

# Certification and Qualification Information for Manufacturers

## MIL-PRF-31032



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## INTRODUCTION

This document is applicable to the MIL-PRF-31032 program administered by the Defense Supply Center Columbus (DSCC) in its capacity as the qualifying activity. This document has been developed to help the manufacturer obtain and maintain certification and qualification to MIL-PRF-31032. It is not the intent of this document to add requirements.

Any questions or clarifications may be submitted to: [5998\\_Qualifications@dsc.dla.mil](mailto:5998_Qualifications@dsc.dla.mil)  
We thank you for your participation and support of the DoD Product Qualification Program.

Sincerely,

L. DARRELL HILL  
Chief  
Sourcing and Qualifications Unit

# I. PREFACE

*QML* is an acronym for Qualified Manufacturers List. QML allows both the printed board manufacturers and the user community to take advantage of best commercial practices. QML will result in quick implementation of new technology into military systems at a higher level of quality and reliability and at a lower price. This document is an introduction to the concept of QML and how the printed board industry can benefit from it.

Today's military printed board industry has evolved a great deal since the generic qualification concept was first added to MIL-P-55110 and MIL-P-50884. In the past, the Department of Defense (DoD) drove the leading edge technology and the commercial industry followed along. Most printed board manufacturers were captive facilities building product for specific systems. Today, the commercial industry has much to offer the DoD in the way of technology and cost savings. QML attempts to capture these "best commercial practices" and apply them to military product.

A key concept in QML is the development of a working relationship between the manufacturer and the Qualifying Activity. This relationship is established during the certification process, and is maintained through status reports and revalidations. Although the certification process may seem quite involved, the development of this relationship will allow the manufacturer the freedom to make its own decisions regarding certified product.

The QML concept complies with all of the performance specification goals of the DoD Process Action Team report on implementing best commercial practices into DoD acquisition. QML has already been implemented into the DoD specifications for monolithic and hybrid microcircuits and discrete semiconductors.

As with other DoD QML documents, manufacturers participating in the QML for MIL-PRF-31032 may request an ISO-9001 or ISO-9002 audit in conjunction with the validation audit. This service has been offered to strengthen the military industrial base, help make QML suppliers globally competitive, and increase customer confidence in military suppliers. Contact the Qualifying Activity for more information concerning ISO-9000 assessments.

The major aspects of the MIL-PRF-31032 QML program are as follows:

## Flexibility

This specification allows manufacturers and customers to tailor design and verification requirements. This allows customers to push the envelope of manufacturing capability without waiting for specification changes. It also allows manufacturers to be more creative and cost effective in how they meet the specification requirements.

## Commercial Practices:

Manufacturers are encouraged to use their existing process flow and quality system to meet the DoD's needs.

## Quality System:

The manufacturer must maintain a documented and disciplined quality system which emphasizes process controls, defect prevention and continuous improvement.

## Technical Review Board (TRB):

The manufacturer forms a team of in-house experts to make decisions regarding printed board acceptability and certification. This time saving step reduces costs and lead time by minimizing the government approval loop.

## Test Optimization:

The manufacturer may use statistical and historical commercial or military data to reduce, modify, or move verification tests to make them more cost effective or applicable to a technology.

## Associated Specification ("slash sheets"):

These documents supplement the base document and contain detailed performance requirements for specific printed board technologies. Technologies are the different constructions or types of printed boards, such as rigid, flex, multilayers, metal cores, etc. This allows special requirements for different or unique technologies to be addressed as well as quick implementation of new technologies.

## QML Listing:

This is a detailed listing of the capabilities that the manufacturer demonstrated qualification testing. This allows customers to quickly determine which manufacturers are capable of meeting their needs.

## II. PREPARING FOR QML

### **Gather Information:**

Obtain a copy of MIL-PRF-31032 and all referenced documents that may be related to the technology to be certified and read them carefully. One of the key concepts of QML is the merging of commercial and military quality systems. QML uses a manufacturer's existing quality system as much as possible. Once the manufacturer determines which technologies to certify, it reviews its quality system and compares it to the Quality Management (QM) program requirements of MIL-PRF-31032. Section III, QM Program, lists the elements to be addressed.

**Prepare Pre-Validation Submission:** To obtain a certification audit from DSCC, the manufacturer must prepare the following items:

**1. QM Plan:** A manufacturer's QM program is its means of assuring that QML printed boards meet the requirements of MIL-PRF-31032. The QM plan documents the QM program. The QM plan is a controlled document with a separate section for each element of MIL-PRF-31032, even if it is to explain why a particular element is not applicable. The QM plan summarizes each element of the QM program in a paragraph to a page. Any documents or procedures with specific information should be referenced by number in the appropriate section of the QM plan. If a similar document already exists, such as a Quality Assurance Manual with ISO-9000 requirements incorporated, it may be used as part of the QM plan to save a lot of extra work. Don't create a military unique quality system if an adequate system is already in place.

**2. Self-Validation:** The manufacturer must convince itself that its QM program is working as documented and that it addresses the requirements of MIL-PRF-31032 before the Qualifying Activity will begin the certification process. A self-validation is performed for this purpose. The self-validation must be in accordance with the manufacturer's QM plan and MIL-PRF-31032. Any discrepancies found should be corrected, including changes to the QM plan, before certification can be requested. Information on the self-validation, including results and corrective actions must be submitted with the QM plan prior to the initial validation survey by the Qualifying Activity. The TRB must assume responsibility for the self-validation and assure all processes comply with the QM plan. A company with a good self-validation program reporting to the TRB shows that the manufacturer has taken responsibility for its own system. This increases the Qualifying Activity's confidence level in the company, which will lead to a reduction in Qualifying Activity oversight.

**3. Qualification Test Plan:** The qualification test plans describes how the manufacturer will demonstrate its capability to meet the MIL-PRF-31032 associated specification requirements for the capabilities for which it wants qualified. Section IV Qualification Test Plans describes what is required. Manufacturers are encouraged to use existing data as much as possible to reduce the cost of qualification. It is possible for a manufacturer to compile the necessary information and data with no additional cost of testing.

### III. QM PROGRAM

The QM program forms the backbone of a manufacturer's QML certification. It is the manufacturer's tailored internal system for meeting the requirements of MIL-PRF-31032. The QM program integrates all aspects of production and quality, from the initial order, through production, test, and shipment of product, and the controls and feedback to allow continuous improvement. A manufacturer's QM program is documented in the QM plan.

Appendix A of MIL-PRF-31032 is the baseline for a QM program. The QM Plan Outline lists the elements of a QM program that a manufacturer should meet. If a particular requirement of MIL-PRF-31032 does not apply to a technology or a company and this can be demonstrated to the Qualifying Activity, the requirement may not have to be met. Manufacturers are encouraged to use their existing quality systems when possible. Quality systems based on ISO-9000 or equivalent standards are good building blocks for a QML system. The elements of a QM plan are detailed below.

#### Hints to a QM Program

1. Don't recreate something you already have.
2. Have a living system that can change easily.
3. Don't create a system so complex that it can't be implemented or controlled.
4. There is no "DoD format" to follow. Use your own system.

#### **Technical Review Board (TRB):**

The TRB should be made up of responsible individuals from all areas of the QM program. The TRB assumes full responsibility for managing the QM program. Thus, the TRB is the mechanism that the Qualifying Activity uses to reduce oversight. The TRB members must be identified by name and title. The TRB will be making important decisions about QML product, so how decisions will be made (majority rules, unanimous approval, etc.) needs to be identified. Also consider how often the TRB meets to evaluate the status of the QM program and how records of these meetings are kept. Keep in mind that no two manufacturer's TRB will be designed the same. TRB membership, meeting frequency, etc. will depend on the size, structure, and capabilities of each unique manufacturing facility. A summary of TRB responsibilities from MIL-PRF-31032 is shown below:

1. Implementation of QM program: The TRB makes sure the QM program, as listed in the QM plan, is in place and working properly.
2. Maintenance of certified processes: Through process controls, process monitors, and continuous improvement the TRB assures the processes are producing high quality product.
3. Process change control: The TRB must be privy to process changes and must approve any major changes prior to Qualifying Activity notification.
4. Reliability data analysis: The TRB must not only collect reliability data through lot and periodic conformance testing but also analyze the results to assure continued compliance and product reliability.
5. Failure analysis: When failures occur the TRB must determine the cause of

- failure to help prevent reoccurrence.
6. Corrective action approval: The TRB must assure corrective actions are taken, that they are effective, and that any changes comply with the QM plan.
  7. QML product recall: When problems are discovered that may affect product in the field the TRB must communicate with customers to help assure continued operation and fielding of the affected weapon systems.
  8. Review of qualification status: This is done periodically to assure the QML-31032 accurately reflects proven capability.
  9. Disposition of test failures: The TRB assures non-conforming product is properly segregated and oversees rework to make sure only fully compliant product is shipped.
  10. Ensure communication throughout process: Good communication helps prevent costly failures later in the process.
  11. Submit status reports to qualifying activity: A good status report involves all members of the TRB compiling data on the status of the QM program.
  12. Assess impact of changes in personnel and business plans: These changes can impact the QM program, so the TRB must be aware of them.
  13. Approve and update QM plan: The Qualifying Activity bases QML certification on the QM plan, so it is important that it accurately reflect the manufacturer's current QM program.
  14. Assure correlation between test coupons and printed boards: Testing is expensive, and the TRB must assure that testing on coupons is accurately evaluating the product it represents.
  15. Approval of periodic conformance test vehicles, frequency, and procedures: The PCI program is important for long-term reliability assurance and process characterization. The TRB must assure the program is meeting the specification requirements in a cost effective manner.

Other TRB activities include:

1. Approval and documentation of specification deviations when requested by the acquiring activity.
2. Approval of test optimization.
3. Development of custom technology associated specification.
4. Approval of add-on qualification (test plans, data to submit to qualifying activity, and product shipment prior to qualifying activity approval)

### **Process Flow:**

A process flow is a sequential list of all processes required to build printed boards from the time the order is taken to the time the product is shipped. A process flow must be generated for each technology to be qualified. This may be a flow chart, a set of travelers, or any other means of documenting the flow. The process flow must include any possible processes to be used for QML product, including rework steps, key process monitors, and contract services. Procedure numbers or references for each step must be identified.

**Process Flow Documentation Index:**

A list of all procedures used in the QM program must be compiled. It should include the procedure number, title, and revision level. The product flow documentation index should also be periodically reviewed and updated.

**Organizational Chart:**

The organizational chart shows all organizations affecting QML product and should specifically show where each TRB member fits into the organization.

**Conversion of Customer Requirements (Conversion):**

Conversion of customer requirements is the manufacturer’s system to review the customer's printed board procurement documentation (purchase order, master drawing, electronic data files, etc.) and assure the customer’s needs are met. This conversion includes the transfer of hard copy and computerized data into manufacturing tools such as drill tapes, phototools, route programs, etc. It also checks that a manufacturer’s QML listing meets the design requirements. When the conversion system identifies that the current QML listing does not cover a particular part number or technology, the conversion system determines what process changes are needed, what testing must be done, and how to demonstrate the capability of these changes. Conversion should include feedback to customers when the review indicates problems.

**Self-Validation:**

| <b>Conversion evaluates procurement documentation for:</b> | <b>What happens if it’s not in the procurement documentation:</b>  |
|--|--|
| Design standard  | Use the default design standard listed in the associated specification   |
| Design parameters (such as minimum annular ring)           | Use the design parameters listed in the applicable design standard   |
| Material requirements                                      | TRB determines what materials will meet the performance requirements of the associated specification   |
| Coupon configuration                                       | Use the coupon configuration listed in the applicable design standard  |
| Current QML listing covers the complexity of the design    | TRB must determine what test data must be collected to qualify the capabilities required, including the addition of coupons to complete tests. |

Self-validation is the manufacturer's means of determining compliance to MIL-PRF-31032 and the QM program. Self-validation results must be reported to the TRB. An effective self-validation system is key to the reduction in Qualifying Activity oversight. As a minimum, the self-validation should cover all areas of the QM program, including self-validation itself. The self-validation program should also include the frequency of review, auditor eligibility, and records retained.

**Documentation, Data Retention, Storage, and Disposition:**

This shows how the manufacturer will maintain the traceability, history, and certification information of QML product. This may include production and test travelers, test data sheets, revised process procedures, used and unused test vehicles, and anything else used to record the process history of QML product.

**QML Status Report and TRB Reporting:**

The TRB must communicate with the Qualifying Activity to maintain its QML certification. The status report is the mechanism for the TRB to inform the Qualifying Activity that the QM program is still in control and growing. The QM plan should indicate what information will be submitted, the method of reporting, and frequency of report submission. A status report should contain the following information:

1. Summary of TRB activity.
2. Self-validation results.
3. Continuous improvement update.
4. Process control initiatives and accomplishments.
5. Corrective actions taken.
6. Changes to manufacturing and test equipment or facilities.
7. Customer return information.
8. Summary of compliant boards shipped (including QPL product).
9. Summary of LCI testing, including part fallout and pass/fail information.
10. Summary of PCI information and assessment of test vehicles.
11. Future business plans.

**Continuous Improvement:**

For a QM program to be effective and strong it must be monitored and improved. Continuous improvement is the system that identifies problems and works to correct them. Consideration should be given to identification of goals, mechanisms for measuring improvement, and evaluation of progress.

**QML Traceability**

Each printed board and test coupon shall be traceable to the following:

1. Material lot.
2. Production lot.
3. Lot conformance inspection lot.
4. Coupon to printed board.
5. Production history (date, equipment, operator, etc.).

Traceability must be maintained for a minimum of 3 years after product delivery.

**Failure Analysis:**

This describes when failure analysis is performed, how the tests are determined, what data is to be taken, and who is informed of the failure.

| <u>Failure Analysis Triggers</u> |  |
|----------------------------------|--|
| 1.                               | Lot Conformance Inspection failures.     |
| 2.                               | Periodic Conformance Inspection failures |
| 3.                               | Percent Defective Allowable failures     |
| 4.                               | Field returns                            |
| 5.                               | In-process failures                      |

**Process Control:**

This gives a general description of how processes are controlled. This may include, but is not limited to, machine settings, periodic calibration or verification, material controls, statistical methods, etc. System-wide process controls with procedures that span several different process steps, such as statistical process control (SPC) should be addressed in the process control section of the QM Plan.

**Corrective Action:**

This outlines when corrective actions are necessary (field returns, test failures, validation findings, etc.), what actions are taken to initiate corrective actions, and what is done to assure that they are carried out. The corrective action system should also be used by the TRB as a feedback loop to prevent similar problems in the future.

**Change Control:**

As changes are made to the QM program a methodology must be in place to control these changes. Change control should explain how to determine if a change is major or minor, who approves changes, what evaluations must be performed, and how the changes are recorded and reported. Manufacturers are required to notify the Qualifying Activity concurrently of all major changes. This should be reflected in the change control procedure.

| <u>Major Changes Include:</u>   |
|---|
| 1. Changes that affect the performance, quality, or reliability of the printed board. |
| 2. Changes to the QM Plan.  |

**List of Test and Inspection Methods:**

All testing must be performed at a location with laboratory suitability granted by the Qualifying Activity for the particular test method performed. The Qualifying Activity grants lab suitability to printed board manufacturers as well as commercial testing laboratories. The manufacturer should indicate all tests that are performed at its facility and which tests will be performed at other facilities. An equipment list for all tests performed in-house should also be supplied. This lists by test method what equipment is used, the equipment identification number, calibration interval, and any other special notes (capability if limited, etc.).

## IV. QML CERTIFICATION

### **Pre-Validation Submission:**

#### Initial Certification Request

When a manufacturer is ready to begin the certification process the following pre-validation items must be submitted to the Qualifying Activity:

1. **QM Plan:** The QM plan should already be implemented, self-validated, and approved by the TRB.
2. **Self-Validation Report:** List all elements validated, discrepancies found, and corrective actions taken.
3. **Qualification Test Plan:** List the technology to be certified, the tests performed, where the testing will be performed, and a description of the test vehicles (coupons, specially designed panels, etc.). Any deviations to the required tests in the associated specification is submitted at this time. Information on the use of existing data, if applicable, must also be submitted. Note: Actual completion of qualification testing is not required prior to the validation.
4. **Customer Participation:** The manufacturer may opt for the validation team to include two to three customers, arranged by the manufacturer. This will help reduce the number of facility audits, increase customer awareness of the QML program, and promote the manufacturer's process.
5. **ISO-9000 Information:** If ISO-9000 assessment is also desired the Qualifying Activity will request additional information that must be submitted.

When initial contact is made with the Qualifying Activity, you should let them know up front what you expect to be certified to. This should include the projected QML technologies you wish to qualify and if ISO-9000 registration is desired.

It is advised that a manufacturer contact the qualifying activity prior to submitting the pre-validation package. This is to give the Qualifying Activity an idea of what technologies the manufacturer wants to certify and whether ISO-9000 will be part of the validation. The Qualifying Activity will send a pre-validation letter with more information on what is needed for review prior to the validation. Other information such as past military business and process control data may be requested to flesh out a manufacturer's QM program.

### **Qualifying Activity Review:**

The Qualifying Activity will review the pre-validation submissions for compliance to MIL-PRF-31032. Any initial concerns will be addressed at this time. Additional information, such as detailed procedures, may be requested to answer questions. The Qualifying Activity will schedule a validation once all of the pre-validation information is approved.

To establish a good working relationship with each company the Qualifying Activity must get to know how the company works. Don't be surprised if the Qualifying Activity has a lot of questions prior to the validation.

### **Validation:**

Once the pre-validation submission has been approved by the Qualifying Activity a validation can be scheduled. The Qualifying Activity will form a validation team, which may include key customers and any required technical experts (with prior approval of the manufacturer) before the validation.

The validation team will perform a sample validation to ensure that the TRB has control of the QM program and that it has been implemented as described in the approved QM plan. The areas validated will be reviewed in detail. Any concerns by the validation team will be brought to the attention of the TRB during the validation. The TRB is responsible for completion of all corrective actions. Once corrective actions have been taken and approved by the Qualifying Activity, certification will be issued. The validation will be very thorough. The team will talk directly to the operators and read procedures carefully to assure the TRB has the QM Program under control.

### **Issue Certification:**

Once QML certification is granted the Qualifying Activity will issue an official certificate and a certification letter detailing which technologies are certified. If testing is performed at the manufacturing facility a laboratory suitability letter listing all approved test methods will also be issued. If ISO 9000 registration was a part of the validation, an ISO 9000 certificate and registration letter will also be issued.

# V. QML QUALIFICATION

## Qualification

Qualification is the process where the manufacturer demonstrates its ability to produce a selected printed board technology to a set of design limits, referred to in MIL-PRF-31032 as the QML manufacturer's *capability*. The TRB is responsible for establishing a qualification process procedure. This procedure must describe how the manufacturer will develop test plans, collect supporting data, present the data for the TRB review, determine acceptability, utilize failure analysis and corrective actions prior to any resubmission of additional vehicles for retesting after failure, complete and retain the qualification test report, and report the results to the qualifying activity.

### Qualification Test Plan:

An acceptable qualification test plan must detail:

- the methods used for gathering qualification test data
- the test flow
- the applicable accept/reject criteria for testing results
- a description of the test vehicles
- the test facilities for the performance of each test
- the proposed QML listing to be achieved

The first step is for the TRB to identify the printed board capabilities to be listed on the QML-31032; an example QML listing appears at the end in this section. Then, for each capability, the TRB explains how it will demonstrate that it can meet the performance requirements for the MIL-PRF-31032 slash sheet. Multiple test vehicle designs may be incorporated into a qualification test report. Qualification for some technologies may require a test plan to deviate from a slash sheet's standard testing flow; in this case, the TRB should get prior authorization from the qualifying activity for an alternate test flow to ensure that final the qualification report will be accepted for listing on QML-31032. For initial qualification, the test plan should be submitted to the Qualifying Activity prior to the start of qualification testing.

MIL-PRF-31032 allows the use of existing test data if it is applicable to the certified process flow. A portion of the qualification data requirement can be fulfilled using data previously compiled for either the manufacturer's internal evaluation or an external customer.

### Perform Qualification Testing:

Testing in accordance with the approved qualification test plan must be performed at a facility with laboratory suitability for the test methods used. A list of

#### Custom Technologies

Manufacturers wishing to qualify product that does not fit any of the current associated specifications may still seek qualification on these "custom" technologies. The TRB develops and approves a test plan, test specimens, etc. like a regular add-on qualification. If an associated specification is later written that addresses the technology, the custom qualification can then be transferred.

these facilities may be obtained from the Qualifying Activity. The TRB must review and approve the test data prior to submission to the Qualifying Activity.

**Submit Test Report to Qualifying Activity:**

Once the testing is completed, the TRB is responsible for incorporating the data and results of the testing into a qualification test report. This report must be retained by the manufacturer as evidence of successful qualification testing for QML-31032 listing, in addition to submitting a copy to DSCC.

The qualification test report should include production and test travelers, test vehicles used, sample size, test conditions, procedure used, pass/fail information, and read and record data on all dimensional and electrical measurements. Destructive test samples should also be included with the report. The Qualifying Activity will review the report and compare it to the approved test plan. Upon approval of the test report qualification will be granted.

**Example QML Listing**

|   |   |  |
|---|---|--|
| MANUFACTURER<br>NAME & ADDRESS                              | BASIC PLANT<br>LOCATION   | CAGE CODE: XXXXX   |
| DSCC Circuits<br>3990 E. Broad Street<br>Columbus, OH 43213 | SAME  | PHONE #: (614) 692-0627<br>FAX #: (614) 693-1659<br>EMAIL: 5998_Qualifications<br>@dsc.dla.mil |
| CAPABILITIES BY TECHNOLOGY / PRINTED BOARD TYPE             |   | QUALIFICATION LETTER   |
| MIL-PRF-31032/1   |   |  |
| Panel Size  | 18 X 24   | VQE-03-0000  |
| Max. Board Thickness  | 0.150"  |  |
| Max/Min PTH Hole Size (as drilled)                          | Mech. Drill: 0.200" / 0.010"<br>Laser Drill: - / 0.002"               |  |
| Aspect Ratio  | 6:1 (Blind Vias 1:1)  |  |
| Max. Number of Layers                                       | 18  |  |
| Min. Conductor Width  | 0.003"  |  |
| Min. Conductor Spacing                                      | 0.003"  |  |
| Part Mounting   | THM, SMT, MIX   |  |
| Base Material   | GF (Woven E-glass, Epoxy resin)<br>GI (Woven E-glass Polyimide resin) |  |
| Finish System   | HASL, Fused SnPb, Au, Ni  |  |
| Hole Preparation  | Plasma Etchback/Desmear   |  |
| Copper Plating  | Electrodeposited acid copper  |  |
| Solder Resist   | Liquid Photoimageable, Dry film                                       |  |
| Alternate Construction                                      | Sequen. Lam., Blind & Buried Vias                                     |  |
| Controlled Impedance  | Characteristic ( $\pm 5\%$ )<br>Differential ( $\pm 10\%$ )           |  |

## VI. QML MAINTENANCE

### **Status Reports:**

The status report allows the Qualifying Activity to monitor the manufacturer's QM Program. The frequency of submission is quarterly for the first year, then as determined by the TRB and Qualifying Activity. Well prepared status reports increase the confidence level of a manufacturer with the Qualifying Activity, thereby reducing the amount of oversight. See Section III. QM Program for more details on status reports.

### **Changes to the QM Program:**

As changes occur in a manufacturing environment, so will a QM program change. The TRB must decide if changes are major or minor, as defined in the QM plan. All major changes are reported to the Qualifying Activity concurrent with their implementation. As changes are made to the qualified processes and the QM program, the TRB must assess these changes to determine if the QML listing and/or MIL-PRF-31032 Certification is affected. The TRB must also notify the DSCC-VQE of any modifications to its QML listing resulting from these changes.

### **Add-on Qualifications :**

Add-on qualifications allow a manufacturer to expand its QML listing. This may be adding new technologies or increasing the capabilities within a technology. Add-on qualifications are governed by the QM plan and the manufacturer's qualification test procedure. The TRB must approve all add-on qualification test plans and must review and approve the report. Once testing is completed and the results are found compliant by the TRB, product may be shipped without pre-approval by the Qualifying Activity. The Qualifying Activity must be notified concurrently with the TRB's approval and any concerns must be addressed. For example, a company qualified for 12 layers gets an order for a 20 layer board. The TRB determines they need to perform testing that is normally part of their PCI program to qualify this lot. They make sure thermal shock coupons are added to the panel. When production is complete, they send coupons off to a lab for testing. When the TRB reviews the data and determines the testing passed, they update their internal documentation to reflect the new qualified capabilities, ship the product, and must concurrently notify DSCC-VQE of the change.

### **Revalidations :**

The Qualifying Activity will determine the need to perform revalidations based on findings from the original validation, status reports, and other correspondence. As the confidence level between the manufacturer and the Qualifying Activity increases, the need for revalidations decreases. Revalidations are similar to validations regarding submission of pre-validation info, customer participation, etc.

## VII. OTHER ASPECTS OF QML

### **Process Monitors**

The manufacturer must identify the key processes in its process flow and assign process monitors. These key processes will likely be different for each manufacturer. Feedback from failure analysis, process control, and continuous improvement will help the TRB identify processes which need monitors.

NOTE: MIL-PRF-55110 referred to the "master drawing" as the governing document. The "printed board procurement documentation" referred to in MIL-PRF-31032 also includes the purchase order, contract, phototools, etc.

### **Printed Board Procurement Documentation:**

Printed board procurement documentation is a fancy phrase that includes everything a manufacturer receives to describe what a customer wants to purchase. This includes the master drawing, contract, purchase order, artwork, detail specifications, electronic data, etc.

### **Percent Defective Allowed (PDA)**

PDA is most useful when the nature of the commodity makes it unreasonable to perform destructive testing on finished product, such as printed boards. The idea behind PDA is that if a significant portion of a lot is defective or if a significant portion of representative test vehicles has defects, there is a chance that the remaining lot may have defects that the inspections did not uncover. PDA is a flag for the TRB to look twice at suspect lots before shipment.

PDA's do not normally apply to inspections based on a sampling plan. One exception could occur when an inspection lot fails sample inspection. If the lot goes through a 100 percent sort to remove defective product, a PDA would apply to this "tightened inspection" lot.

When the specified inspection has been completed, the number of printed boards or panels rejected for the failures listed in the associated specification is totaled. Divide the number rejected by the number in the lot. If this percentage exceeds the PDA limit the lot is rejected.

If a lot is rejected due to PDA failure this does not mean the entire lot is thrown away. The manufacturer must evaluate the rest of the lot and take corrective actions, approved by the company's TRB, and scrap any further defective product discovered. The TRB may have to perform failure analysis or review the process parameters before disposition of the remaining product.

## **Lot Conformance Inspection (LCI)**

LCI (formerly called in-process and group A testing) is the method of verifying printed board compliance on a lot-by-lot basis. The associated specifications list the baseline LCI requirements for each technology.

## **Periodic Conformance Inspection (PCI)**

PCI is performed periodically at defined intervals rather than on each lot. The tests and frequencies listed in the associated specifications are guidelines to a PCI assessment program. The TRB defines the actual test frequency, methods, test vehicles, and procedures in the QM plan. PCI test vehicles must assure that the manufacturer's capability is demonstrated, typically using coupons or test boards representing the worst-case or most difficult product qualified, not what happened to be produced that month. PCI must be performed at periodic intervals established by the TRB in the QM plan, even when no QML product has been produced during a given period. PCI can include data generated from in-line process controls.

It is possible to use MIL-PRF-55110 or MIL-P-50884 group B/C data to cover the PCI test requirements. Manufacturers must make sure to periodically assess the group B/C data to assure that the capabilities listed on the QML are still valid. For example, a manufacturer listed for 20 layer boards which has only produced 10 layer boards for a while (and thus only tested 10 layer boards) may have to produce and submit 20 layer samples for testing. The TRB determines when this is necessary based on the length of time and on what changes were made to the process during that time. Also note that thermal shock is not a part of group B/C testing, but is a requirement of PCI in MIL-PRF-31032.

## **Test Optimization**

Appendix D of MIL-PRF-31032 gives guidance on test optimization. Keep in mind that test optimization includes modification of test methods and moving tests in-process, not just adjusting the frequency of a test. It is highly recommended initially that the TRB discuss any planned test optimization with the Qualifying Activity prior to implementation. This will allow the Qualifying Activity to bring any concerns to the TRB's attention early and have them addressed. Manufacturers who test optimize are still responsible for the product meeting all specified performance requirements just as if the tests had been performed.

### **In-process Inspections**

Tests requirements listed in the associated specification may not be defined as to where in the process flow they must be performed. The manufacturer is responsible for all testing in the associated specification. If the only way to properly perform a test or inspection is to perform it in -process, the TRB must account for this and include it in his process flow.

# MIL-PRF-31032 QM PLAN QUICK CHECKSHEET

## INSTRUCTIONS

|                               |                                 |  |
|-------------------------------|---------------------------------|--|
| Manufacturer Name and Address | Contact Name, Phone, Fax, Email | QM Plan:<br><br>Process Flow:<br><br>CAGE Code:<br><br>Web Site: |
|-------------------------------|---------------------------------|--|

| QM Plan Requirement  | 31032 ¶   | Covered By... | QM Plan Requirement   | 31032 ¶   | Covered By... |
|--|---|---------------|---|---|---------------|
| Technical Review Board (TRB)<br>◇ Structure defined<br>◇ Records of decisions retained<br>◇ Assess status of QM program and quality of product<br>◇ Address changes in personnel and business plans<br>◇ Take corrective actions when failures occur | A.3.2.1a<br>A.4.1.1<br>A.4.1.1<br>A.4.1.2<br>A.4.1.2<br>A.4.1.2 |               | Documentation, Data Retention, Storage and Disposition<br>◇ Traceability of materials, processing, production and inspection lot kept for 3 years<br><br>Continuous Improvement<br>◇ Areas for improvement are identified and actions taken<br>◇ Success measured | 3.9<br><br><br>A.3.2.1i<br>A.4.7<br>A.4.7<br>A.3.2.1j<br>A.4.8<br>A.4.8 |               |
| Process Flow<br>◇ Procedures for all processes<br>◇ Rework controlled and included in process flow<br>◇ Contract services addressed  | A.3.2.1b<br>A.4.2<br>A.4.2.1<br>A.4.14                          |               | Failure Analysis (FA)<br>◇ FA triggers identified<br>◇ Corrective actions taken   | A.3.2.1k<br>A.4.9<br>4.4, 4.4.1   |               |
| Process Flow Doc. Index<br>◇ List of procedures, numbers and revisions that define the QM Program  | A.3.2.1c<br>6.4.23  |               | Process Control<br>◇ All processes controlled<br>◇ Process controls and monitors defined  | A.3.2.1l<br>A.4.10  |               |
| Organizational Chart<br>◇ Include all TRB members  | A.3.2.1d<br>A.4.3   |               | Corrective Action<br>◇ Procedure addresses steps to correct problems or processes out-of-control or defective   | A.3.2.1m<br>A.5.1.1   |               |
| Conversion of Customer Requirements<br>◇ All items of A.4.4 (a-m) are addressed<br>◇ QML qualification is reviewed for coverage<br>◇ Test coupon panelization meets the specified design std<br>◇ Printed board material requirements are identified | A.3.2.1e<br>A.4.4<br>A.4.4g<br>A.4.4.1.2<br>A.4.4.2             |               | Change Control<br>◇ All changed reviewed and approved by TRB<br>◇ Major vs. minor defined<br>◇ DSCC notified on major changes   | A.5.1.2<br>A.5.1.3  |               |
| Self-Validation<br>◇ Procedure addresses frequency and checklists used<br>◇ All elements of the QM plan  | A.3.2.1f<br>A.4.5<br>A.4.5<br>A.3.2.1g                          |               | Qualification Testing<br>◇ All items in A.4.11 addressed  | A.3.2.1o<br>A.4.11<br>A.3.2.1p<br>C.4                                   |               |
| QML Status Report and TRB Reporting<br>◇ Status report includes all items of A.4.6<br>◇ Frequency and mechanism for reporting to DSCC in place   | A.4.6<br>A.4.6<br>A.3.2.1h                                      |               | Periodic Conformance Inspection<br>◇ Plan complies with C.4<br><br>Calibration<br>◇ All equipment used to accept/reject product is calibrated<br><br>Training<br>◇ Training is documented<br>◇ Training to changes in   | A.3.2.1q<br>E.5.1<br><br>A.3.2.1r<br>A.4.13<br>A.4.13                   |               |



