Supplier to the Approved Supplier List**

Now that your evaluations are complete, set up a matrix that outlines the pluses and minuses of those companies that have not been eliminated for any specific reason. Choose those that you consider meeting or exceeding your expectations in critical areas.

### **What to Do if You Cannot Do it All**

There is minimal cost involved in performing Internet searches, polling colleagues, and checking a supplier's quality credentials and industry involvement. Attending an IPC conference or two is slightly more costly, but this will be time well spent with the industry experts. Testing a supplier's product will provide a wealth of information. An expert from a knowledgeable test laboratory would be able to assist you in gaining the most knowledge with the funds available. Often PCB suppliers are willing to pay for the testing or split the costs if the anticipated orders are large enough to justify this expense. If resources are available to fund travel, auditing the supplier's facility will give you an inside look at what type of production facility with which you are dealing.

*Note: Paper previously published in the IPC Midwest Conference Proceedings, Schaumburg, IL, September 22-28, 2007 and Printed Circuit Design & Fab, December 1, 2007.*



**Figure 1: Steps In Qualifying Your Printed Circuit Board Supplier**