November 3, 2000

TRANSITIONING FROM MIL-P-50884C and MIL-PRF-31032 TO IPC-6013 AND AMENDMENT 1

(A Historical Perspective and Guide Developed and Approved by the IPC Flexible Circuits Committee)

A

IPC
2215 Sanders Rd.
Northbrook, Ill. 60062-6135

1 SCOPE

This position paper serves as a guide for manufacturers and users of flexible and rigid-flex printed circuit boards (PCBs) to transition from the use of MIL-P-50884 and MIL-PRF-31032 to the industry standard IPC-6013 and Amendment 1.

This paper has been developed and approved by the IPC Flexible Circuits Committee. This group supports the full cancellation of MIL-P-50884C and MIL-PRF-31032 and their associated Qualified Product Listings (QPLs) and Qualified Manufacturer Listings (QMLs) and the full transition as an industry to IPC-6013 and Amendment 1.

2 APPLICABLE DOCUMENTS

2.1 IPC

IPC-FC-231 – Flexible Bare Dielectrics for Use in Flexible Printed Wiring
IPC-FC-232 – Adhesive Coated Dielectric Films for Use as Cover Sheets for Flexible Printed Wiring and Flexible Bonding Films
IPC-FC-241 – Flexible Metal-Clad Dielectrics for Use in Fabrication of Flexible Printed Wiring
IPC-1710 - OEM Standard for Printed Board Manufacturers' Qualification Profile
IPC-2223 - Sectional Design Standard for Flexible Printed Boards
IPC-4101 - Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-6013 and Amendment 1 - Qualification and Performance Specification for Flexible Printed Boards

2.2 Department of Defense (DoD)/Defense Supply Center Columbus (DSCC)

MIL-STD-130 - Identification Marking of U.S. Military Property
MIL-STD-202 – Test Methods Standard: Electronic and Electrical Component Parts
MIL-STD-961D – Standard Practice for Defense Specifications
MIL-STD-2118 - Flexible and Rigid Flex Printed Wiring for Electronic Equipment Design Requirements
MIL-P-50884C - Military Quality and Performance Specification Governing the Manufacture of Flexible and Rigid-Flex Printed Wiring Boards
MIL-P-50884D - Military Quality and Performance Specification Governing the Manufacture of Flexible and Rigid-Flex Printed Wiring Boards
MIL-PRF-31032 - Qualified Manufacturers List (QML) Specification for Printed Circuit Boards

3 HISTORY

Military standards and specifications at one time were the primary documents the PCB industry used for the qualification, conformance and performance requirements of base materials, design and performance of fully manufactured printed circuit boards.

In the early 1990s, the U.S. Department of Defense (DoD) began to review its functions as an entity in both the military and commercial worlds. It was determined by then Secretary of Defense William Perry that the DoD should not be investing time and money in areas driven by commercial markets.

One of these areas is the development and management of standards, specifications and qualification audits of commercial materials and products. In response to this issue, Perry developed the Perry Initiative, a document that called upon the DoD to review its standards and specifications in existence and work with the commercial industry to transition these documents and their management under the auspices of the industry itself.

3.1 Perry Initiative

3.1.1 Background On 29 June 1994, Secretary of Defense Perry signed his policy, "Specifications and Standards - A New Way of Doing Business," which dramatically changed the way requirements would be written in acquisitions. The policy directed the use of performance and commercial specifications and discouraged the use of military specifications and standards by requiring the approval of a waiver. The DoD policy was initially implemented within Department of the Navy (DoN) by an ASN (RDA) memo on 27 July 1994 and was fully implemented by the Standards Improvement Program Plan on 21 December 1994.

3.1.2 Application of the Initiative The Standards Improvement Program Plan emphasizes three major thrust areas, detailed in 3.1.2.1 through 3.1.2.3.

3.1.2.1 Performance-Based Solicitation Process Actions to facilitate a performance-based solicitation process include:

- Benchmarking performance-based RFPs
- Holding forums to share lessons learned on preparing performance-based solicitations
- Developing tools for assisting in the preparation of performance specs and RFPs (SPECRITE, RFP templates, guide specs)
- Publicizing the availability of existing databases and references for use in defining requirements (Program Managers Work Station, COTS user documentation).

3.1.2.2 Military Document Improvement The military document improvement effort includes the review, disposition, and actions taken on the over 8000 military specifications and standards owned by DoN. The exhaustive review of these documents resulted in the final disposition decisions:

- Thirty-six percent are being canceled or inactivated,
- Sixteen percent are being converted to performance-based,
- Nineteen percent are being converted to commercial documents,
- Twenty-two percent are being retained and updated as military-unique detail documents, and
- Seven percent are being transferred to another activity.

3.1.2.3 Cultural Change The cultural change thrust area requires a longer term investment in training and communication. Key functional training topics on specifications and standards reform developed and being offered include:

- Writing performance specs,
- Preparing performance-based statements of work,
- Impacts on supportability from using performance specs,
- Military standard conversion,
- How to conduct Market Research, and
- How to participate effectively with non-government standards bodies.

3.1.3 Phase II Implementation Program DoN has made significant accomplishments in specs and standards reform since the Perry Initiative in June 1994. In building on the successful actions and following the themes of the three major thrust areas, a Phase II implementation plan provides a broadened, accelerated agenda for accomplishing the next phase of specs and standards reform.

This plan includes emphasis on:

- Reprocurements and smaller acquisition programs,
- Early industry involvement in requirements determinations,
- Transitioning the RFP benchmarking process to be Systems Command managed,
- The need to accelerate the conversion or update of specifications and standards,
- Improving the conduct of market analysis,
- Maximizing the use of commercial items,
- Implementing pollution prevention actions within our military documents, and
- Reviewing currency and applicability of International Standardization agreements.

The Phase II implementation plan provides a broadened, accelerated agenda for accomplishing the next phase of specs and standards reform This plan includes emphasis on:

- Reprocurements and smaller acquisition programs
- Early industry involvement in requirements determinations
- Transitioning the RFP benchmarking process to be Systems Command managed
- The need to accelerate the conversion or update of specifications and standards
- Improving the conduct of market analysis
- Maximizing the use of commercial items
- Implementing pollution prevention actions within our military documents
- Reviewing currency and applicability of International Standardization agreements.

3.1.4 Current Status Since the release of the Supplemental Plan in October 1996, ASN (RDA) has issued a policy memo on applying specifications and standards reform to reprocurements. The objective was to make sure a deliberate business-case analysis was conducted that effectively weighed the life cycle cost savings and other benefits of moving towards performance-based requirements for reprocurement items against the costs and risks of conversion. A policy memo was also issued on 15 Jan 1998 requiring each Systems Commander, PEO, and DRPM to ensure the appropriate review and approval of standard management approaches and manufacturing processes prior to their imposition on MDAP and other ACAT new system acquisition contracts. Approval under a structured review constitutes waiver approval for use of processes on contract. A quarterly metrics briefing will describe the approach and experience in implementing this policy guidance.

> **New training opportunities have been developed to assist the program offices in the preparation of Requests for Reprocurement. The Performance Based RFP course provides three days of training for writing sound solicitations based on performance requirements. A new automated tool, Turbo SpecRite, will assist DoD and industry personnel in developing performance specifications and converting military specifications into performance specifications. The tool will include decision matrices to help decide whether or not a specific specification should be converted, a market research tool to assist in determining what is available commercially, and an electronic tool called SpecRite for drafting a new specification to the requirements in MIL-STD-961D.**

3.1.5 Performance-Based Solicitation Process

1. Benchmarking performance-based RFPs.
2. Holding forums to share lessons learned on preparing performance-based solicitations.
3. Developing tools for assisting in the preparation of performance specs and RFPs (SPECRITE, RFP templates, guide specs).
4. Publicizing the availability of existing databases and references for use in defining requirements.

3.1.6 Military Document Improvement

1. Review, disposition, and actions taken on the over 8000 military specifications and standards owned by DoN.
2. The exhaustive review of these documents resulted in the final disposition decisions:
   Thirty-six percent are being canceled or inactivated,
   Sixteen percent are being converted to performance-based,
   Nineteen percent are being converted to commercial documents,
   Twenty-two percent are being retained and updated as military-unique detail documents, and
   Seven percent are being transferred to another activity.

Cultural change requires a longer term investment in training and communication.

Key functional training topics on specifications and standards reform developed and being offered include:

1. Writing performance specs.
2. Preparing performance-based statements of work.
3. Impacts on supportability from using performance specs.
4. Military standard conversion.
5. How to conduct market research.
6. How to participate effectively with non-government standards bodies.

3.2 History of Military Specification Cancellations and Transitions Since 1994, DSCC has cancelled several military specifications used by the PCB industry and worked with industry along the way. Once an IPC standard or specification parallel to that of a military specification was published, DSCC would send out a cancellation notice, which included a statement of supersession by the IPC specification.

There were only two instances where such a statement was not supplied by DSCC, with the most recent being the cancellation of the rigid laminate specification, MIL-P-13949. In this instance, DSCC did not reference the IPC standard, IPC-4101, even though early notices showed intentions to call out the IPC specification.

3.2.1 MIL-STD-2118 Cancellation When IPC published IPC-2223, the IPC standard for the design of flexible circuits, DSCC sent out notification of the adoption of IPC-2223. This notice created a paper trail companies could use for existing and current drawings and contracts, thus eliminating unnecessary paperwork by the user and manufacturer.

> **NOTE: MIL-STD-2118 and MIL-P-50884 used to be a pair of documents that worked together. With the cancellation of MIL-STD-2118 and publication of IPC-2223 and IPC-6013, the pair are now the IPC specifications.**

3.2.2 MIL-P-50884C Development In the early 1990s, IPC members from within the flexible circuits manufacturing community submitted a fully written MIL-P-50884D to DSCC. DSCC turned down the document and instead chose to revise it on its own.

It was at this time that the IPC membership began the development of IPC-6013 to replace IPC-FC-245 and IPC-FC-250.

3.2.3 MIL-P-50884C Inactivation and MIL-PRF-31032 Soon after the publication of IPC-6013 in November 1998, DSCC sent out an announcement of the inactivation of MIL-P-50884C for all

new drawings. The notice instructed industry to begin using MIL-PRF-31032, Flex Slash Sheet, for all new drawings.

The callout of the MIL-PRF-31032 Flex Slash Sheet went directly against Acquisition Reform and the policies set out in the Perry Initiative as there was an acceptable industry equivalent in IPC-6013.

MIL-PRF-31032, in and of itself, is very similar to an ISO 9000 document, and the Flex Slash sheet reads like and has requirements similar to IPC-6013. At the time of publication of the this paperguideline, only three manufacturers have gone through the qualification to be on its QML.

Of those three companies one has since been bought by a company that uses IPC-6013, and it is believed that one of the others doesn't even manufacture flex circuits anymore.

3.2.4 MIL-P-50884D In spring 2000, IPC received an announcement from DSCC regarding the revision of MIL-P-50884C, an inactive document. DSCC was seeking comments to this draft that itself would be published as a document inactive for new designs, essentially dead on arrival (DOA).

Rather than comment on the document, IPC staff consulted with its membership, representing leaders in the use and manufacture of flex circuits. Those individuals determined that DSCC was not helping the industry through the revision of MIL-P-50884C and publication of the MIL-PRF-31032 Flex Slash Sheet. Based on this, they indicated IPC should officially request the cancellation of MIL-P-50884C and immediate halt to the revision of MIL-P-50884D.

3.2.5 IPC Activities in Cancellation Since the advent of the Perry Initiative, IPC membership and staff have worked closely with DSCC and other governmental offices in the transition from military to industry specifications. Once IPC has a parallel specification published, it will send an announcement to its membership, stating it is proposing the cancellation of a military specification. This is done to make industry aware of the proposal and generate feedback.

In the past, IPC has received some resistance from membership during these announcements, but when it sent out the announcement on the proposed cancellation of MIL-P-50884C and a halt in the revision to MIL-P-50884D, there was no negative feedback whatsoever from industry.

IPC then polls the companies on the document's QML to see if they support the cancellation of the military specification and its associated QML/QPL. IPC polled the MIL-P-50884 list in the summer of 2000, and of the 17 companies that responded, 12 indicated the support of the cancellation of the document and that they are currently transitioning military contracts to IPC-6013.

3.2.6 DSCC's Change in Policy At an IPC June 2000 meeting in Dallas to discuss the cancellation of MIL-P-50884C, DSCC staff present indicated DSCC had changed its policy on document cancellations. Rather than pointing to an applicable industry standard or specification to create a paper trail, it will no longer offer a pointer when canceling one of its specifications.

It is now DSCC's philosophy that if it is called upon to cancel a specification, it is not because there is a parallel industry specification available. It is instead because the subject matter of the specification is no longer being manufactured by any part of any industry, thus there is no need for a specification of any kind.

It is IPC's position that DSCC's activities in not calling out approved industry standards is anti-conversion behavior and goes against Acquisition Reform. DSCC's position is intended to make it harder for the industry to move to acceptable alternatives, thus preserving government jobs.

3.2.7 Defense Logistics Agency (DLA) Response to IPC Cancellation Request In July 2000, IPC received an official response from Defense Logistics Agency (DLA) to its request for the cancellation of MIL-P-50884C and halt in revision to MIL-P-50884D. This letter is shown in Appendix 3.

As can be seen in the letter, DLA presented five reasons, listed A through E, as to why there is still a need for military specifications.

The following is the IPC membership's response to each item:

(a) While there may be 50 manufacturers still qualified to MIL-P-50884C, an IPC survey indicates a shift by these manufacturers away from MIL-P-50884C. Twelve of the 17 manufacturers that responded to the survey support the cancellation of the military specifications and intend to support IPC-6013 for future military programs. Many already do.

(b) Supersession of MIL-P-50884C by MIL-PRF-31032 has been met with significant resistance. At this time (per QML-31032-7, dated 25 January 2000) there is only one flexible circuit manufacturer qualified to the Flex Slash Sheet of MIL-PRF-31032. This manufacturer does not supply flex circuits per this document and its slash sheet.

MIL-PRF-31032 was written in an era where ISO 9000 documentation already existed, creating even more duplication on an industry-wide basis.

(c) Given the environment of acquisition reform, contractors have been selecting the procurement document of their choice. OEMs have overwhelmingly selected IPC-6013 for new drawings. Having multiple specifications available doesn't benefit industry.

(d) While DSCC has the right to provide quality audits to the military PCB specifications, they are, in practice, rarely done. Moreover, they are being done to cancelled specifications, and most manufacturers are already being audited annually by their ISO registrar.

(e) MIL-P-50884D only brings MIL-P-50884C into concurrence with MIL-P-55110, which is itself a cancelled document, so there is no need to expend the effort. The IPC Flexible Circuits Committee recommends the use of IPC-6013, Class 3, for all military product previously supplied to MIL-P-50884C.

4 MAKING THE TRANSITION

The remainder of this document focuses on making the transition from MIL-P-50884 to IPC-6013 when DSCC cancels the document without replacement, as well as how to transition contracts and drawings in the meantime.

IPC fully anticipates and will continue to work until the industry is notified of DSCC's cancellation of all three of its PCB specifications. IPC and the IPC Flexible Circuits Committee recommend the flexible circuit industry work with its customers on transitioning current and old drawings from this point forward in preparation of the cancellation of the military specifications.

4.1 Making the Transition in the Interim Before DSCC cancels MIL-P-50884, it is necessary for the flexible circuits industry to prepare itself by beginning the transition on its own. This will alleviate any further stresses caused by the immediate cancellation of a document because best practices and open communications between customer and manufacturer will already be in place.

The items in 4.1.1 through 4.1.7 are recommended practices for making the transition in the interim.

4.1.1 Provide Guideline to Customers As a first step, manufacturers should provide this guideline to their customers. IPC has made this document available for free and open distribution

to assist the flexible circuits manufacturer and its customer in this transition. IPC has also provided this guideline directly to the customers and will keep it current and available for free download on the IPC Web site (www.ipc.org).

The guideline serves as a detailed overview of the history of military specifications in the electronics industry, specifically the flexible circuit market, a step-by-step guide for making the transition, detailed comparison of the requirements and a pros and cons checklist.

4.1.2 Attending IPC Meetings IPC will continue discussions on this issue during technical committee meetings, workshops and tutorials, and as necessary, during technical conferences. IPC practices openness and fairness in all of its projects and will continue to do so with this issue due to the importance of keeping the industry aware and current of the progress of the cancellation and the successes during transitions.

4.1.3 Supplier Qualification It is recommended that all manufacturers complete an IPC-1710 supplier qualification profile and keep it on file. This industry-approved document enables manufacturers to have a consistent questionnaire to provide its customers.

Further to this qualification, some OEMs have been known to have product similar or exacting to that being built for them qualified to the standard it calls out. Although it may not be willing to share its end data, the supplier and OEM, as part of the contract negotiations, can work out a way for the OEM to allow the manufacturer to state they have met the qualifications of IPC-6013 for said OEM.

The OEM can also call upon the manufacturer to adhere to a third-party audit.

4.1.4 Internal Specifications Internal specifications should be developed that state the manufacturer is now building to IPC-6013 for all existing and future drawings.

4.2 MIL-P-50884C Cancelled Without Replacement When DSCC sends out its cancellation notice for MIL-P-50884C, it will do so without pointing to a replacement document. Although the industry will move to IPC-6013, there will still be some steps to take from a paper trail and training/communications perspective to make the transition as smooth as possible.

4.2.1 Old Drawings One of the main concerns with the cancellation of the military specifications without a pointer involves the old drawings. For some companies, these drawings can number well into the hundreds and would take many man-hours to go through each one and change the requirements to IPC-6013.

The IPC Flexible Circuits Committee recommends the procedures in 4.2.1.1 and 4.2.1.2 for making the transition as easy as possible.

4.2.1.1 Manufacturers can develop an internal specification that states all drawings calling out MIL-P-50884 will now be built to IPC-6013. Military products will be built to IPC-6013, Class 3, and commercial applications will be built to Class 2, unless otherwise agreed upon between user and supplier.

It is recommended the manufacturers use the matrixes in Appendix 1 and Appendix 2 when working with their customers on the requirements.

4.2.1.2 Manufacturers can also update the drawings as they build to them. Some drawings remain the same but don't see action for quite some time, so the manufacturer should follow the recommendations of 4.2.1.1 on a drawing by drawing basis.

4.2.2 Resources To assist in the transition, IPC has provided this industry-approved guideline as a resource manufacturers can use to assist with the transition internally, as well as something to offer their customers.

Two valuable tools included with this guideline are requirement-by-requirement comparisons between MIL-P-50884C (see Appendix 1) and MIL-P-50884D (see Appendix 2) and IPC-6013 and Amendment 1. The IPC Flexible Circuits Committee recommends including the cross-reference with each drawing to be transitioned.

4.3 Single Process Initiative (SPI) On December 8, 1995, Secretary of Defense Perry and Under Secretary of Defense for Acquisition and Technology Paul Kaminski announced implementation of the (SPI). SPIs transition contractor facilities from multiple government-unique management and manufacturing systems, such as military specifications used by the electronics industry, to the use of common, facility-wide processes. Using a block change modification approach, SPI unifies requirements in existing contracts on a facility-wide basis, rather than on a contract-by-contract basis.[1]

To successfully implement an SPI, the Administrative Contracting Officer (ACO) assigned to the facility will lead the coordination and negotiation of contract modifications (block changes). The contractor (manufacturer) must propose and substantiate SPI common processes. According to the DCMC, industry, the military services, Defense Contract Audit Agency (DCAA) and DCMC must work together expeditiously to take advantage of the initiative.

The SPI is intended to reduce contractor-operating costs and achieve cost, schedule and performance benefits for the government.

4.3.1 Guideline for Preparing a Concept Paper According to the DCMC[2], the first step to completing a successful SPI concept paper is open communication between the contractor, customer, DCAA and DCMC Contract Administration Office. The DCMC also calls for the government representatives to encourage and assist the contractor with development of the paper, although it is up to the contractor to submit the contract paper.

Concept papers should be concise and specifically identify the existing contractual requirements to be replaced or modified and identify contracts and customers that would be affected by the approval of the paper. When the contractor submits the paper to the Contract Administrating Office (CAO), each respective customer Program Executive Officer or Program Manager (or designated representative) and the Block Change Team must be notified of the submission and its subsequent status.

Once the paper has been received by the CAO, there is a 120-day window in which the paper is reviewed and accepted or rejected. It is advised there be early interface between industry and the government before the paper is submitted to facilitate the process.

The following elements need to include the following elements to evaluate a proposed change and allow rapid judgement by the ACO.

1. A description and short summary of the process to be considered.
2. Methodology to move the proposed common processes and a schedule for transition. How will the contractor implement the process? How does the contractor propose to maintain quality and schedule during the transition?

[1] Single Process Initiative: Defense Contract Management Command (DCMC) Information Sheet 96-1, Revision G, April 18, 1996.
[2] Single Process Initiative: DCMC Information Sheet 96-2, Revision G, April 18, 1996.

3. A summary of the proposed metrics that will be used to measure effectiveness and compliance. How will the contractor demonstrate acceptability and reliability (technical feasibility) of the process?
4. Rough order of magnitude cost benefits analysis (to include the current and future costs and savings). Will implementation be advantageous (cost effective) to the Government?
5. Impact on existing contracts and an assessment of future impacts. What is the impact (program risk) to the Government and contractor if the proposal is approved/disapproved?
6. An assessment of changes required in the Government's involvement in the process.
7. Required regulatory/contractual changes.

4.3.2 Governmental Resources The Department of the Navy (DoN) has made available several valuable resources on Acquisition Reform and SPIs, including a template to use for a concept paper.

These resources can be found at: http://www.acq-ref.navy.mil/spi.html

IPC included a tutorial for writing a concept paper in Appendix 4 and a guide for conducting a performance-based block change in Appendix 5.

5 BENEFITS TO USING IPC-6013 VS. MIL-P-50884

5.1 Cost There are many cost-driven benefits to building to IPC-6013 rather than MIL-P-50884.

The main cost is that of qualification. The following is a sample breakdown of the qualification costs involved to meet MIL-P-50884C provided by one flexible circuit manufacturer.

1. Qualification Testing Cost = $3000 per slash sheet.
2. Six circuits (10-layer rigid-flex samples) = $8200 per slash sheet.
3. Tooling = $5600 (Approximately 50 percent additional for each slash sheet.)
4. Engineering labor = $5800

Total Qualification Cost = $15,000 to $25,000

5.2 Cosmetic vs. Performance IPC-6013 is a specification driven by performance requirements of the flexible or rigid-flex board, whereas MIL-P-50884 includes more cosmetic requirements. Due to this fact, flexible circuit manufacturers have had boards rejected based on cosmetic requirements that would have no effect on the final performance of the product. Due to these issues, manufacturers and their customers worked through these requirements when developing IPC-6013.

One such example of this is the foreign material requirement.

5.3 Remaining Parallel with Technology When using IPC-6013, qualification is made to the technology being manufactured, rather than outdated, generic test patterns. Further to that, the qualification and its process are agreed upon between user and supplier.

5.4 OEM Understanding of Products A user-customer qualification process is beneficial to the OEM, which will now have a greater understanding of its supplier's materials and processes.

5.5 Global Consistency Because IPC standards and specifications are recognized worldwide, the use of these documents for qualification and requirements leads to consistency of understanding between user and manufacturer. IPC-4101, which for all intents and purposes replace MIL-P-13949, has fast become the worldwide specification for laminate and prepreg materials, making it easier to buy and sell materials domestic and internationally.

5.6 Materials and Manufacturing Process Whether the OEM calls out MIL-P-50884 or IPC-6013, the materials and manufacturing processes don't change. Both documents call out the IPC materials specifications and neither gives operational instructions or requirements.

5.7 Developing Bodies IPC-6013 is developed and maintained by a balanced group of OEMs, manufacturers, independent testing facilities and consultants. The individuals representing these entities bring with them decades of experience in qualification, manufacture and reliability of flexible circuits.

IPC's policies also call for openness and fairness in development of its specifications, which means any person representing any part of industry can take part in the document's development. All comments must be addressed and resolved by the consensus body, and IPC, in the best interest of its members and the industry, monitors the group's activities to prevent any chance of collusion or antitrust.

IPC-6013, Amendment 1, was held up at the Interim Final stage until the group addressed comments from one manufacturer's customer, which it resolved and incorporated into the document.

DoD employees developed MIL-P-50884. Although it has shown interest in collecting comments for the development of revision D, there is no set policy that DSCC must resolve all comments through a consensus body.

The following companies entail the IPC Flexible Circuits Performance Specifications Subcommittee, which developed IPC-6013 and Amendment 1:

ACME, Inc.
Advanced Circuit Technology
All Flex Inc.
Alliant Techsystems Inc.
B/C Engineering
BAE SYSTEMS Canada, Inc.
Century Circuits & Electronics
Compaq Computer Corporation
CPFilms
Cummins Electronics Co.
Datakey Inc.
Defense Supply Center Columbus
Delphi Delco Electronics Systems
DuPont Teijin Films
E. I. du Pont de Nemours and Co.
E.C.S.
Electro-Materials, Inc.
EMPF/ACI
Flexible Circuits Inc.
Flex-Link Products Inc.
Framatome
Fujikura America Inc.
Fujikura Ltd.
Gould Electronics Inc.
Harmon Industries, Inc.
Hinton 'PWB' Engineering
Honeywell Inc.
Hughes Space & Communications Co.
IBM Corporation
INNOVEX, Inc.
JPCA-Japan Printed Circuit Assn.
Kaneka High-Tech Materials Inc.
L.E. Flex Circuits Inc.
Lockheed Martin
Lockheed Martin Space Systems
Lucent Technologies
Medtronic Inc./Micro-Rel Division
Microtek Laboratories
Minco Products Inc.
Multek, Inc.
Northrop Grumman Corp.
NSWC - Crane
Packard Hughes Interconnect
Parlex Corporation
Polyonics Corporation
Precision Diversified Industries
Printed Circuits Inc.
Raytheon Company
Raytheon Electronic Systems
Raytheon Systems Company
Robisan Laboratory Inc.
Rockwell Automation/Allen-Bradley
Rockwell Collins
Rogers Corp.
Sallo Consulting Services
Sheldahl Inc.
Shin-Etsu Chemical Co. Ltd.
Strataflex Corporation
Teledyne Electronic Technologies
Trace Laboratories - Central
Trace Laboratories - East
Tyco Printed Circuit Group Inc.
Underwriters Laboratories Inc.
Unichem Industries
Vantico Inc.
Viking Components Inc.
Visteon Automotive Systems
William Jacobi & Associates
Yates Foil USA Inc.

5.8 Performance Class Selection Using IPC-6013 enables the user to select from a series of three performance classes, rather than having all products meet the requirements of MIL-P-50884, which are comparable to IPC-6013, Class 3.

The ability to select from the three classes is an added cost benefit to the user and manufacturer.

6 FREQUENTLY ASKED QUESTIONS (FAQ)

Because the cancellation of military specifications is such a sensitive subject to the electronics industry, it is imperative for this guide to address and respond to as many of those concerns as possible. Because this guideline is a living document, as further issues arise, they will be addressed.

The following are the arguments heard as of release of this draft.

1. How do I know my manufacturer?

There are several steps an OEM can take to learn more about a current or potential supplier. These steps enable the OEM to gain more information about the manufacturer that can be provided by DSCC and build a stronger user/manufacturer relationship.

The following are some resources for learning more about a manufacturer:

Call IPC -- IPC can tell you whether or not the company is a member and the range of activities the company and its representatives have taken part in over the years. There are added benefits to using a company steeped in IPC conferences, technical committee activities and training programs.

IPC staff can also provide you with a list of contacts within the organization.

IPC Product and Services Locator Matrix (PSLM) -- A free service provided by IPC on its Web site (www.ipc.org) , the PSLM enables you to highlight the things you are looking for in a facility and search the IPC database for companies matching your requirements.

Dun and Bradstreet -- A Comprehensive D&B Report will provide you an analytical tool that can help you assess new and existing business relationships where the large-dollar and/or long-term nature of the commitment pose a significant risk or opportunity to your business. Reports like this usually run about $100.

The Internet -- The Web offers a substantial amount of information on any company's products, the markets they serve and some of their customers. It will also inform you on a company's ISO certifications and what specs it builds to.

Further to the company's Web site, there are also several other supplier-based Web sites you can visit.

References -- As part of the negotiation process with its customers, many manufacturers will ask said customer if it could be listed as a reference for the company to use for potential customers. Direct contact with these references will provide you with a first-hand perspective of the manufacturer.

2. I've Rejected Boards to IPC-6013.

Although there are no data available comparing boards rejected built to IPC-6013 versus those built to MIL-P-50884C, through contacts made to customers by IPC staff, it is safe to say boards built to both specifications have been rejected. The matter with the board being rejected is not specification driven, as much as it is process controls in the manufacture of the boards.

3. My Customer Requires It.

As the industry waits for the cancellation of MIL-P-50884C, it is important that communications be built between manufacturers and their customers. A step-by-step approach between the customer and manufacturer in the interim will save money and limit risks in time to market once MIL-P-50884C is cancelled.

Resources such as this guideline and the document comparison matrixes in Appendix 1 and Appendix 2 should be made available to all customers. Further resources can be obtained by contacting IPC.

4. If I Don't Build to the Military Specification, I'll Lose Business to Another Manufacturer.

This is possibly one of the soundest arguments in the entire issue. Small to medium-sized manufacturers fear losing business to other manufacturers if they take a stand on no longer building to the military specification. The best way to curtail this issue is through continued communications and good customer relations.

5. DSCC is Needed to Serve as the Objective Third Party for Disagreements Between the Customer and Manufacturer.

It is highly unlikely that DSCC will serve as an arbitrator to resolve a disagreement to a mutual satisfaction. If a customer and supplier cannot come to an agreement it is unlikely they will continue to do business together.

6. DSCC Provides Quality Audits to Ensure Compliance to Military Printed Wiring Board Specifications.

Audits are too few and far between to provide OEMs much assurance of quality control at the supplier. Regular ISO audits and lot based acceptance criteria provide better indication.

7. What About the Third-Party Audits DSCC Provides?

Audits are too few and far between to provide OEMs much assurance of quality control at the supplier. Regular ISO audits and lot based acceptance criteria provide better indication.

8. The Costs the Manufacturer Pays for Audits is Worth Knowing it Meets the Specification.

This is an OEM's prerogative. Lot based testing is probably more indicative.

9. We Don't Have the Manpower to Support DSCC, IPC and Internal Standards Development.

That is why the effort is being done for all parties to condense down to one specification, IPC-6013.

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Annular Ring (External & Internal)	minimum .005" external; and .002" internal	3.5.7.2, 3.7.7, 4.8.3.6	Plated through holes: 180° breakout	Plated through holes: 90° breakout Conductor junction not < 50µm	Plated through holes: Min. external ring not < 50µm	3.4.3
			Unsupported holes: No breakout	Unsupported holes: No breakout	Unsupported holes: Min. annular ring not < 150µm	
			Breakout allowed per Fig 3-5	Hole to pad tangency	0.025mm	3.7.10
Annular Ring and Breakout (Internal)	No Breakout Allowed		Microsection to verify correlation and a calibration standard made for probing technique			3.4.2
Bending Flexibility	The coupon shall pass electrical test after 25 fold cycles with no evidence of degradation or rejectable delamination.	3.6.5.1, 4.8.4.5	As specified in appropriate document/drawing			3.6.1
Bond Strength (Stiffener)	When required must be specified on the drawing per MIL-STD-2118 using materials specified herein. Peel strength shall be 3 lbs./inch of width minimum.	3.3.8, 4.8.4.7	Peel strength between the flexible printed wiring and the stiffener > 1.4kg per 25mm			3.6.4
Bond Strength (Unsupported Lands)	After 5 times soldering and unsoldering type 1 flex boards shall have unsupported lands which withstand 5 lbs. pull or 500 psi, whichever is less.	3.6.4, 4.8.4.4	As per IPC-TM-650, Method 2.4.20, unsupported land shall withstand 1.86kg pull or 35kg/cm², whichever is less, after subjection to five cycles of soldering and unsoldering			3.6.3
Bow & Twist (Individual Rigid or Stiffener Portion Only)	Max allowable bow and twist is 1.5% unless otherwise specified on the drawing.	3.5.3, 4.8.3.2	Surface applications: 0.75% bow & twist (or determined by user and supplier)			3.4.4
			All other applications: 1.5% bow & twist (or determined by user and supplier)			
Circuit Repair	No repair is allowed.	3.9	No more than two repairs for each 0.09m²; no impedance or min electrical spacing req violated Only when agreed upon between user and supplier			3.11.3, 3.11.4
Circuitry		4.8.6.3	Testing conducted in accordance with IPC-ET-652			3.9.2

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
	Certification: No open circuits in specimen. Tested at 1 amp for 30 sec on the coupon. Production: No open circuits in specimen.	3.8.3.1, 4.8.6.3.1 3.8.3.2, 4.8.6.3.2	**Continuity** Flexible printed wiring and qualification testing of flexible printed wiring **shall** be tested in accordance with the procedure outlined below. There **shall** be no circuits whose resistance exceeds the values established in IPC-ET-652. The presence of long runs of very narrow conductors or high resistance metals may increase these values. When required by the user, interconnect shorts and continuity coupon D **shall** be used for evaluation of interconnection resistance and circuit continuity. A current **shall** be passed through each conductor or group of interconnected conductors by applying electrodes on the terminals at each end of the conductor or group of conductors. The current passing through the conductors **shall** not exceed that specified in IPC-2221 for the smallest conductor in the circuit. For qualification, the test current **shall** not exceed one ampere. Flexible printed wiring with designed resistive patterns **shall** meet the resistance requirements specified on the procurement documentation.			**3.9.2.1**
	Insulation resistance shall be greater than 100 megohms when tested at 100 VDC	3.8.3.3, 4.8.6.3.3	**Isolation (Circuit Shorts)** Flexible printed wiring **shall** be tested in accordance with the following procedure. The isolation resistance between conductors **shall** meet the values established in IPC-ET-652. The voltage applied between networks must be high enough to provide sufficient current resolution for the measurement. At the same time, it must be low enough to prevent arc-over between adjacent networks, which could induce defects within the product. For manual testing, the voltage **shall** be 200 volts minimum and **shall** be applied for a minimum of five seconds. When automated test equipment is used, the minimum applied test voltage **shall** be the maximum rated voltage of the flexible printed wiring. If the maximum is not specified, the test voltage **shall** be 40 volts minimum.			**3.9.2.2**
Circuits/Plated-Through Hole Shorts to Metal Substrates	No Requirement exists. Document does not cover this topic		Metal core flexible printed board will withstand 500 volts DC between circuitry/plated-through holes and metal core substrates w/o flashover or dielectric breakdown			3.9.3
Cleanliness	Shall be free of ionic and other contamination on final product and beneath solder mask coatings.	3.8.5, 4.8.6.5	Type 4 & Type 5 flexibles shall be tested and evaluated in accordance with 3.10.3.1			3.10.3
Coefficient of Thermal Expansion	No Requirement exists. Document does not cover this topic		If have metal cores/reinforcements with a req to constrain thermal expansion in planar directions, CTE shall be within ±2 ppm/°C for CTE & temp range spec on master drawing; testing w/ strain gauge method, according to IPC-TM-650, Method 2.4.41.2 unless otherwise agreed by user and supplier			3.11.6

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Color Variations in Bond Enhancement Treatment	No Requirement exists. Document does not cover this topic		Mottled appearance / color variation accept; Random missing areas of treatment shall not be > 10%			3.3.2.7
Conductor Definition	No Requirement exists		Meet visual & dimension req., pattern & thickness as specified in procurement documentation			3.5
Conductor Edge Outgrowth	No overhang allowed on fused tin/lead or solder coated edges. Other coatings may have up to .001" overhang.	3.6.3, 4.8.4.3	No outgrowth on edges of conductors that have been solder coated or tin-lead plated and fused when tested according to IPC-TM-650, Method 2.4.1			3.5.3.7
Conductor Imperfections	20% max reduction of conductor width allowed. Peak to valley .005" max; over a max length of .500" of conductor. No cracks or tears	3.5.5, 4.8.3.4	Cross-sectional area of conductor not reduced > 30% of min value (Class 1) No cracks, splits or tears	Cross-sectional area of conductor not reduced > 20% of min value; total defect not > 10% of conductor or 13mm (whichever is less) (Class 2 & 3)		3.5.1
Conductor Spacing	.004 min internal; .005 min external	3.5.4, 4.8.3.3	Minimum conductor spacing may be reduced an additional 30% due to conductor edge roughness, spikes, etc. (Class 1)	Min. conductor spacing may be reduced < 20% (Class 2 & 3)		3.5.2
Conductor Thickness Reduction	Not specified		Reduction of conductor thickness not > 30% of minimum (Class 1)	Reduction of conductor thickness not > 20% of minimum (Class 2 & 3)		3.5.1.2
Conductor Width Reduction	20% max reduction of conductor width allowed	3.5.5, 4.8.3.4	Reduction of conductor width not > 30% of minimum (Class 1)	Reduction of conductor width not > 20% of minimum (Class 2 & 3)		3.5.1.1
Construction Imperfections	Acceptable, providing it meets following Fiber not cut, disturbed, or exposed No bridging (weave texture may) Dielectric spacing>min requirements. Measling & crazing: translucent, 0.031" max size, 25% max bridge between conductors, does not reduce spacing below minimum reqmt, does not propagate with stress testing.	3.4.2, 3.4.3	Measling, crazing, blistering, delamination, and haloing shall be in accordance with IPC-A-600. Section 2.3.3			3.3.2
Continuity	Certification: No open circuits in specimen. Tested at 1 amp for 30 sec on the coupon. Production: No open circuits in specimen.	3.8.3.1, 4.8.6.3.1 3.8.3.2, 4.8.6.3.2	No circuits with resistance > the values in IPC-ET-652; current passed through for evaluation will not be > values in IPC-2221 for smallest conductor of circuit			3.9.2.1
Covercoat Coverage in Non-Flex Areas	No Requirement exists. Documents does not cover this topic	3.5.9.1, 3.5.9.3	Conductors not exposed where covercoat required			3.3.2.10.1

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
			Blistering does not bridge between conductors (Class 1)	Two per side, max size 0.25mm in longest dim, spacing between conductors not reduced by > 25% (Class 2 & 3)		
Covercoat Cure and Adhesion	No Requirement exists. Documents does not cover this topic	3.5.9.1	Max % loss allowed (µm) Copper (10µm) Gold or Nickel (25µm) Base Laminate (10µm) Melting Metals (50µm) (Class 1)	Max % loss allowed (µm) Copper (5µm) Gold or Nickel (10µm) Base Laminate (5µm) Melting Metals (25µm) (Class 2)	Max % loss allowed (µm) Copper (0µm) Gold or Nickel (5µm) Base Laminate (0µm) Melting Metals (10µm) (Class 3)	3.3.2.10.2
Covercoat Requirements	No Requirement exists. Documents does not cover this topic		See 3.3.2.10.1 through 3.3.2.10.3			3.3.2.10
Covercoat Thickness	No Requirement exists. Documents does not cover this topic		Not measured unless required by procurement documentation			3.3.2.10.3
Coverfilm Separations	There shall be no coverlayer separation in excess of a quantity of 3, no larger than .010 square inch and is not within .040" of the board edge; No larger than .02" in width or 20% of the spacing between conductors along conductor edges; No cover layer delamination along the outer edges of the cover layer. The cover layer, if misregistered shall not violate the annular ring requirements. If anchoring spurs are not used on unsupported holes the coverlayer shall overlap the land a minimum of .010".	3.5.9.1, 3.5.9.3	Uniform coverfilm, free of separations. Non-lamination good if according to 3.3.2.3, not > 2.5mm x 2.5mm, not > 3 in 25mm x 25mm space, not > 25% of spacing between conductors			3.3.2.9
Dewetting	No Requirement exists. Documents does not cover this topic		Individual areas of Solder connection: 15% max (Class 1)	Individual areas of Solder connection: 5% max (Class 2 & 3)		3.5.3.4
			Dewetting on Conductors and planes are permitted on non solder connection areas (all classes)			
Dielectric Thickness	Prepreg min 2 sheets, .0035" min for rigid dielectric materials; .0015" min for flexible dielectric.	3.7.8.1, 3.7.8, 3.7.8.2	90µm min dielectric thickness (spacing) unless otherwise specified in procurement documentation			3.7.15

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Dielectric Withstand Voltage	Certification: 500 Vdc for 60 sec	3.8.2, 4.8.6.2.1, 4.8.6.2.2	See Table 3-12; the dielectric withstanding voltage test shall be performed in accordance with IPC-TM-650, Method 2.5.7 No Reqt Class 1; 500VDC 30 sec Class 2; 1000VDC 30 sec Class 3			3.9.1
Dimensional Requirements	As specified herein and on the drawing.	3.5.1	As specified in procurement documentation			3.4
Edge Board Contact, Junction of Gold Plate to Solder Finish	No Requirement exists. Documents does not cover this topic		Copper: 2.5mm	Copper: 1.25mm	Copper: 0.8mm	3.3.7
			Gold: 2.5mm	Gold: 1.25mm	Gold: 0.8mm	
Edge Connector Lands	No Requirement exists. Documents does not cover this topic		No cuts or scratches that expose nickel or copper; Pits, dents, or depressions accept if not exceed 0.15mm in longest dimension with no more than 3 per land, and not appear in > 30% of lands			3.5.3.3
Edges, Flexible Section	Trimmed edges shall be free of burrs, nicks, tears, or delamination. Discoloration or resin recession along the trimmed edges is allowed following surface solderability and thermal stress tests providing it does not violate drawing edge spacing requirements and does not exceed the thickness of the adhesive material in the bonding area.	3.4.1.1, 4.8.2.1	Free of burrs, nicks, delamination, or tears in excess of that allowed in the procurement documentation (except if a result of tie-in tabs to facilitate circuit removal)			3.3.1.2
Edges, Ridged Section	Burrs, nicks, and halloing along the edges of rigid boards shall be acceptable provided the penetration is less than 0.10 inch and does not reduce the edge spacing 50% of the drawing edge spacing requirements.	3.4.1.2, 4.8.2.1	Accept if penetration not > 50% of distance from edge to nearest conductor or 2.5 mm, whichever is less			3.3.1.1
Environmental		3.8				3.10
Etchback (Type 3 & Type 4 Only)	Shall be free of resin smear. .0001" min (.003mm); .003" max (.08mm); .0005" preferred; shadowing is permitted on one side	3.7.5, 3.7.5.1, 4.8.5.5	Between 0.003 mm (copper exposed) and 0.08 mm (maximum material removed) Shadowing is permitted on one side			3.7.5, 3.7.6
Final Finish Coverage	Thickness is defined with no allowance for isolated exposure	3.7.2	Exposed copper on area not to be soldered allowed up to 5% (Class 1 & 2)		Exposed copper on area not to be soldered allowed up to 1% (Class 3)	3.5.3.6
			Shall meet requirements of J-STD-003			
Flexible Endurance	Cert: The coupon shall pass electrical test after 100,000 cycles using a .250 inch dia bending mandrel with no evidence of degradation or rejectable delamination.	3.6.6, 3.6.6.1, 4.8.4.6	Definition of number of cycles, bend radius, etc. are as specified in appropriate document/drawing, according to IPC-TM-650, Method 2.4.3			3.6.2

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
	Prod: The coupon shall pass electrical test after 100,000 bending cycles with no evidence of degradation or rejectable delamination. More cycles can be specified on the drawing. Types 1 & 2 shall have a bend radius 12 x the thickness reduced to the nearest 1/8 inch, Types 3,4, & 5 shall be 24 x the thickness reduced to the nearest 1/8 inch. The radius cannot be less than 1/8 inch.	3.6.6, 3.6.6.2, 4.8.4.6				
Foreign Inclusions	Measling & crazing: translucent, 0.031" max size, 25% max bridge between conductors, does not reduce spacing below minimum reqmt, does not propagate with stress testing.	3.4.3, 4.8.2.3	Translucent particles accept; others only if distance to nearest conductor is > 0.125mm			3.3.2.3
Fungus Resistance	No Requirement exists. Documents does not cover this topic		No fungus growth according to IPC-TM-650, Method 2.6.1			3.10.5
Haloing	Acceptable, providing it meets following Fiber not cut, disturbed, or exposed No bridging (weave texture may) Dielectric spacing>min rqmts	3.4.2, 4.8.2.2	Does not penetrate more than 2.5mm or 50% of distance to closest conductor, whichever is less.			3.3.2.1
Hole Size and Hole Pattern Accuracy	As specified on the drawing.	3.5.2, 4.8.3.1	As specified in procurement documentation			3.4.1
Impedance Testing	No Requirement exists. Documents does not cover this topic		As specified in procurement documentation; TDR used for electrical testing, but for large impedance tolerances (±10%), mechanical measurements from a microsection utilizing a special test coupon			3.11.2
Insulation Resistance (As Received)	Insulation resistance shall be greater than 100 megohms. Min 500 megohms between conductors for 60 sec.	3.8.3.3, 4.8.6.3.3, 3.8.1, 4.8.6.1	As received: Maintain electrical function (Class 1)	As received: 500 megohms (Class 2 & 3)		3.9.4
			After exposure to moisture: Maintain electrical function (Class 1)	After exposure to moisture: 100 megohms (Class 2)	After exposure to moisture: 500 megohms (Class 3)	
Ionic (Resistivity of Solvent Extract)	Shall be free of ionic and other contamination on final product and beneath solder mask coatings. Resistivity shall not be less than 2 x 10^6 ohm-cm.	3.8.5, 3.8.5.1, 4.8.6.5	Testing in accordance to IPC-TM-650, Method 2.3.25, with contamination level of < 1.56µg/cm² of sodium chloride			3.10.3.1
Isolation (Circuit Shorts)	Insulation resistance shall be greater than 100 megohms	3.8.3.3, 4.8.6.3.3	Isolation resistance between conductors shall meet values established in IPC-ET-652; 200volt min for manual testing for at least five seconds; for automated tests, if min voltage not specified - 40 volts min			3.9.2.2

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Laminate Integrity (Flexible)	Cover layers shall be adhesive coated dielectric. IPC-FC-241Class 3, with a base dielectric thickness of 0.001 inch min. plus sufficient adhesive to get a 0.0015 in. min dielectric thickness. Insulation material, IPC-FC-231 Class 3, 0.001 inch thick minimum. IPC-FC-232 Class 3, Adhesive coated, 0.0005 inch thick minimum. Adhesive films, IPC-FC-233, Class 3	3.3, 3.3.3, 3.3.4, 3.3.5, 3.3.7	No laminate voids in Zone B (see Fig 3-11) in excess of 0.50 mm			3.7.3
Laminate Integrity (Rigid)	MIL-P-13949 GF or GI. When stiffener required, must be specified on the drawing per MIL-STD-2118 using materials specified herein. Peel strength shall be 3 lbs./inch of width minimum.	3.3, 3.3.1, 3.3.2, 3.3.8	See section 3.7.4 and Figure 3-11			3.7.4
Lifted Lands	No lifted lands allowed on the microsection specimens. 50% of the pad shall be bonded for each side of the hole and the pad may be lifted no more than .001" after thermal stress rework simulation, or bond strength tests.	3.7.10, 4.8.5.10, 3.7.13, 4.8.5.13	No lifted lands on finished circuits or as-received coupons. Lifted lands allowed after thermal stress			3.3.8, 3.7.8, Table 3-8
Marking	Per MIL-STD-130 and master drawing, mark the date, Manufacturer's code, and traceability designation for boards and coupons. Mark with etched copper, ink, or polyimide labels. Marking shall not violate dielectric spacing, shall be compatible with materials and parts, and shall remain legible after all tests.	3.4.4	Conductive marking must be compatible with materials, and not reduce electrical spacing requirements. Allowable marking includes etched copper, ink, paint, laser, or label			3.3.4
Material	Per master drawing	3.3	Per Procurement documentation			3.2
Measling and Crazing	Translucent, 0.031" max size, 25% max bridge between conductors, does not reduce spacing below minimum reqmt, does not propagate with stress testing.	3.4.3, 4.8.23	Measling and crazing shall be acceptable			3.3.2.2
Metal Cores	As specified on the drawing plus Aluminum cores per QQ-A-250, Copper cores per QQ-C-576, adhesive and dielectric as specified herein.	3.3.15	Wicking, radial cracks, lateral spacing, or voids in the hole-fill insulation material shall not reduce electrical spacing between adjacent conductive surfaces to < 0.100mm			3.7.14
Minimum Layer/Copper Foil Thickness	No minimum specified	3.7.4	If not specified in procurement documentation, see Table 3-10			3.7.12
Minimum Surface Conductor Thickness	No minimum specified	3.7.4	If not specified in procurement documentation, see Table 3-11			3.7.13

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Moisture and Insulation Resistance	Min 500 megohms between conductors for 60 sec	3.8.1, 4.8.6.1	No measling, blistering or delamination in excess of that allowed in 3.3.2; insulation resistance meet requirements of Table 3-13; moisture & insulation resistance testing according to IPC-TM-650			3.10.1
Negative Etchback	.003" max allowed	3.7.5.2, 3.7.12	Not to exceed 25µm if etchback specified on procurement documentation	Not to exceed 25µm if etchback specified on procurement documentation	Not to exceed 13µm if etchback specified on procurement documentation	3.7.7
Nicks and Pinholes in Ground or Voltage Planes	No Requirement exists. Documents does not cover this topic		Maximum size 1.5mm (Class 1)	Maximum size 1.0mm (Class 2 & 3)		3.5.3.1
Nonwetting	No Requirement exists. Documents does not cover this topic		For tin, tin/lead reflowed, or solder coated surfaces, only allowed outside minimum solderable area or annular ring requirement			3.5.3.5
Organic Contamination	No Requirement exists. Documents does not cover this topic		Tested according to IPC-TM-650, Method 2.3.38 or 2.3.39, w/ no positive id of organic contamination			3.10.4
Outgassing	No Requirement exists. Documents does not cover this topic		Testing in accordance to procurement documentation; not resulting in a weight loss of more than 0.1%			3.11.1
Pink Ring	No Requirement exists. Documents does not cover this topic		Acceptable			3.3.2.8
Plating Adhesion	No plating removed by tape test except for overhang as allowed herein.	3.6.2, 4.8.4.2	No portion of protective plating or conductor pattern foil shall be removed. Testing in accordance with IPC-TM-650, Method 2.4.1			3.3.6
Plating/Coating Thickness	.0003 min at surface; .0001 min inside the hole	3.7.2, 4.8.5.2	Shall meet requirements of Table 3-1 or as specified in procurement documentation, isolated areas of reduced copper thickness shall be measured and evaluated to the copper plating void rejection criteria specified in 3.3.3			3.7.11
Plating and Coating Voids in the Hole (Visual)	No more than 3 voids allowed. The combined length of the voids cannot exceed 5% of the hole wall length or the area exceed 10% of the total barrel surface area. No voids are allowed at conductor interfaces.	3.7.3, 4.8.1, 4.8.1.2	Copper: 3 voids per hole in < 10% of holes	Copper: 1 void per hole in < 5% of holes	Copper: none	3.3.3
			Finish Coating: 5 voids per hole in < 15% of holes	Finish Coating: 3 voids per hole in < 5% of holes	Finished Coating: 1 void per hole in < 5% of holes	
Plating Integrity	Three holes to be examined for hole wall integrity such as nailheading, plating thickness, fiber protrusions, plating folds, & etc.	3.7.1, 4.8.5.1, 3.7.2, 3.7.3	No separation of layers (except as noted in Table 3-8)			3.7.8
			Areas of contamination or inclusions not to exceed 5% of each side of the interconnection or occur in the interface of the copper cladding on the core and the copper plating in the hole wall			

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Plating Voids (Microsection)	No more than 3 voids allowed. The combined length of the voids cannot exceed 5% of the hole wall length or the area exceed 10% of the total barrel surface area. No voids are allowed at conductor interfaces.	3.7.3, 4.8.1, 4.8.1.2	Three voids allowed per hole. Voids in the same plane are not allowed. No void shall be longer than 5% of flexible printed wiring thickness. No circumferential voids are allowed. (Class 1)	No more than 1 void per test specimen, regardless of length or size (Class 2 & 3)		3.7.9
Repair	No repair is allowed.	3.9	As agreed upon by user and supplier			3.11.3
Resin Fill of Blind and Buried Vias	Heat sinking plane hole fill insulation material: As specified on the drawing. No requirement for modern blind or buried vias	3.3.15.1	No fill requirement for blind and buried vias			3.7.16
Rework	No Requirement exists. Documents does not cover this topic		Allowable if does not affect functional integrity of board			3.11.5
Scratches, Dents, and Tool Marks	Acceptable, providing it meets following Fiber not cut, disturbed, or exposed No bridging (weave texture may) Dielectric spacing>min rqmts	3.4.2, 4.8.2.2	Not bridge conductors, expose fibers > allowed in 3.3.2.3 and 3.3.2.4, and do not reduce dielectric spacing below minimum			3.3.2.5
Smear Removal (Type 3 & Type 4 Only)	Etchback: .0001" min; .003" max; .0005" preferred; shadowing is permitted on one side	3.7.5.1, 4.8.5.5	Shall be sufficient to completely remove resin from surface of the conductor interface (see Fig 3-13)			3.7.6
Solder Wicking/Plating Migration	No Requirement exists. Documents does not cover this topic		As agreed upon between user and supplier	0.5mm maximum	0.3mm maximum	3.3.2.11
Solderability	Conforms to IPC-S-804	3.4.6, 4.8.2.6, 3.7.14, 4.8.5.14	Solderability testing and accelerated aging will be in accordance to J-STD-003			3.3.5
Solderable Annular Ring (External)	External: An Isolated 20% reduction due to pits, dents, nicks, pinholes, or splay is acceptable Non-supported: .015" min, or less if the land is anchored by spurs or is elongated. Plated-through hole: Type 2 and external type 3 & 4 shall have a .005" min annular ring. Internal layers of type 3 & 4 shall have a .002 " min annular ring.	3.5.7, 3.5.7.1, 3.5.7.2, 3.5.9.3	Meet requirements of 3.4.3			3.4.3.1
Stiffener	When required must be specified on the drawing per MIL-STD-2118 using materials specified herein. Peel strength shall be 3 lbs./inch of width minimum.	3.3.8, 4.8.4.7	Requirements agreed upon between user and supplier			3.3.2.12
Stiffener Access Hole	No Requirement exists. Documents does not cover this topic		Shall not reduce external annular ring requirements below that specified in 3.4.3			3.4.3.2
Surface Microvoids	No Requirement exists. Documents does not cover this topic		Not exceed 0.8mm in longest dimension, bridge conductors, nor exceed 5% of printed area			3.3.2.6

Appendix 1
MIL-P-50884C vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884C Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Surface Mount Lands	No Requirement exists. Documents does not cover this topic		Defects along edge of land not > 30%; internal defects not > 20% (Class 1)	Defects along edge of land not > 20%; internal defects not > 10% (Class 2 & 3)		3.5.3.2
Thermal Shock	A circuitry test shall be passed after thermal shock per MIL-STD-202 method 107 test condition B-3 for 100 thermal cycles (-65 to +125 C) with 2 minute transition time between extremes.	3.8.4, 4.8.6.4	Testing/evaluation according to IPC-TM-650, Method 2.6.7.2, with temp range between -65°C & 125°C			3.10.2
Thermal Stress Testing	Type I: No plating or conductor cracks, separation, lifted lands, blistering or delamination in excess of that allowed in 3.7.13 or 3.4.2. Type II, III, IV: After a 10 sec. Solder float the hole shall show no plating or conductor cracks. Blistering, delamination, voids, and measling (per IPC-R-600 class 3 allowances) are allowed per the requirements herein.	3.7.12, 3.7.12.1, 3.7.12.2, 4.8.2.7	Specimens conditioned by baking at 120°C-150°C for six hours, depending on thickness and according to IPC-TM-650, Method 2.6.8. After microsectioning, plated-through holes shall be examined for foil and plating at 100X ± 5%. Referee examinations made at 200X ± 5%.			3.7.1
Transition Zone, Rigid Area to Flexible Area	No Requirement exists. Documents does not cover this topic		Imperfections in excess of that allowed shall be agreed upon between the fabricator and user, or as so stated on the procurement documentation.			3.3.1.3
Visual	Flex: Trimmed edges shall be free of burrs, nicks, tears, or delamination. Discoloration or resin recession along the trimmed edges is allowed following surface solderability and thermal stress tests providing it does not violate drawing edge spacing requirements and does not exceed the thickness of the adhesive material in the bonding area. Rigid: Burrs, nicks, and halloing along the edges of rigid boards shall be acceptable provided the penetration is less than 0.10 inch and does not reduce the edge spacing 50% of the drawing edge spacing requirements.	3.4.1.1, 3.4.1.2, 4.8.2	Finished product shall be examined, be of uniform quality, and conform to 3.3.1 through 3.3.9			3.3
Weave Exposure		3.4.2, 4.8.2.2	Acceptable if does not reduce conductor spacing below minimum			3.3.2.4
Workmanship	Shall be free of contaminants and defects per this spec. There shall be no whiskers of solder or plating on the surface of flex or rigid-flex circuits.	3.4.5, 4.8.2.5	Shall be free of defects and of uniform quality - no visual of dirt, foreign matter, oil, fingerprints			3.3.9

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Annular Ring (External)	The minimum external annular ring shall be as specified (see A.3.1.1). Unless otherwise specified, the external annular ring may have, in isolated areas, a 20 percent reduction of the minimum external annular ring specified (see A.3.1.1), due to defects such as pits, dents, nicks, and pinholes.	A3.5.2.1	Plated through holes: 180° breakout	Plated through holes: 90° breakout Conductor junction not < 50µm	Plated through holes: Min. external ring not < 50µm	3.4.3
			Unsupported holes: No breakout	Unsupported holes: No breakout	Unsupported holes: Min. annular ring not < 150µm	
Annular Ring (Internal)	The minimum annular ring for functional internal lands on types 3 and 4 printed wiring boards shall be as specified (see A.3.1.1).	A.3.6.1	Breakout allowed per Fig 3-5	Hole to pad tangency	0.025mm	3.7.10
Annular Ring and Breakout (Internal)	NONE		Microsection to verify correlation and a calibration standard made for probing technique			3.4.2
Bending Flexibility	As specified. Number of fold cycles for qualification shall be 25 cycles in both directions.	A3.7.4.4 through A3.7.4.4.2	As specified in appropriate document/drawing			3.6.1
Bond Strength (Stiffener)			Peel strength between the flexible printed wiring and the stiffener > 1.4kg per 25mm			3.6.4
Bond Strength (Unsupported Lands)	After undergoing the test specified in 4.8.4.6.1, the unsupported land shall withstand 5 pounds (2.27 Kg) pull or 500 lb/in (3.4 MPa), whichever is less.	A3.7.4.6.1	As per IPC-TM-650, Method 2.4.20, unsupported land shall withstand 1.86kg pull or 35kg/cm², whichever is less, after subjection to five cycles of soldering and unsoldering			3.6.3
Bow & Twist (Individual Rigid or Stiffener Portion Only)	When tested as specified in A.4.8.4.1, the maximum allowable bow and twist for stiffener sections shall be as specified (see A.3.1.1).	A3.7.4.1	Surface applications: 0.75% bow & twist (or determined by user and supplier)			3.4.4
			All other applications: 1.5% bow & twist (or determined by user and supplier)			
Circuit Repair	When inspected in accordance with A.4.8.1, printed wiring boards shall not reveal any evidence of repair.	A.3.10	No more than two repairs for each 0.09m²; no impedance or min electrical spacing req violated			3.11.4
Circuitry			Testing conducted in accordance with IPC-ET-652			3.9.2

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
	Continuity The circuit continuity test shall be in accordance with A.4.8.5.1. For qualification inspection there shall be no open circuits whose resistance exceeds 5 ohms. For production testing, there shall be no open circuit whose resistance exceeds 10 ohms. For referee purposes, 0.5 ohm maximum per inch of circuit length shall apply.	A.3.7.5.1	**Continuity** Flexible printed wiring and qualification testing of flexible printed wiring **shall** be tested in accordance with the procedure outlined below. There **shall** be no circuits whose resistance exceeds the values established in IPC-ET-652. The presence of long runs of very narrow conductors or high resistance metals may increase these values. When required by the user, interconnect shorts and continuity coupon D **shall** be used for evaluation of interconnection resistance and circuit continuity. A current **shall** be passed through each conductor or group of interconnected conductors by applying electrodes on the terminals at each end of the conductor or group of conductors. The current passing through the conductors **shall** not exceed that specified in IPC-2221 for the smallest conductor in the circuit. For qualification, the test current **shall** not exceed one ampere. Flexible printed wiring with designed resistive patterns **shall** meet the resistance requirements specified on the procurement documentation.			**3.9.2.1**
	Circuit shorts When tested as specified in A.4.8.5.2, the resistance between mutually isolated conductors shall be greater than 2 megohms.	A.3.7.5.2	**Isolation (Circuit Shorts)** Flexible printed wiring **shall** be tested in accordance with the following procedure. The isolation resistance between conductors **shall** meet the values established in IPC-ET-652. The voltage applied between networks must be high enough to provide sufficient current resolution for the measurement. At the same time, it must be low enough to prevent arc-over between adjacent networks, which could induce defects within the product. For manual testing, the voltage **shall** be 200 volts minimum and **shall** be applied for a minimum of five seconds. When automated test equipment is used, the minimum applied test voltage **shall** be the maximum rated voltage of the flexible printed wiring. If the maximum is not specified, the test voltage **shall** be 40 volts minimum.			**3.9.2.2**
Circuits/Plated-Through Hole Shorts to Metal Substrates	NONE		Metal core flexible printed board will withstand 500 volts DC between circuitry/plated-through holes and metal core substrates w/o flashover or dielectric breakdown			3.9.3
Cleanliness	When printed wiring boards are tested in accordance with A.4.8.3.1, the levels of cleanliness shall be in accordance with the requirements of A.3.7.3.1.1 or A.3.7.3.1.2, as applicable.	A3.7.3.1	Type 4 & Type 5 flexibles shall be tested and evaluated in accordance with 3.10.3.1			3.10.3
Coefficient of Thermal Expansion	NONE		If have metal cores/reinforcements with a req to constrain thermal expansion in planar directions, CTE shall be within ±2 ppm/°C for CTE & temp range spec on master drawing; testing w/ strain gauge method, according to IPC-TM-650, Method 2.4.41.2 unless otherwise agreed by user and supplier			3.11.6
Color Variations in Bond Enhancement Treatment	NONE		Mottled appearance / color variation accept; Random missing areas of treatment shall not be > 10%			3.3.2.7

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Conductor Definition			Meet visual & dimension req., pattern & thickness as specified in procurement documentation			3.5
Conductor Edge Outgrowth			No outgrowth on edges of conductors that have been solder coated or tin-lead plated and fused when tested according to IPC-TM-650, Method 2.4.1			3.5.3.7
Conductor Imperfections	The conductor pattern shall contain no cracks, splits or tears. Unless otherwise specified (see A.3.1.1), any combination of edge roughness, nicks, pinholes, cuts or scratches exposing the base material shall not reduce each conductor width more than 20 percent of its minimum specified width. There shall be no occurrence of the 20 percent reductions greater than .50 inch (12.70 mm) or 10 percent of a conductor length, whichever is less.	A.3.5.2.3.1	Cross-sectional area of conductor not reduced > 30% of min value		Cross-sectional area of conductor not reduced > 20% of min value; total defect not > 10% of conductor or 13mm (whichever is less)	3.5.1
			No cracks, splits or tears			
Conductor Spacing	On procurement drawing.	A.3.5.2.2	Minimum conductor spacing may be reduced an additional 30% due to conductor edge roughness, spikes, etc.		Min. conductor spacing may be reduced < 20%	3.5.2
Conductor Surfaces						3.5.3
Conductor Thickness Reduction	Copper plating thickness (on the surface, in plated-through holes or blind/buried vias) shall be as specified (see A.3.1.1). Unless otherwise specified (see A.3.1.1), a 20 percent reduction of the specified copper plating thickness shall be acceptable. Any 20 percent thickness reduction shall be non-continuous (isolated; not more than 10 percent of the composite board thickness). Any copper plating less than 80 percent of the specified thickness shall be treated as a void.	A.3.6.8.2	Reduction of conductor thickness not > 30% of minimum		Reduction of conductor thickness not > 20% of minimum	3.5.1.2
Conductor Width Reduction	Per master drawing.	A3.5.2.3	Reduction of conductor width not > 30% of minimum		Reduction of conductor width not > 20% of minimum	3.5.1.1
Construction Imperfections	IPC-A-600	A3.5.1.3	Measling, crazing, blistering, delamination, and haloing shall be in accordance with IPC-A-600			3.3.2

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Continuity	Continuity. The circuit continuity test shall be in accordance with A.4.8.5.1. For qualification inspection there shall be no open circuits whose resistance exceeds 5 ohms. For production testing, there shall be no open circuit whose resistance exceeds 10 ohms. For referee purposes, 0.5 ohm maximum per inch of circuit length shall apply.	A.3.7.5.1	No circuits with resistance > the values in IPC-ET-652; current passed through for evaluation will not be > values in IPC-2221 for smallest conductor of circuit			3.9.2.1
Covercoat Coverage in Non-Flex Areas	NONE		Conductors not exposed where covercoat required			3.3.2.10.1
			Blistering does not bridge between conductors	Two per side, max size 0.25mm in longest dim, spacing between conductors not reduced to < 25%		
Covercoat Cure and Adhesion	**Solder resist cure and adhesion.** When tested as specified in A.4.8.4.8, the cured solder resist coating shall not exhibit tackiness, blistering, or delamination and the maximum percentage of cured solder resist lifted from the surface of the base material, conductors, and lands of the coated printed wiring board test specimen shall be in accordance with the following: a. Bare copper or base material: Maximum percentage of lifting 0 percent. b. Gold or nickel plating: Maximum percentage of lifting 5 percent. c. Tin-lead plating or solder coating: Maximum percentage of lifting 10 percent.	A.3.7.4.8	Max % loss allowed (µm) Copper (10µm) Gold or Nickel (25µm) Base Laminate (10µm) Melting Metals (50µm)	Max % loss allowed (µm) Copper (5µm) Gold or Nickel (10µm) Base Laminate (5µm) Melting Metals (25µm)	Max % loss allowed (µm) Copper (0µm) Gold or Nickel (5µm) Base Laminate (0µm) Melting Metals (10µm)	3.3.2.10.2
Covercoat Requirements	NONE		See 3.3.2.10.1 through 3.3.2.10.3			3.3.2.10
Covercoat Thickness	Conductor finish thickness (when applicable). The conductor finish plating or coating thickness shall be as specified (see A.3.1.1)(Also see A.3.5.2.4).	A.3.6.8.1	Not measured unless required by procurement documentation			3.3.2.10.3

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Coverfilm Separations	There shall be no cover lay delamination along the outer edges of the cover lay (see A.3.5.1.1). Cover lay delamination shall be acceptable providing the following conditions are met: a. At random locations away from conductors if each delamination is no larger than .01 square inch (6.45 square mm) and is not within .040 inch (1.0 mm) of the printed wiring board edge or on access hole edge. The total number of the above delaminations shall not exceed three in any 1 square inch (645 square mm) of cover lay surface area. b. Along conductor edges, the total delamination does not exceed either .02 inch (0.051mm) in width or 20 percent of the spacing between adjacent conductors, whichever is smaller.	A3.5.3.2	Uniform coverfilm, free of separations. Non-lamination good if according to 3.3.2.3, not > 2.5mm x 2.5mm, not > 3 in 25mm x 25mm space, not > 25% of spacing between conductors			3.3.2.9
Dewetting	NONE		Solder connection: 15%		Solder connection: 5%	3.5.3.4
			Conductors and planes are permitted			
Dielectric Thickness	Dielectric layer thickness. The minimum dielectric thickness separating the conductor layers of the printed wiring boards shall be as specified (see A.3.1.1).	A.3.6.3	90µm min dielectric spacing unless otherwise specified in procurement documentation			3.7.15
Dielectric Withstand Voltage	Dielectric withstanding voltage. When inspected as specified in A.4.8.5.3, there shall be no flashover, sparkover, or breakdown.	A.3.7.5.3	See Table 3-12; the dielectric withstanding voltage test shall be performed in accordance with IPC-TM-650, Method 2.5.7			3.9.1
Dimensional Requirements	As specified in text of A3.5.3.	A.3.5.1	As specified in procurement documentation			3.4
Edge Board Contact, Junction of Gold Plate to Solder Finish	When edge board contacts are part of the pattern, at least one pull must be on the contacts. Fresh tape shall be used for each pull. If overhang metal breaks off (slivers) and adheres to the tape, it is evidence of outgrowth (see A.3.7.4.2), but not a plating adhesion failure (see A.3.7.4.5).	A.4.8.4.5	Copper: 2.5mm	Copper: 1.25mm	Copper: 0.8mm	3.3.7
			Gold: 2.5mm	Gold: 1.25mm	Gold: 0.8mm	

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Edge Connector Lands	When edge board contacts are part of the pattern, at least one pull must be on the contacts. Fresh tape shall be used for each pull. If overhang metal breaks off (slivers) and adheres to the tape, it is evidence of outgrowth (see A.3.7.4.2), but not a plating adhesion failure (see A.3.7.4.5).	A.4.8.4.5	No cuts or scratches that expose nickel or copper; Pits, dents, or depressions accept if not exceed 0.15mm in longest dimension with no more than 3 per land, and not appear in > 30% of lands			3.5.3.3
Edges, Flexible Section	Defects such as burrs, nicks, tears, or delamination, along the trimmed edges of flexible sections of printed wiring boards shall be acceptable provided the penetration does not reduce the edge spacing by more than 50 percent of the edge spacing specified (see A.3.1.1). Discoloration or resin recession along the trimmed edges of the flexible sections following the surface solderability test is acceptable providing the discoloration or resin recession dimension does not exceed the thickness of the adhesive material in the bonding area (when applicable) or reduce the edge spacing below the requirements of the master drawing.	A.3.5.1.1	Free of burrs, nicks, delamination, or tears in excess of that allowed in the procurement documentation (except if a result of tie-in tabs to facilitate circuit removal)			3.3.1.2
Edges, Ridged Section	Edges of rigid sections (types 4 and 5 only). Defects such as burrs, nicks, and haloing along the edges of rigid sections of printed wiring boards shall be acceptable provided the penetration does not reduce the edge spacing by more than 50 percent of the edge spacing specified (see A.3.1.1).	A.3.5.1.2	Accept if penetration not > 50% of distance from edge to nearest conductor or 2.5 mm, whichever is less			3.3.1.1
Electrical	Magnitude of test voltage: Condition B (1,000 V dc +25 V dc, -0 V dc). Duration of application of test voltage: 30 seconds +3, -0 seconds.	A.4.8.5.3	Voltage: No requirements Time: No requirements	Voltage: 500Vdc (+15, -0) Time: 30 sec (+3, -0)	Voltage: 1000 Vdc (+25, -0) Time: 30 sec (+3, -0)	3.9
Environmental						3.10
Etchback (Type 3 & Type 4 Only)	Etchback limits. Unless otherwise specified (see A.3.1.1), the etchback shall be .0002 inch (0.005 mm) minimum and .003 inch (0.08 mm) maximum when measured at the internal copper contact area protrusion with a preferred depth of .0005 inch (.013 mm).	A.3.6.5.1.1	Between 0.003 mm (copper exposed) and 0.08 mm (maximum material removed)			3.7.5

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Final Finish Coverage	Conductor finish coverage. The conductor finish plating or coating shall completely cover the basis metal of the conductive pattern. Complete conductor coverage by solder does not apply to the vertical conductor edges. There shall be no evidence of any lifting or separation of conductor finish plating or coating from the surface of the conductive pattern. There shall be no whiskers of solder or plating on the surface of the conductive pattern. For designs using solder resist over bare conductors, it shall be acceptable to have up to .010 inch (0.25 mm) of exposed base metal at the interface between the solder resist and the basis metal conductor finish. For design requiring unfused tin-lead plating as a final conductor finish coverage, the thickness shall be as specified (see A.3.1.1 and A.3.3).	A3.5.2.4	Exposed copper on area not to be soldered allowed up to 5%		Exposed copper on area not to be soldered allowed up to 1%	3.5.3.6
			Shall meet requirements of J-STD-003			
Flexible Endurance	When tested as specified in A.4.8.4.3, printed wiring board test specimen shall be capable of withstanding the specified conditions of A.3.7.4.3.1 or A.3.7.4.3.2, as applicable, without any evidence of damage, degradation or rejectable delamination. After the test, the requirements specified in A.3.5.3.2.1, A.3.7.5.1 and A.3.7.5.2 shall be met.	A.3.7.4.3	As specified in appropriate document/drawing, according to IPC-TM-650, Method 2.4.3			3.6.2
Foreign Inclusions	Foreign inclusions. Foreign inclusions shall be permitted when they meet the following: a. The inclusion is trapped within the flexible portion of the printed board. b. The inclusion is located at least .010 inch (0.25 mm) from the nearest conductor. c. The inclusion does not reduce the spacing between conductors below the minimum conductor spacing specified (see A.3.1.1). d. The inclusions longest dimension is no greater than .032 inch (0.81 mm) in circuitry areas and has no maximum dimension in non-circuitry areas.	A.3.5.1.4.1	Translucent particles accept; others only if distance to nearest conductor is > 0.125mm			3.3.2.3
Fungus Resistance	NONE		No fungus growth according to IPC-TM-650, Method 2.6.1			3.10.5

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Haloing	Does not bridge more than 25 percent of the distance between conductors or plated-through holes.	A.3.5.1.4	Does not penetrate more than 2.5mm or 50% of distance to closest conductor, whichever is less.			3.3.2.1
Hole Size and Hole Pattern Accuracy	The accuracy of the hole pattern (size and location) on the printed wiring board shall be as specified (see A.3.1.1).	A.3.5.4	As specified in procurement documentation			3.4.1
Impedance Testing	NONE		As specified in procurement documentation; TDR used for electrical testing, but for large impedance tolerances (±10%), mechanical measurements from a microsection utilizing a special test coupon			3.11.2
Insulation Resistance (As Received)	Moisture and insulation resistance. When tested as specified in A.4.8.6.1, the printed wiring board test specimen shall have a minimum of 500 megohms of resistance between conductors. After the test, the specimen shall be inspected in accordance with A.4.8.1 and the specimen shall not exhibit blistering, measling, or delamination in excess of that allowed in A.3.5.1.3.	A.3.7.6.1	As received: Maintain electrical function	As received: 500 megohms		3.9.4
			After exposure to moisture: Maintain electrical function	After exposure to moisture: 100 megohms	After exposure to moisture: 500 megohms	
Ionic (Resistivity of Solvent Extract)	Cleanliness (by resistivity of solvent extract) (see A.3.7.3.1 and 6.5). The printed wiring board shall be inspected for cleanliness in accordance with IPC-TM-650, method 2.3.25.	A.4.8.3.1	Testing in accordance to IPC-TM-650, Method 2.3.25, with contamination level of < 1.56µg/cm² of sodium chloride			3.10.3.1
Isolation (Circuit Shorts)	A test voltage shall be applied between each net and all other nets that are adjacent to the net under test. The voltage shall be applied between nets of each layer and the electrically isolated net of each adjacent layer. For manual testing the voltage shall be 200 volts minimum and shall be applied for a minimum of 5 seconds. When automated test equipment is used, the minimum applied test voltage shall be as specified on the applicable master drawing. If a test voltage of the printed wiring board is not specified on the applicable master drawing, the test voltage shall be the maximum rated voltage of the net being tested. If no maximum rated voltage is specified, the minimum test voltage shall be 40 volts.	A.4.8.5.2	Isolation resistance between conductors shall meet values established in IPC-ET-652; 200volt min for manual testing for at least five seconds; for automated tests, if min voltage not specified - 40 volts min			3.9.2.2

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Laminate Integrity (Flexible)	Adhesive voids (for metal clad flexible base materials only). Adhesive voids that are no greater than .020 inch (0.51 mm) or 25 percent of spacing shall be acceptable. Multiple adhesive voids in the same plane between adjacent plated holes shall not have a combined length which exceeds .003 inch (0.08 mm).	A3.6.6.3	No laminate voids in Zone B (see Fig 3-11) in excess of 0.50 mm			3.7.3
Laminate Integrity (Rigid)	As received condition. Laminate voids with the longest dimension of .003 inch (0.08 mm) or less shall be acceptable. After rework simulation, thermal shock or thermal stress testing. Laminate voids are not evaluated in zone A. Laminate voids in zone B with the longest dimension of .003 inch (0.08 mm) or less shall be acceptable provided the conductor spacing is not reduced below the minimum dielectric spacing requirements, laterally or vertically, as specified (see A.3.1.1).	A3.6.6.1 A3.6.6.2	See section 3.7.4 and Figure 3-11			3.7.4
Lifted Lands	There shall be no lifted lands on the deliverable printed wiring board.	A.3.5.5	No lifted lands			3.3.8
Marking	All marking shall be able to withstand solder fluxes, cleaning solutions, and molten solder encountered in the manufacture of printed wiring boards, shall remain legible after all tests, and in no manner affect printed wiring board performance.	A3.8	Conductive marking must be compatible with materials, and not reduce electrical spacing requirements			3.3.4
Material			Manufacturer's Certification			
Measling and Crazing	When inspected as specified in A.4.8.1, there shall be no evidence of blistering, crazing, or delamination in excess of that allowed in A.3.5.	A.3.7.4.6.2	Measling and crazing shall be acceptable			3.3.2.2
Metal Cores	Wicking of plating or solder extending .010 inch (0.25 mm) into the base material shall be acceptable provided it does not reduce the conductor spacing below the minimum clearance spacing requirements specified (see A.3.1.1).	A.3.5.9	Wicking, radial cracks, lateral spacing, or voids in the hole-fill insulation material shall not reduce electrical spacing between adjacent conductive surfaces to < 0.100mm			3.7.14

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Minimum Layer/Copper Foil Thickness	NONE		If not specified in procurement documentation, see Table 3-10			3.7.12
Minimum Surface Conductor Thickness	The conductor thickness shall be as specified (see A.3.1.1). When a copper foil weight requirement is specified, a reduction in thickness up to 10 percent below the minimum allowable foil thickness specified by the applicable material specification shall be considered acceptable in order to accommodate a processing allowance for cleaning either by chemical or mechanical means.	A.3.6.2	If not specified in procurement documentation, see Table 3-11			3.7.13
Moisture and Insulation Resistance	Moisture and insulation resistance. When tested as specified in A.4.8.6.1, the printed wiring board test specimen shall have a minimum of 500 megohms of resistance between conductors. After the test, the specimen shall be inspected in accordance with A.4.8.1 and the specimen shall not exhibit blistering, measling, or delamination in excess of that allowed in A.3.5.1.3.	A.3.7.6.1	No measling, blistering or delamination in excess of that allowed in 3.3.2; insulation resistance meet requirements of Table 3-13; moisture & insulation resistance testing according to IPC-TM-650			3.10.1
Negative Etchback	Negative etchback is not acceptable when etchback is specified (see A.3.1.1).	A3.6.5.1	Not to exceed 25µm if etchback specified on procurement documentation	Not to exceed 25µm if etchback specified on procurement documentation	Not to exceed 13µm if etchback specified on procurement documentation	3.7.7
Nicks and Pinholes in Ground or Voltage Planes	NONE		Maximum size 1.5mm	Maximum size 1.0mm		3.5.3.1
Nonwetting	NONE		For tin, tin/lead reflowed, or solder coated surfaces, only allowed outside minimum solderable area or annular ring requirement			3.5.3.5
Organic Contamination	NONE		Tested according to IPC-TM-650, Method 2.3.38 or 2.3.39, w/ no positive id of organic contamination			3.10.4
Outgassing	NONE		Testing in accordance to procurement documentation; not resulting in a weight loss of more than 0.1%			3.11.1
Physical Requirements						3.6
Pink Ring	NONE		Acceptable			3.3.2.8
Plating Adhesion			No portion of protective plating or conductor pattern foil shall be removed. Testing in accordance with IPC-TM-650, Method 2.4.1			3.3.6

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Plating/Coating Thickness	When tested as specified in A.4.8.4.5, there shall be no plating particles or conductor patterns removed from the printed wiring board test specimen except for outgrowth.	A.3.7.4.5	Shall meet requirements of Table 3-1 or as specified in procurement documentation, isolated areas of reduced copper thickness shall be measured and evaluated to the copper plating void rejection criteria specified in 3.3.3			3.7.11
Plating and Coating Voids in the Hole	Copper plating voids. The copper plating in the plated-through holes shall not exhibit any void in excess of the following: a. There shall be no more than one plating void per panel, regardless of length or size. b. There shall be no plating void in excess of 5 percent of the total printed wiring board thickness. c. There shall be no plating voids evident at the interface of an internal conductive layer and plated hole wall.	A.3.6.8.2.1	Copper: 3 voids per hole in < 10% of holes	Copper: 1 void per hole in < 5% of holes	Copper: none	3.3.3
			Finish Coating: 5 voids per hole in < 15% of holes	Finish Coating: 3 voids per hole in < 5% of holes	Finished Coating: 1 void per hole in < 5% of holes	
Plating Integrity	Plating separations (see A.6.4.3). Except for along the vertical edge of the external copper foil, there shall be no separations or contamination between the hole wall conductive interfaces. Conductive interface separations along the vertical edge of the external copper foil shall be acceptable.	A.3.6.8.2.2	No separation of layers (except as noted in Table 3-8)			3.7.8
			Areas of contamination or inclusions not to exceed 5% of each side of the interconnection or occur in the interface of the copper cladding on the core and the copper plating in the hole wall			
Plating Voids	Copper plating voids. The copper plating in the plated-through holes shall not exhibit any void in excess of the following: a. There shall be no more than one plating void per panel, regardless of length or size. b. There shall be no plating void in excess of 5 percent of the total printed wiring board thickness. c. There shall be no plating voids evident at the interface of an internal conductive layer and plated hole wall.	A.3.6.8.2.1	Meet requirements established in Table 3-8	No more than 1 void per specimen, regardless of length or size		3.7.9
Repair	When inspected in accordance with A.4.8.1, printed wiring boards shall not reveal any evidence of repair.	A.3.10	As agreed upon by user and supplier			3.11.3

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Requirements for Microsectioned Coupons		A4.8.2	See table 3-8			3.7.2
Resin Fill of Blind and Buried Vias	NONE		No fill requirement			3.7.16
Rework	NONE		Does not affect functional integrity of board			3.11.5
Scratches, Dents, and Tool Marks	Surface imperfections. Surface imperfections (such as scratches, pits, dents, and weave texture) shall be acceptable providing the imperfection meets the following: a. The base material reinforcement material (woven or non-woven fiber) is not cut, disturbed, or exposed. b. The imperfection does not bridge between conductors (weave texture may bridge conductors). c. The dielectric spacing between the imperfection and conductors does not reduce conductor spacing below the specified minimum requirements (see A.3.1.1).	A.3.5.1.3	Not bridge conductors, expose fibers > allowed in 3.3.2.3 and 3.3.2.4, and do not reduce dielectric spacing below minimum			3.3.2.5
Smear Removal (Type 3 & Type 4 Only)	When etchback is not specified (see A.3.1.1), the vertical faces of the internal conductors of the plated-through hole shall be cleaned to be free of resin smear. Lateral removal of base material from the hole wall shall not exceed .001 inch (0.03 mm). When etchback is not specified (see A.3.1.1), a negative etchback of .0005 inch (0.013 mm) maximum shall be acceptable.	A.3.6.5.2	Shall be sufficient to completely remove resin from surface of the conductor interface (see Fig 3-13)			3.7.6
Solder Wicking/Plating Migration	Wicking of copper plating extending .003 inch (0.08 mm) into the base material shall be acceptable provided it does not reduce the conductor spacing below the minimum clearance spacing requirements specified (see A.3.1.1).	A.3.6.13	As agreed upon between user and supplier	0.5mm maximum	0.3mm maximum	3.3.2.11

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Solderability	Solderability testing is applicable only on printed wiring board designs that require soldering during circuit card assembly processes. Printed wiring board designs that use compliant pin technology only for component attachment do not require solderability testing. Printed wiring board designs that use surface mount components only shall be tested for surface solderability, not hole solderability. A.3.7.4.7.1 Hole solderability. After undergoing the test specified in A.4.8.4.7.1, the printed wiring board test specimen shall conform to the criteria specified in J-STD-003 class 3 or appendix E, as applicable. A.3.7.4.7.2 Surface solderability. After undergoing the test specified in A.4.8.4.7.2, the printed wiring board test specimen shall conform to the criteria specified in J-STD-003 class 3 or appendix E, as applicable.	A.3.7.4.7	Solderability testing and accelerated aging will be in accordance to J-STD-003			3.3.5
Solderable Annular Ring (External)	The minimum external annular ring shall be as specified (see A.3.1.1). Unless otherwise specified, the external annular ring may have, in isolated areas, a 20 percent reduction of the minimum external annular ring specified (see A.3.1.1), due to defects such as pits, dents, nicks, and pinholes.	A.3.5.2.1	Meet requirements of 3.4.3			3.4.3.1
Special			As specified in procurement documentation			3.11
Stiffener	Complete bonding of the stiffener to the flexible portion of the printed wiring board is not required (see A.6.9).	A.3.5.8	Requirements agreed upon between user and supplier			3.3.2.12
Stiffener Access Hole	Stiffener access hole registration shall be such that the size or diameter of the access hole shall not reduce the component land area or minimum annular ring below the limits specified (see A.3.5.2.1).	A.3.5.8.1	Shall not reduce external annular ring requirements below that specified in 3.4.3			3.4.3.2
Structural Integrity	NONE		Shall meet structural integrity requirements for thermally stressed (after solder float) evaluation coupons specified in 3.7.2			3.7
Surface Microvoids	NONE		Not exceed 0.8mm in longest dimension, bridge conductors, nor exceed 5% of printed area			3.3.2.6

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Surface Mount Lands	The printed wiring board test specimens shall be inspected in accordance with J-STD-003 class 3 or appendix E.	A.4.8.4.7.2	Defects along edge of land not > 30%; internal defects not > 20%	Defects along edge of land not > 20%; internal defects not > 10%		3.5.3.2
Thermal Shock	While undergoing the test specified in A.4.8.6.2, a resistance change of 10 percent or more between the first and last high temperature measurements shall be considered a reject. After the test, the printed wiring board test specimens shall meet the following requirements: a. External visual and dimensional inspection (all types): When inspected as specified in A.4.8.1, there shall be no evidence of plating cracks, blistering, crazing, or delamination in excess of that allowed in A.3.5.1.3. b. Internal visual and dimensional inspection (types 3 and 4): When the printed wiring board test specimen is microsectioned and inspected in accordance with 4.8.2, the requirements specified in A.3.6 shall be met.	A.3.7.6.2	Testing/evaluation according to IPC-TM-650, Method 2.6.7.2, with temp range between -65°C & 125°C			3.10.2
Thermal Stress Testing	Types 1 and 5. After undergoing the test specified in A.4.8.4.10, the printed wiring board test specimen shall be inspected in accordance with A.4.8.1 and shall not exhibit any cracking or separation of plating and conductors, blistering or delamination shall not exceed the limits allowed in A.3.5.1.3 and lands shall not lift in excess of that allowed in A.3.5.5. Types 2, 3 and 4. After undergoing the test specified in A.4.8.4.10, the printed wiring board test specimen shall be examined in accordance with A.4.8.1 and shall exhibit no blistering or delamination in excess of that allowed in A.3.5.1.3. After meeting the visual and dimensional requirements of A.3.5, the printed wiring board test specimen shall be microsectioned and inspected in accordance with A.4.8.2 and shall meet the requirements of A.3.6.	A.3.7.4.10	Specimens conditioned by baking at 120°C-150°C for six hours, depending on thickness and according to IPC-TM-650, Method 2.6.8. After microsectioning, plated-through holes shall be examined for foil and plating at 100X ± 5%. Referee examinations made at 200X ± 5%.			3.7.1
Transition Zone, Rigid Area to Flexible Area	NONE		Imperfections in excess of that allowed shall be agreed upon between the fabricator and user, or as so stated on the procurement documentation.			3.3.1.3

Appendix 2
MIL-P-50884D vs. IPC-6013 and Amendment 1

Characteristic	MIL-P-50884D Requirement	Paragraph	IPC-6013 and Amendment 1 Requirements			Requirement Paragraph
			Class 1	Class 2	Class 3	
Visual	According to all of A3.5 when using IPC-A-600.	A3.5	Finished product shall be examined, be of uniform quality, and conform to 3.3.1 through 3.3.9			3.3
Weave Exposure	Surface imperfections. Surface imperfections (such as scratches, pits, dents, and weave texture) shall be acceptable providing the imperfection meets the following: a. The base material reinforcement material (woven or non-woven fiber) is not cut, disturbed, or exposed. b. The imperfection does not bridge between conductors (weave texture may bridge conductors). c. The dielectric spacing between the imperfection and conductors does not reduce conductor spacing below the specified minimum requirements (see A.3.1.1).	A.3.5.1.3	Acceptable if does not reduce conductor spacing below minimum			3.3.2.4
Workmanship	Printed wiring boards shall be processed in such a manner as to be uniform in quality and shall be free of defects in excess of those allowed in this appendix that could affect life or serviceability.	A.3.11	Shall be free of defects and of uniform quality - no visual of dirt, foreign matter, oil, fingerprints			3.3.9

Appendix 3
Defense Logistics Agency (DLA) Response Letter

DEFENSE LOGISTICS AGENCY
DEFENSE SUPPLY CENTER, COLUMBUS
POST OFFICE BOX 3990
COLUMBUS, OH 43216-5000

IN REPLY REFER TO DSCC-VAC

July 14, 2000

Mr. David Bergman, CAE
Vice President Standards, Technology
and International Relations
IPC
2215 Sanders Road
Northbrook, IL 60062-6135

Dear Mr. Bergman,

Reference your letter of June 22, 2000 regarding the project to issue Revision D to MIL-P-50884. After a careful review of the points in your letter, we offer the following:

(a) There are 50 manufacturers still qualified and producing parts to the specification.

(b) MIL-P-50884 was inactivated for new design on February 28, 1999 with supersession to the new performance-based QML specification, MIL-PRF-31032. Use of performance-based specifications support DoD acquisition reform policies. This action was approved under the DoD acquisition reform effort.

(c) Under acquisition reform, contractors have the flexibility to use any procurement document.

(d) DSCC provides quality audits to ensure compliance to the military printed wiring board specifications.

(e) Revision D to MIL-P-50884 was undertaken to incorporate all of its amendments and streamline the document in order to reduce the administrative differences between it and MIL-PRF-55110. Even though MIL-P-50884 is inactive for new design, we have a responsibility to keep this specification current for procurements on existing DoD systems.

As a result, we believe it is necessary for us to continue our transition to a performance specification while maintaining a qualification audit program for DoD high-reliability applications. Consequently, DSCC believes that it is in the best interest of the DoD not to cancel MIL-P-50884 and proceed with the action to issue Revision D to MIL-P-50884.

Thank you for your feedback on the DoD standardization program for printed wiring boards. If you have any questions or comments, please don't hesitate to call me at 614-692-0674.

MONICA L. POELKING
Chief
Active Devices Team

Appendix 4
Guidance on Writing a Single Process Initiative (SPI) Concept Paper

1 Background

- The Secretary of Defense issued guidance in December 1995, allowing the Department of Defense (DoD) to eliminate multiple processes within contractor facilities.
- This initiative is known as the Single Process Initiative (SPI); it is sometimes referred to as the block change initiative.
- Contractors submit proposals/concept papers to reduce multiple, Government-directed business or manufacturing processes at a given site to a single process, where possible.
- The SPI program modifies all applicable Government contracts via block change procedures to ensure that the benefits are not offset by administrative expense.

2 Definition of a Concept Paper

- A concept paper is a definitive paper that describes the process the contractor proposes to adopt, the methodology for moving to that process, and a cost benefit analysis adequate to determine a rough order of magnitude of the costs and benefits resulting from the proposed change (including any impact on the cost of performance of existing contracts).

3 General

- A concept paper may involve a proposal to combine multiple processes into one process (a single process) or an improvement to an existing process (process re-engineering).
- Communication is the key to preparing a successful concept paper.
    - From the beginning contractors, customers, the Defense Contract Management Command (DCMC), and the Defense Contract Audit Agency (DCAA) should conduct open discussions to explore the viability of proposed changes.
    - Although contractors are responsible for preparing and submitting concept papers, Government representatives should encourage and assist contractors in developing the papers.
    - The Contract Administration Office (CAO) acts as the primary industry interface; the CAO proactively informs contractors about the single process approach and advises them on how to prepare and submit initial concept papers and more detailed proposals if necessary.
    - A risk assessment methodology to identify contractor candidates includes, as a minimum, an assessment of the criticality of the product base to national defense; the magnitude of Department of Defense dollars; and the potential for SPI improvement opportunities.
    - Geographical CAOs should approach contractors with the highest potential for return on investment; the approach selected should be tailored to the individual contractor and include a profile that describes potential processes for SPI involvement as well as other Acquisition Reform opportunities.
    - When appropriate, CAOs should work with prime contractors to encourage participation by subcontractors.
    - CAOs should use Management Councils to facilitate timely and constructive exchange of SPI information, and make recommendations for approval.
- Once a contractor has committed to participate in SPI, the first step is to assess areas where there is potential for adaptation of a single process.
    - There are obvious candidates for conversion to single processes when an objective assessment is made of the multiplicity of military specifications and standards and

duplicative requirements that are imposed on existing contracts by different customers for the same management and manufacturing processes.

- Based on all SPI activity as monitored by DCMC, the most frequently proposed process changes include the requirements for the quality system; configuration management; calibration standards; material review; cost data reporting; military soldering; subcontractor approval; property management; and test requirements.

- The success of SPI depends greatly upon the speed with which the block change is implemented.
  - The expeditious implementation of technically acceptable single processes can significantly decrease the costs of performance and facilitate the realization of the full benefits of the Acquisition Reform Initiatives.
  - The Under Secretary of Defense (Acquisition and Technology) established a cycle time goal of 120 days from the establishment of a concept paper to the date of the block change modification; this goal should be adhered to except where technical or cost benefit assessments cannot be adequately performed within that timeframe.
  - The four step process comprising the 120 day cycle time are: Proposal Development (30 days), Approval (60 days), Contract Modification (30 days), and Implementation.
  - CAOs should not start the 120 clock with the submission of an "idea paper;" such a paper usually contains only a brief description, an estimated rough order of magnitude cost impact, and a statement of the probability of success – it is used to present ideas to the Management Council or to gather information to prepare a concept paper.
  - Once the CAO receives a concept paper, regardless of whether the paper is acceptable or definitive, the clock begins to click.
  - The clock cannot stop or be restarted while awaiting an acceptable or definitive paper.
  - CAOs should report receipt of the concept paper as soon as it is received and use the remainder of the initial 30 day period to obtain additional data as needed.
  - Disagreements should be escalated up through the chain of command.
- To the maximum extent possible, the concept paper should be written in performance based language; it should be concise, yet definitive. There is no specified page count (generally two to five pages are common).
  - State process requirements in terms of specified results.
  - Include criteria and methods of performance measurement for verifying compliance, without stating methods and procedures for achieving the results.
  - Emphasize the outcomes rather than the mechanics of the process ("what is needed" and not "how to").
  - Allow flexibility to seek innovative solutions on how to achieve specified results (emphasize "results-oriented requirements rather than "how-to" contract requirements).
  - Avoid inappropriate application of MIL-SPECS or MIL-STDS; use commercial standards or measures of performance when available.

Appendix 4
Guidance on Writing a Single Process Initiative (SPI) Concept Paper

4 Contents of the Concept Paper

A "definitive" concept paper includes elements needed to effectively evaluate a proposed change and allow rapid judgment by the Administrative Contracting Officer (ACO). Although some of these elements may not always apply in specific situations, a definitive concept paper would generally include the following:

- Title
- Descriptive Summary
- Planned Transition Approach
- Implementation of Proposed Process
- Proposed Metrics
- Cost Benefit Analysis
- Impact on Contracts
- Assessment of Changes in Government's Involvement
- Statutory/Regulatory/Contractual Changes
- Identification of Contractor and DCMC Subject Matter Experts

Specific information to be included in these elements is provided in the Template at attachment 1.

5 Additional Guidance

- Attachment 1 (Template for Concept Paper).
- Attachment 2 (SPI Performance Based Contract Block Change Guidance, developed by the Integrated Product Team that was chartered by the Block Change Management Team).

6 Summary

- It is important to remember that a concept paper can come in many different formats and styles because it needs to be tailored to the specific process and situation prevailing at a particular location.
- The fact that some elements listed above may not be included in a particular concept paper does not necessarily make the paper inadequate; it is expected that additional information requested by the local Management Council can be supplied to the cognizant ACO during the review process.
    - The bottom line is: time is money. Do not let preconceived ideas or checklists "block" the Block Change process.

Appendix 4
Guidance on Writing a Single Process Initiative (SPI) Concept Paper

Template for Writing a Single Process Initiative (SPI) Concept Paper

Title:

- [Use a discrete subject title that concisely captures the nature of the process being proposed].

Descriptive Summary:

- [Identify the existing contractual requirement that will be replaced/modified].
- [Describe the proposed process improvement (e.g., replace Military Standards/ Specifications with commercial performance standards)].
- [Provide background information on existing process and purpose of proposed change (e.g., reduce packaging material cost and labor hours through implementation of the bulk quantity packaging process)].
- [The descriptions should be in sufficient detail so the Government can determine if a detailed cost impact proposal for current contracts will be required].

Planned Transition Approach:

- [Develop methodology to move to the proposed common process and a schedule for transition].

Implementation of Proposed Process:

- [Identify any perceived impact on quality or schedule].
- [Describe how quality and schedule will be maintained during the transition].

Proposed Metrics:

- [Identify proposed metrics to measure the effectiveness and compliance with the proposed change (e.g., Reports of Discrepancies from customers, feedback on packaging problems, and successes that have been achieved)].
- [Describe how acceptability and reliability (Technical Feasibility) of the process will be demonstrated].

Cost Benefit Analysis:

- [Present a rough order of magnitude analysis which includes current and future cost and savings (show net cost savings as there may be initial costs associated with implementation)].
- [Determine if implementation is advantageous (cost effective) to the Government.
- [Base information on empirical data].
- [Identify requirements to be deleted along with an estimated annual savings to existing contracts; if the impact on a particular contract or program is material, provide details by contract or my customer].
- [Include an estimate of annual future savings forecasted for the period covered by contractor's indirect expense rate forecast (usually five years)].
- [Break down estimated costs and savings by normal direct and indirect cost elements and identify recurring costs vice non-recurring costs and savings].
- [Will the Government recognize savings in the way of lower overhead rates to be used in pricing products in future years?].
- [Will forward pricing rate agreements be affected?].
- [If monetary costs do not exceed implementation costs, identify how change will benefit the Government (e.g., increased quality, faster deliveries, etc.)].
- [Perform analysis without requesting certified cost or pricing data].
- [Usually, the same information prepared by the contractor to obtain management approval for the proposed change will suffice].

Impact on Contracts:

- [Describe the impact (program risk) to the Government and the contractor if the proposal is approved or disapproved].
- [Identify contracts and customers impacted if the paper is approved].
- [Include all prime contract numbers if they can be identified at the time the concept paper is developed].
- [The contracts listed should include candidate Government contracts for change implementation on which the contractor is a subcontractor; identify the applicable prime contractors, the subcontract numbers, and the cognizant ACOs) and indicate that the concept paper is being

submitted to prime contractor customers for review so that "parallel processing" can be performed].

- [Explain the impact on existing contracts and an assessment of future impacts on such areas as quality, delivery schedules, performance milestones, product shipments, warranty provisions, maintenance, life cycle costs, etc.].

Assessment of Changes in Government's Involvement:

- [Include an assessment of changes required in the Government's involvement in the process (for example, will the change result in reduced Government oversight or less time spent in contract negotiations?)].

Statutory/Regulatory/Contractual Changes:

- [Explain any required statutory/regulatory/contractual changes (include specific wording to be added and identify language to be deleted)].

Identification of Contractor and DCMC Subject Matter Experts:

- [Provide names and telephone numbers of the contractor and DCMC subject matter experts who can be contacted to address technical questions regarding the proposed process change].

Appendix 5
Single Process Initiative (SPI) Performance Based Contract Block Change Guidance

This document provides guidelines for preparation of SPI proposals and contract changes in performance language per USD(A&T) Memorandum, "The Single Process Initiative – A Long Term Perspective," 3 June 1998.

Definition:

A Performance Based Contract Block Change states process requirements in terms of specified results with criteria for verifying compliance, without stating methods and procedures for achieving the results. Performance Based Block Change modifications change "how-to" contract requirements to results-oriented requirements allowing greater contractor flexibility. It may affect functional, interface, interchangeability, or other performance requirements for the desired output(s).

Acquisition Reform Principle:

An overarching goal of acquisition reform is to reduce costs, remove barriers, and promote business efficiencies between government and industry. SPI is the mechanism for implementing block changes to existing contracts. Use of Performance Based Contract Block Changes, in lieu of government-imposed specifications, standards, processes, and management systems, places increased responsibility on the contractor for meeting contract requirements. Performance-based requirements provide industry the flexibility to seek innovative solutions and supports DOD's goal of civil/military integration.

Performance Based Contract Block Change Application:
Performance Based Contract Block Change modifications should be written in performance language whenever practicable. It is the preferred approach for the contractor's proposed SPI block change(s). However, due to variations in organizations, business practices, and product requirements, it may not be feasible for every block change to be in performance terms. Performance language for a contract block change provides flexibility so that process improvements or changes can be pursued without having to negotiate additional contract changes. Performance Based Block Changes should be based on assessments of risk, adherence to overall requirements, as well as good business judgment and common sense.
When developing SPI proposals and Performance Based Contract Block Changes,
Look to apply the following:
Requirements stated in terms of results and criteria for verifying compliance.
Block changes that clearly state "what we need" and not "how to."
Technical and schedule requirements stated in terms of results.
Contractor flexibility on how to achieve specified results.
Criteria and methods of performance measurement.
Clearly defined deliverables and reporting requirements.
Appropriate use of warranties and incentives (positive or negative) tied to process and product performance.
Key characteristics, interface requirements, and performance parameters.
Flexible language that allows contractor process improvement, and use of best practices and advanced technologies.
Manageable and acceptable risk.
Look to avoid the following:
Detailed processes, work methods, or procedures defining "how" a design, manufacturing, or management requirement is to be achieved or performed.
Requirements that are not measurable or verifiable.
Language that constrains the contractor to a single approach.
Mandatory processes or management systems that restrict flexibility or innovation.
Inappropriate application of MIL-SPECS or MIL-STDS.
Adverse impact on performance and supportability (e.g., function, interface, interchangeability, reliability, maintainability).

Appendix 5
Single Process Initiative (SPI) Performance Based Contract Block Change Guidance

Additional Guidelines:
Management Councils should not apply Performance Based Contract Block Change guidelines retroactively to redo previously approved block changes unless proposed by the contractor. Performance based standards, interface standards, and standard practices (defined in the DoD Index of Specifications and Standards (DODISS), may be used when appropriate, in Performance Based Contract Block Changes. Also, a Performance Based Block Change does not restrict use of processes directed by DoD 5000.1, DoD 5000.2-R, FAR, DFARS, or public law.