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**The Layman's Guide to Qualifying
a Process to J-STD-001B**

By Douglas Pauls,
Contamination Studies Laboratories, IN



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2215 Sanders Road
Northbrook, Illinois
60062-6135
Tel 847 509.9700
Fax 847 509.9798

The Layman's Guide to Qualifying A Process to J-STD-001B

Douglas Pauls
Contamination Studies Laboratories

Introduction

Electronics manufacturers are faced with the difficult task of proving that a candidate manufacturing process can produce acceptable hardware, either to the customer of the product, or for internal quality control. In the past, assembly level specifications (e.g. MIL-STD-2000A) told you exactly how to go about this demonstration. It wasn't always precisely correct, but you didn't have to figure out all of the fine points of the qualification on your own. In our modern era, "how-to" specifications are now evil things and taboo to all involved with them. The users now have to determine many of the process qualification steps on their own, and sadly, many don't have the faintest idea where to start. That is the purpose of this document. It makes no assumptions about what you know and leads you through the somewhat complex task of qualifying a candidate process to the B revision of J-STD-001.

Who Am I?

So, who died and made me Grand Wazoo? My name is Doug Pauls and I am Technical Director of Contamination Studies Laboratories. I have been involved with MIL-STD-2000, J-STD-001, and many other IPC technical activities. Much of my writing was the basis for J-STD-001A, Appendix D, and I have been actively involved with the B revision to J-STD-001. Since I have been involved with the development of these assembly documents, and because I regularly counsel assemblers who must qualify new processes, I undertook this writing to assist process professionals faced with qualifying their process. The above self-aggrandizing wording was not done to brag, but to illustrate some of my credentials.

I should probably warn you that there is some rather warped humor contained herein. I find that humor makes a document more readable and a little less "dry". Some feel it unprofessional; I don't.

I have included a short bibliography (attached) of other articles that would be helpful in qualifying a manufacturing process.

When Do I Do This Testing?

Often, the first decision that a process engineer must make is if the new process must be qualified. I'll give you my favorite engineering answer - it depends. The biggest driving factor is the customer of your product. What test data or test protocol do they desire in order to feel comfortable with the new process? If your customer wants MIL-STD-2000A, Appendix A testing, that's what you do. If they want J-STD-001A,



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Appendix D testing, that's what you do. Unfortunately, this assumes that your customer is knowledgeable about what testing to specify. Often, a customer has no more idea of what to specify than you do. There is an incredibly wide learning curve in the industry.

A question that is asked frequently by military manufacturers is "What testing do I do now that MIL-STD-2000A has been canceled without replacement?" The answer is MIL-STD-2000A, Appendix A, unless told otherwise by your contract officer. The contract officer is in somewhat of a quandary, since there is a DoD mandate that they be "silent" on the issue of soldering.

My specialty is not contractual law, but my understanding is that the day you signed the contract, the revision in place at that time is the revision you manufacture to. Any changes that come later are immaterial unless the contract is upgraded to the new revision. If you still manufacture to MIL-STD-2000A and the contracts have not been changed, then you still have to do Appendix A testing if you want to use a new process.

The second most asked question, with respect to J-STD-001B (J1B) is "If I qualified to the A revision (J1A), must I repeat the testing to qualify to J1B?". The answer is no, there is a grandfather clause. See the note in paragraph 4.2 of J1B.

In previous process qualification protocols, you were given a set of instructions on what vehicle to use, how to process it, how to test it, etc. With J1B, rather than a task list, the assembler is faced with a series of choices to be made (oh, joy).

Choice #1. When must I do Appendix D qualification testing?

There are three instances where the testing in Appendix D is required.

- When your customer requires it. After all, your customer drives the bus, even if they don't have a road map and should not have a license.
- When your customer feels that the Appendix D testing is the only acceptable way to demonstrate the Materials Compatibility requirement of J-STD-001B, paragraph 3.4.
- If you are using a flux that is not contained in the following J-STD-004 designations: ROL0, ROL1, REL0, REL1, ORL0, or ORL1 (cleaned). This requirement is found in J-STD-001B, paragraph 4.2.

Let us look at each one of these in turn.

When your customer requires it Your customer may read over the specification and conclude that Appendix D testing is required in order to be compliant to J-STD-001B. This is not the case, but we have all been in situations where the customer is dead wrong, but we still have to do it his way. It may be necessary to educate your customer

on when it is appropriate to require the Appendix D protocol and when it is more appropriate to use other test data. More on this later.

Materials Compatibility Demonstration Section 3.4 tells you, the assembler, that all of the materials and processes you use should be compatible with each other. A good, sound policy. Let us look at the wording of paragraph 3.4 and see how it relates to Appendix D testing.

The materials and processes used to assemble / manufacture electronic assemblies MUST be selected such that their combinations produce products acceptable to this standard. Objective evidence of this compatibility SHALL be maintained and available for review. When major elements of the proven processes are changed, (e.g. flux, solder paste, cleaning media or system, solder alloy or soldering system) validation of the acceptability of the change(s) MAY be performed and documented in accordance with Appendix D. These process changes can involve a change in one of the process steps. They can also pertain to a change in board supplier, solder mask or metalization.

The first sentence is what in the spec writing business is called a “motherhood and apple pie statement”. If you manufacture electronic assemblies, you have to choose materials and processes that are compatible with each other. The use of MUST means this is a requirement for everyone. Notice, there is no mention yet of how such compatibility is demonstrated. This is a reasonable requirement for everyone. If you have not sat down and examined how each and every step in the process impacts the quality of your assembly, you should. Incompatible materials and processes are one of the leading causes of assembly failure in the field.

Objective evidence of this compatibility SHALL be maintained and available for review.

The second sentence says that you are required, if you are building class 3 hardware, to have some documented evidence that your materials and processes are compatible. The use of the word SHALL means its required for class 3 and highly recommended (but not required) for class 1 or 2. Still no mention of how the compatibility is to be demonstrated. If you desire to do the Appendix D protocol, that is an acceptable way to demonstrate compatibility. On the other hand, if you wanted to use some alternative demonstration of compatibility, for example an ion chromatography evaluation, there is nothing in the wording here that says you can't or that it is less valid than Appendix D. The intent is that you have some data that shows your materials and processes are compatible; how you do it is up to you.

When major elements of the proven processes are changed, (e.g. flux, solder paste, cleaning media or system, solder alloy or soldering system) validation of the acceptability of the change(s) MAY be performed and documented in accordance with Appendix D.

The third sentence can strike very deeply into the pockets of the assembler, depending on the interpretation. Consider all the potential changes implied that could cause you to repeat the Appendix D protocol or other compatibility testing. Changes in: fabricator, solder mask, metalization, laminate, flux, paste, reflow profiles, wave profiles, cleaning chemistry, cleaning parameters, coating types, coating thinners. The last sentences of 3.4 show such changes as cause for re-testing. Yes sir, I could retire a very rich man after a few years of this continual re-testing. Unfortunately for my Swiss bank account, the use of the term MAY removes it as a requirement for anyone. The third sentence could now alternatively read "If you change anything in the process, it would be a real good idea to do some testing to make sure the change you implemented is not detrimental to your product". Do you HAVE to do it? No. Should you do some form of testing? Yes, you should, if for nothing more than your peace of mind. Must it be Appendix D? Not necessarily. An alternative demonstration could be used.

The third sentence of 3.4 is the weakest (in contractual strength) of the paragraph. Appendix D testing MAY be used to show process compatibility. Oh, thanks. It would have been fairly pointless to generate an Appendix D protocol for the document if it wasn't an acceptable demonstrator of compatibility. All this sentence tells you is that Appendix D is an acceptable demonstrator. This could be useful if you have already done Appendix D testing, but someone else wants you to do an alternate protocol to demonstrate compatibility. You could then show your Appendix D report and say that your compatibility has already been acceptably demonstrated. So there.

In summary, everyone should check for compatibility. Only class 3 assemblers are required to show compatibility. Anyone can use Appendix D to demonstrate compatibility, but alternative methods are perfectly acceptable too. Of course, your customer could throw this entire discourse into a cocked hat by requiring you to do Appendix D testing. Get used to this idea, I use it a lot.

Now, if your customer does specify that you have to do Appendix D as a demonstrator of materials and process compatibility, you need to come to a very specific understanding on what kinds of changes in the process require, in his/her eyes, a repeat of the Appendix D (or other) testing. How much latitude on reflow or cleaning parameter variation? Can you change to another paste or flux that is highly similar to the qualified flux (e.g. going from a 5% solids to a 3% solids of the same flux)? If your customer requires Appendix D testing for every minor variation, I might just be able to afford that yacht yet.

The Choice of the Flux J-STD-001B, paragraph 4.2 reads:

Flux MUST be in accordance with J-STD-004. Flux shall conform to flux activity levels L0 or L1 of flux materials rosin (RO), resin (RE), or organic (OR), except organic flux activity level L1 SHALL not be used for no-clean soldering. When other activity levels or flux materials are used, data demonstrating compliance with testing of Appendix D SHALL be available for review.