SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS7108

Issued 1995-03

Submitted for recognition as an American National Standard

NATIONAL AEROSPACE AND DEFENSE CONTRACTORS ACCREDITATION PROGRAM REQUIREMENTS FOR CHEMICAL PROCESSING

1. SCOPE

This Aerospace Standard (AS) establishes the requirements for suppliers of Chemical Processing Services to be accredited by the National Aerospace and Defense Contractors Accreditation Program (NADCAP). NADCAP accreditation is granted in accordance with SAE AS7003 after demonstrating compliance with the requirements herein. These requirements may be supplemented by additional requirements specified by NADCAP Chemical Processes Task Group. Using the audit checklist (AC7108) will ensure that accredited Chemical Process suppliers meet all of the requirements in this standard and all applicable supplementary standards.

2. REFERENCES

2.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS7001	National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Program Description
AS7002	National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Rules for Implementation
AS7003	National Aerospace and Defense Contractors Accreditation Program (NADCAP) - Program Operation
AMS 2750	Pyrometry
ARP1820	Chord Method of Evaluating Surface Microstructural Characteristics

2.2 PRI Publications

Available from Performance Review Institute, 163 Thornhill Road, Warrendale, PA 15086-7527.

AC7101/6 NADCAP - Materials Test Laboratories - Corrosion and Oxidation
AC7108 NADCAP - Audit Criteria for Chemical Processing

2.3 U. S. Government Publications

Available from DODSSP Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

FED-STD-141	Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing
MIL-STD-202	Test Method for Electronic and Electrical Component Parts
MIL-STD-865	Selective (Brush Plating), Electrodeposition
MIL-STD-45662	Calibration Systems Requirements

2.4 ASTM Publications

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 117	Test Method for Salt Spray (Fog) Testing
ASTM B 571	Test Methods for Adhesion of Metallic Coatings
ASTM B 678	Test Method for Solderability of Metallic-Coated Products
ASTM D 1748	Test Method for Rust Protection by Metal Preservative in the Humidity Cabinet
ASTM D 4060	Test Method for Abrasion Resistance of Organic Coatings
ASTM E 384	Test Method for Microhardness of Materials
ASTM F 519	Test Method for Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals

3. GENERAL QUALITY SYSTEM

The NADCAP Chemical Processes Task Group recognizes SAE AS7004, SAE AS7006, and SAE AS7107 as equivalent to Section 3 of this document with exceptions as noted in the NADCAP Auditor Handbook.

3.1 Quality Policy

3.1.1 A documented, comprehensive quality policy shall be in place.

3.1.2 There shall be a quality manual which ensures the implementation of the quality policy.

3.1.3 The quality policy shall be reviewed at least annually by the president or other top location managers. Corrective actions shall be taken to correct any nonconformances.

3.1.4 The supplier shall have a quality policy which promotes continuous improvement.

3.1.5 There shall be a policy that specifies continuous communications between management and employees including solicitation, review, and acknowledgement of employee suggestions and comments.

3.2 Organization

3.2.1 A formal organizational chart shall exist that defines the organizations within the company, the responsibility and authority of the quality organization, and its relationship with other organizations within the company.

3.2.2 The company shall have a functioning quality organization without longstanding vacancies.

3.3 Contract Review

3.3.1 Policies shall exist for review of requests for quotations, purchase orders, and contracts by all affected organizations.

3.3.2 Records shall support that requests for quotations, purchase orders, and contracts are accomplished in accordance with customer requirements.

3.3.3 The review shall assure that all quality and technical requirements are defined and documented.

3.4 Purchasing - Source Selection

3.4.1 There shall be a policy that provides for the selection of suppliers on the basis of their ability to meet requirements.

3.4.2 The recorded history, in-plant and/or source inspection and testing, of supplier performance and supplier corrective action data shall be included in supplier selection decisions.

3.4.3 The supplier's purchasing policy shall reserve the right to verify, at source or delivery, the quality of purchased products and services.

3.4.4 Documents shall support that the verifications are performed in accordance with policy.

3.4.5 The results of the verifications shall be used in a program to preclude nonconforming purchases.

3.4.6 All sources shall be qualified according to contract requirements (i.e., NADCAP or customer accredited) or if not they shall be otherwise controlled according to an internal procedure.

3.4.7 All sub-tier suppliers used shall be taken from an approved supplier list.

3.4.8 All areas shall have access to approved supplier lists and they shall use them.

3.5 Product Identification and Traceability

3.5.1 Policies shall provide for identification of parts (traceable to the applicable drawings, specifications, or other documents) during all stages of processing and delivery.

3.5.2 An examination of in-process parts shall indicate conformance to the policies.

3.5.3 All age-sensitive and shelf-life materials shall be controlled in accordance with requirements.

3.6 Stamp and/or Signature Control

3.6.1 There shall be a procedure that provides for control of issuance of stamps and/or authorization of signatures.

3.6.2 Appropriate actions shall be included in the stamp/signature control procedure covering lost, mutilated, or worn stamps, reassigned stamps, and removal of stamp or signature authority.

3.6.3 A record shall be maintained showing stamps issued or authorized signature, date of issue, and to whom issued.

3.6.4 Procedures shall be followed.

3.7 Control of Nonconforming Parts

3.7.1 There shall be procedures to control identification, documentation, evaluation, segregation, and disposition of nonconforming product including notification of the internal organizations and the customer.

3.7.2 Documents shall support that nonconforming materials are handled in accordance with the procedure.

3.7.3 There shall be a policy to ensure that customers are informed of discrepancies affecting hardware (e.g., out-of-tolerance conditions).

3.7.4 There shall be a procedure for timely notification to customer of nonconforming material that has been shipped.

3.7.5 The supplier shall have part/process specific rework/repair procedures which include reinspection.

3.7.6 Procedures shall provide for traceability of reworked/repaired parts to specific lots or serial numbers.

3.7.7 The supplier's quality or engineering function shall review and approve rework/repair procedures.

3.7.8 The rework/repair procedure shall be approved by the customer when required.

3.7.9 Reworked/repaired product shall be reinspected in accordance with procedures.

3.7.10 Procedures shall be followed.

3.8 Corrective Action

3.8.1 Procedures shall be established and maintained requiring the determination of the cause of nonconformances, internal and external, and the corrective action needed to prevent recurrence.

3.8.2 The supplier shall periodically analyze the history of nonconforming parts, the cause of each nonconformance, and the corrective actions to determine that the goal of reducing the frequency of the nonconformance is being achieved.

3.8.3 Procedures shall be followed.

3.9 Delivery and Service

3.9.1 There shall be a procedure to provide for the protection of the parts after final inspection and during shipment that includes customer requirements.

3.9.2 Shipping document shall conform to the requirements of the purchase order or contract.

3.9.3 Procedures shall be followed.

3.10 Statistical Methods - Process Integrity

For the purpose of this Standard, the requirements contained in 3.10 shall be deemed an acceptable alternative until SPC requirements in Appendix A can be instituted.

If the supplier does not comply with the SPC requirements contained in Appendix A, the requirements contained in 3.10.1 through 3.10.7 shall apply.

3.10.1 The supplier shall have a plan to implement SPC.

3.10.2 The quality system shall provide for the effective use of a sampling inspection plan.

3.10.3 There shall be an approved procedures for sampling (material, product, service, and in-process) consistent with customer requirements.

3.10.4 The supplier shall utilize first piece/lot inspection to ensure quality.

3.10.5 Samples shall be taken as scheduled, documented, and traceable to their source (i.e., lot, date, location).

3.10.6 Personnel shall be trained in procedures and techniques for using sampling plans.

3.10.7 If used, supplier-developed sampling plans shall be available for review and approved by the customer when required by contract.

3.11 Internal Quality Audits

3.11.1 Documented audits of the quality system, processes and/or products shall be carried out by supplier personnel independent of those having direct responsibility for the work being performed.

3.11.2 Procedures shall require periodic internal audits that systematically evaluate compliance with all specifications, standards, and procedures. Audits shall be performed annually at a minimum.

3.11.3 The audits being performed/documented shall be at the required frequency.

3.11.4 The results of the internal audits shall be reviewed, acted upon by management, and followed-up.

3.11.5 Procedures shall be followed.

3.12 Training, Qualification, and Evaluation of Processing, Inspection, and Testing Personnel

3.12.1 Procedures shall require periodic evaluations to ensure that approved personnel maintain proficiency in their assigned tasks.

3.12.2 Records shall indicate that evaluations are conducted and the results reviewed with employees.

3.12.3 The results of evaluations shall be used in a program of continuous improvement of personnel.

3.12.4 Records shall indicate that training is scheduled and attended in accordance with procedure.

3.12.5 Documented definitions of the personnel functions shall exist that describe special skill categories that require training and qualification including:

a. Processing personnel
b. Testing/inspection personnel
c. Data review personnel
d. Specimen preparation personnel

3.12.6 Testing and data review personnel shall be qualified through at least one of the following:

a. Training by personnel with technical degree and/or related experience
b. Initial technical examination
c. Periodic technical examination
d. Comparison to a standard

3.12.7 Specimen preparation personnel shall be qualified through at least one of the following:

a. Training by personnel with technical degree and/or related experience
b. Periodic review of work

3.13 Job Documentation

3.13.1 Procedures shall require that documentation/travelers detailing each operation accompany each job.

3.13.2 Procedures shall require traceability from all documentation to the parts (e.g., by part number, serial number).

3.13.3 In-process documentation shall include process status, inspection status, engineering change notices, and all other relevant information.

3.13.4 Shop paper/traveler, which accompanies each job, shall contain as a minimum the following information:

a. Relevant purchase order requirements
b. Part identification, material, condition, number of parts
c. Test coupons when required
d. A step for each process performed with applicable internal process or inspection procedure numbers including as applicable:
    1) Incoming inspection
    2) Pre-process cleaning method(s)
    3) Fixturing, racking
    4) Precoat thermal treatment
    5) Masking
    6) Etch
    7) Strike/activation
    8) Plate
    9) Primer
    10) Paint/film

3.13.4 Continued

11) Post-process cleaning methods
12) Post-coating thermal treatment
13) In-process and final tests and inspections, including disposition
14) Rework
15) Shipping

e. Each step, or logical group of steps in the process flow, signed off and dated by the operator as completed

f. Specific process parameters which are controlled by the operator are recorded for the first batch of parts processed, including:

1) Masking material used
2) Estimated surface area of part
3) Temperature, time, current (as applicable) for strike/activation, plating, anodize, conversion coat, chemical milling, etching
4) Pre/post thermal treatments, racking and fixturing

3.14 Documentation Control

3.14.1 Procedures and other instructions shall be established and maintained to control all documents and data related to product quality.

3.14.2 Procedures and other instructions shall conform to a written system of revision control.

3.14.3 Documents shall be reviewed and approved by authorized personnel prior to issue, and/or marked and identified.

3.14.4 Procedures shall require that the pertinent revisions of appropriate documents are available at all locations where operations essential to the effective functioning of the quality system are performed.

3.14.5 Procedures shall require that obsolete or illegible documents are promptly removed and/or marked at all points of issue or use.

3.14.6 Changes shall be identified in the document or historically maintained; and made only through the authorized release system.

3.14.7 A master list or equivalent document control procedure shall be established to identify the current revision of internal documents in order to preclude the use of nonapplicable documents.

3.14.8 The procedures shall clearly delineate the supplier's responsibility for change control with sub-tier suppliers.

3.14.9 When customer approved frozen processes are in place, process changes shall be made only after approval by the cognizant customer organization.

3.14.10 Procedures shall be followed.

3.15 Process and Quality Planning

3.15.1 Procedures shall require review of purchase orders to assess the processor's ability to conform to requirements.

3.15.2 Repeat orders shall be reviewed for changes in requirements.

3.15.3 Procedures shall ensure that the documentation requirements are included on job orders entering the production system.

3.15.4 There shall be a procedure to specify current density, voltage, amperage, time, bath composition and concentrations, temperature, and other significant process variables as applicable.

3.15.5 Quality planning shall address removal of defective or nonconforming platings and coatings and its reapplication (rework or repair) to preclude part life degradation or nonconforming part dimensions.

3.15.6 Rework or repair quality planning shall be approved by customer's procuring, engineering, and/or quality functions or shall be permitted by engineering documents or specifications.

3.15.7 All rework or repair procedures shall provide documentation to assure unambiguous traceability to the job/parts.

3.15.8 Records shall indicate that the procedure is being followed.

3.16 Receiving Procedure

3.16.1 The processor shall verify, through customer-provided documentation, part identification, material and condition such as stress relief, hardness, shot-peening, or heat treat, carburize or nitride case hardened.

3.16.2 The system shall provide for holding and segregation of hardware pending receipt of proper material documentation.

3.16.3 The supplier shall have incoming inspection procedures identifying characteristics to be checked and methods to be used.

3.16.4 The supplier shall verify dimensional requirements in as-received condition for jobs having post-processing dimensional requirements.

3.16.4.1 Gauging shall be available.

3.16.5 Incoming material quality planning shall provide for shelf-life monitoring and control for materials as required.

3.16.6 Procedures shall be followed.

3.17 Corrosion and Handling Damage Protection

3.17.1 Procedures shall ensure handling, packaging and corrosion protection of parts.

3.17.2 Records and/or observations shall indicate that the procedure is followed.

3.18 Lot Integrity

3.18.1 Procedures shall specify how lots and sub-lots of similar parts are to be identified to preclude mixing and ensure lot integrity.

3.18.2 Travelers or other documentation, both completed and in-process, shall demonstrate that the procedures are followed.

3.19 Housekeeping

3.19.1 The company's facilities shall be clean, uncluttered, and well lighted.

3.19.2 Incompatible materials such as acids/alkalines or oxidizers/organics shall be segregated in storage.

3.19.3 Process materials shall be stored to preclude damage or degradation from heat, cold, water, atmospheric moisture, or other environmental considerations.

3.19.4 Process materials that are transferred from original manufacturer's containers shall be controlled to maintain identity and to prevent contamination or degradation.

3.19.5 Training or procedures shall address cleaning of pumps and other transfer equipment after use to preclude material contamination and operator safety.

3.20 Environmental and Safety

3.20.1 Safety equipment such as eye washes, safety showers, protective eye and faceware, and protective clothing shall be available.

3.20.1.1 Personnel shall be trained in the use of such equipment.

3.20.2 The supplier shall have a training procedure for storage, handling, and disposal of hazardous materials.

3.20.3 The supplier shall have an Environmental Compliance Plan that outlines a program to comply with applicable regulations.

3.21 Automated Processes and Recordings

3.21.1 Where automated chemical processes and/or record-keeping are used, there shall be a procedure in effect to assure the integrity of the process and records.

3.21.2 Procedures shall include a method of controlling electronic/magnetic programs such that they can not be altered without authorization.

3.21.3 There shall be a procedure to assure integrity of the process if the automation fails.

3.22 Calibration of Process and Test Equipment

3.22.1 There shall be a documented calibration program that assures calibration for the following:

a. All shop equipment used to control a process.
b. All test and inspection equipment used to accept product or control a process.

3.22.2 Calibration procedures shall be established, documented, and maintained to describe the following:

a. Details of equipment type
b. Identification number

3.22.2 Continued

c. Location
d. Frequency of checks
e. Check method
f. Acceptance criteria and action to be taken when results are unsatisfactory
g. Assurance that inspection, measuring, and test equipment is capable of the necessary accuracy, precision, and operating range.
h. Assurance that test hardware or test software that is used to verify product acceptability is subject to controls similar to those provided for inspection, measuring, and test equipment
i. Provisions for the supplier to maintain and provide a written description of the calibration system, covering measuring and test equipment, calibration intervals, sources of calibration, environmental calibration conditions and measurement standards (including a list of measurement standard sources of calibration) that are traceable to the National Institute of Standards and Technology (NIST) or other nationally recognized laboratory.
j. Control and identification of inspection, measuring, and test equipment not in current calibration, damaged, or inaccurate
k. Recall system for the mandatory recall of measurement standards and inspection measuring, and test equipment within established interval programming

3.22.3 Procedures and supporting records shall show an individual record of calibration for each item, including date of certification, next due date, results of last calibration (variable data), and out-of-tolerance conditions.

3.22.4 Environmental controls shall be used to the extent necessary including temperature, humidity, vibration, cleanliness and compensating corrections.

3.22.5 Periodic calibration intervals shall be based upon stability, purpose, and degree of usage.

3.22.6 The results of previous calibrations shall be used to adjust calibration schedules.

3.22.7 Procedures shall be adequate, and they shall require comparison with higher accuracy level standards including accuracy, stability, range sensitivity, and resolution.

3.22.8 Calibration standards shall be traceable to NIST or other recognized standards. The report or data sheet shall attest to the date, accuracy, and conditions of calibration including environmental conditions.

3.22.9 The calibration system shall provide for a gage identification method indicating, as a minimum, the date of last calibration, by whom, and the date of next calibration. There shall be recall procedures and records assuring adherence to the calibration schedule.

3.22.10 There shall be a procedure for the documented analysis of the impact of out-of-tolerance measuring and test equipment on product quality.

3.22.11 Calibration records shall reflect traceability to the device being calibrated, personnel performing calibrations, reference standards, and procedures used.

3.22.12 Documentation shall define a "significant out-of-tolerance condition". There shall be a system in place (including assignment of responsibility) to notify users and customers when this is exceeded.

3.22.13 Measuring and test equipment shall be handled, stored, and transported in a manner that does not adversely affect the calibration or condition of the equipment.

3.22.14 The supplier shall maintain a system to assure that outside calibration sources are capable of performing the required services.

3.22.15 The supplier shall have provisions to assure that subcontractors maintain a calibration system which conforms to MIL-STD-45662.

3.22.16 Procedures shall make provision for the calibration and control of inspection, measuring and test equipment that is on loan, provided by the customer, or that is employee owned.

3.22.17 Requirements for tamper resistant seals shall be identified and they shall be used as prescribed.

3.22.18 Items that are not calibrated to their full capability or which have other limitations of use shall be identified as such to preclude use for acceptance of articles.

3.22.19 Ripple shall be periodically verified for electrochemical rectifiers as part of calibration.

3.22.20 "Calibration Not Required" stickers shall be used to show that measuring devices determined not to need calibration.

3.22.21 Procedures shall be followed.

4. TEST AND INSPECTION

4.1 Specification Compliance

4.1.1 All preproduction and qualification tests shall be performed as required by specification and on file at the processing supplier.

4.1.2 Test data shall conform to specification requirements.

4.1.3 Periodic test specimens shall be prepared as hardware would be prepared if hardware is received in the condition of the test specimens.

4.1.4 All acceptance and periodic tests required by specification shall be conducted.

4.1.5 All acceptance and periodic tests shall be performed at the correct frequency.

4.1.6 All test sample configurations (number, size, material, etc.) shall conform to specification requirements.

4.1.7 A minimum of four tests shall be selected at random to verify compliance of the supplier's detailed testing procedure to the applicable testing specifications (two acceptance and two periodic). Compliance shall be demonstrated to the applicable portions of Appendix B.

4.1.8 A minimum of two tests which are conducted at an external laboratory shall be selected at random. The applicable purchase orders shall be reviewed for adequate definition of requirements (i.e., coating specification, test specification, samples submitted, sample material, disposition of material after test, etc.) The applicable certificate of test data shall demonstrate compliance to the procedure.

4.2 Documentation

4.2.1 Testing records shall be maintained such that they are traceable to each certification/test report that would enable the processing supplier to reconstruct the test samples or testing conditions and identify any incorrectly tested material.

4.2.2 There shall be a procedure that requires the reviewed test data for conformance to specification whether generated by captive or independent laboratory.

4.2.3 The procedure shall require that the review also include an examination for historical trends in the testing data and that negative or questionable trends be acted upon.

4.2.4 The function/person(s) that is authorized to perform the review shall be identified in the procedure.

4.2.5 The person identified to conduct review shall be someone other than the person responsible for conducting the tests.

4.2.6 The procedure shall require the identified person(s) to sign and date the test results as proof of review.

4.2.7 Errors in the internally generated test data shall be corrected by either line out, write correction, initial, and date; or void the data, make corrections, and retype/reprint.

4.2.8 There shall be a procedure which requires the following in the event that an error is identified in the certificate of test, test data, or testing procedure:

a. Identification of error cause
b. Implementation of corrective actions
c. Notification of affected customers
d. Retesting of correction of certification/test data

4.2.9 Procedures shall be followed.

4.3 Test Specimens Control (Except Solution Analysis)

4.3.1 Test samples shall be traceable to the material from which they are made.

4.3.2 Test samples shall be positively identified during all stages of processing and testing until disposed of (tags, bags, etc.).

4.3.3 All specimens provided for testing (internal/external lab) shall be accounted for (e.g., tested to completion/failure, or replaced).

4.3.4 There shall be documentation which provides for tracking and accountability of all test samples currently in work (processing and testing).

4.3.5 There shall be specific shop paperwork (router, etc.) which is traceable to the test samples/parts which specifies how the samples are to be processed and which tank they were processed in.

4.3.6 All operator controlled parameters associated with the processing of the test samples/parts shall be recorded on the shop paper and traceable to the specific samples.

4.3.7 Material certifications, manufacturer's labels, or the materials themselves shall be verified against the process supplier's purchase orders in order to ensure receipt of correct material.

4.4 Test Failure, Replacement Testing and Retesting (Except Solution Analysis)

4.4.1 There shall be a procedure which establishes specific criteria for replacement and retesting, including specific responsibilities for authorization.

4.4.2 Replacement tests, nonconforming tests, and retests shall be logged and cross indexed, including explanations with entries signed off by authorized personnel.

4.4.3 There shall be a procedure which addresses the following in the event of a testing failure:

a. Immediate notification of all affected customers
b. Identification of all affected hardware by customer
c. Isolation of all affected in-house hardware
d. Immediate shutdown of the affected process/process line pending resolution
e. Investigation of failure, cause, and implementation of corrective action
f. Retest performed after all corrective actions and before production is restarted

4.4.4 Replacement testing and retesting data shall be reviewed at least quarterly for trends which might indicate deterioration of test procedures or methodologies.

4.4.5 Procedures shall be followed.

4.5 Process Control Laboratory Procedures (Solution Analysis)

4.5.1 There shall be assigned responsibilities for review and approval of test results, authorization of retests, calculation of process solution additions and corrections, and the preparation and approval of test procedures.

4.5.2 These assigned responsibilities shall be performed by a degreed chemist or equivalent qualified individual, or by a technician supervised by such an individual. Their job responsibilities, job specification, and qualifications shall be documented.

4.5.3 There shall be solution control logs which contain the following information for each tank monitored:

a. Tank identification
b. Tank contents
c. Tank size (working volume) and level
d. Analysis frequency
e. Constituents to be analyzed (note major and minor)
f. Operating tolerances (temperature, constituents, pH, etc.)
g. Date sampled and analyzed
h. Analysis values
i. Additions
j. Tank dumps
k. Reanalysis after addition when out-of-shop target limits
l. Identity of individual conducting analyses, additions, reanalysis, and dumps

4.5.4 Bath conditions shall be within the ranges indicated when operating.

4.5.5 The solution control logs shall show that corrections and/or additions are made when shop target limits are exceeded.

4.5.6 Solution analyses shall be conducted on frequencies based on specification requirements, activity, stability, and size of tank.

4.5.6.1 Records shall indicate that tanks which are found out-of-target limits after two or more consecutive analyses have the analysis interval increased.

4.5.7 Procedures shall require, and documents shall show, that processing is halted on solutions which exceed technical bulletin limits until the condition is corrected and the solution reanalyzed.

4.5.8 Detailed procedures shall describe the following:

a. Solution analysis conforming to ASTM, standard laboratory, or chemical compound manufacturer's procedures
b. Sample collection which assures that the sample is representative of the bath solution and precludes sample contamination
c. Initial tank make-up and addition calculations
d. Increase or decrease of analysis frequencies based on historical analysis test data in addition to meeting minimum frequency requirements when defined by specification

4.5.9 ACS reagent grade chemicals or equivalent shall be used in chemical analyses.

4.5.10 Laboratory chemicals shall be labeled and stored properly.

4.5.11 Water of at least 500,000 ohm•cm shall be used for analysis purposes.

4.5.12 Certified, commercial-grade or better buffer solutions within shelf-life expiration date and covering the range of testing acceptance shall be used to standardize the pH meter to a procedure before use.

4.5.13 Standards with a limited shelf life shall be properly labeled to preclude usage after the expiration date.

4.5.13.1 Shelf-life disciplines shall be documented and maintained for standards susceptible to deterioration (e.g., evaporation of liquid standards, reaction with glass storage containers, photochemical reactions).

4.5.14 Titration solutions shall be standardized against appropriate documented, certified reference standards, and they shall be monitored for stability and protected against degradation.

4.5.15 ASTM Grade, Class A volumetric glassware shall be used where appropriate.

4.5.16 Laboratory housekeeping shall be maintained to assure accurate analysis and test results.

4.5.17 Procedures shall be followed.

5. PROCESS EQUIPMENT CONTROL AND MAINTENANCE

5.1 General

5.1.1 Current operating manuals or instructions shall be available to operators, maintenance personnel, and other personnel requiring the information.

5.1.2 Tanks shall labeled to include identification number, contents, and temperature ranges.

5.1.3 Tank walls shall be electrically insulated.

5.1.4 The air supply shall be clean, dry, and filtered.

5.2 Maintenance Procedures

5.2.1 Maintenance procedures shall be prepared with preventive maintenance as a goal and based on prior maintenance records.

5.2.2 Records shall indicate that maintenance has been performed in accordance with the procedure to a defined frequency.

5.2.3 Tanks and/or other equipment shall be equipped with sufficient filtration to remove contamination. Filters shall be changed at a predetermined frequency.

5.2.4 Chrome plate anodes shall be monitored periodically for activity/oxide formation (especially yellow film). Procedures shall be in place to clean as appropriate.

5.3 Process Line Equipment

5.3.1 Tanks shall be structurally sound with no evidence of leaking.

5.3.2 Tanks and work surfaces shall be maintained sufficiently free of corrosion and chemical spillage.

5.3.3 Spray and rinse tanks shall be clean, clear, free-running or monitored for contamination levels, and situated in a sequence to prevent cross contamination of process tanks and to assure adequate neutralization and/or removal of process chemicals.

5.3.4 Process and rinse tanks shall be situated such that hardware can be maintained wet from final cleaning and activation through the process to the final rinse without interruption.

5.3.5 Tanks with temperature range requirements shall be equipped with thermostatic controls.

5.3.6 Tanks shall be of sufficient volume and dimensions to contain hardware during processing and assure sufficient coverage of parts.

5.3.7 Tanks that require uniformity of temperature and solution concentration shall be agitated.

5.3.8 Tanks shall be constructed of materials compatible with the process chemicals used and with the alloys of the hardware processed.

5.3.9 Fixtures, workbars, electrical connections, and hard masking shall be sufficiently free of corrosion and physical damage while in use.

5.3.10 Fixtures and masking shall be designed to prevent air or solution entrapment on parts to be processed.

5.3.11 Fixturing and racking design shall be adequate so that, when hardware is positioned for rinsing, there is adequate process solution neutralization and removal and it precludes process solution and rinse water drag-out and cross-contamination of process tanks.

5.3.12 Fixturing and rack design, and the arrangement of workbars and anodes, shall be such that electrical contacts are solid but preclude potential pressure damage or electrical arcing.

5.3.13 Tanks for electrodeposition of coatings (plating, anodizing, etc.) shall be equipped with cathodes or anodes that can be reconfigured as needed. Conforming auxiliary electrodes may be used for processing hardware with variable geometric configuration or for variable lot sizes to promote uniform deposition rates.

5.3.14 Electrode type and placement shall be specified in customer required frozen planning procedures.

5.3.15 Hoists and other lifting equipment shall be labeled as to capacity.

5.3.16 Hoists and other lifting equipment shall be electrically insulated from the work.

5.3.17 Deionized water shall be used for anodize sealant bath make-up.

5.3.18 Deionized water shall be used for electroless nickel and precious metal plating, unless the manufacturer has deemed the water available in the facility is acceptable for use.

5.4 Stress Relief, Hydrogen Embrittlement Relief, and Cure Ovens

5.4.1 There shall be a procedure for temperature uniformity tests, or it shall be performed by an outside source.

5.4.2 The procedure shall specify the following:

a. Test frequency
b. Test temperature(s) and range(s)
c. The range shall cover all baking operations
d. Placement of thermocouples

5.4.3 There shall be evidence that the procedure has been implemented.

5.4.4 Uniformity surveys shall be performed at least semi-annually.

5.4.5 Temperature uniformity surveys shall conform to the uniformity of AMS 2750 or customer requirements.

5.4.6 System accuracy tests (i.e., probe checks) shall be performed at least monthly or by customer requirements.

5.4.7 The tests shall demonstrate that the system accuracy is ± 5 °F.

5.4.8 Instruments on ovens shall be calibrated semi-annually and shall be traceable to NIST.

5.5 Cleaning Procedures: General

5.5.1 Cleaning procedures shall be compatible with part alloys, dissimilar components of assemblies, previously deposited coatings, and braze/solder joint material.

5.5.2 Hardware coupons shall be processed as required through the cleaning procedures with the hardware.

5.5.3 When required by customer or specification, hardware that is susceptible to hydrogen embrittlement shall be mechanically descaled; or if chemically descaled with materials generating hydrogen, it shall be baked directly after chemically descaling.

5.5.4 Hardware shall be visually inspected for embedded grit or contaminants when mechanical methods are used to clean or activate hardware surfaces.

5.5.5 Procedures shall provide for removal of grease, oils, dirt, and other contaminants.

5.5.5.1 Parts shall be suitably protected against recontamination prior to subsequent processing.

5.5.6 Procedures shall be followed.

5.6 Mechanical Cleaning

5.6.1 Procedures and controls shall be in place to assure proper particle size distribution is maintained and cross contamination of alloys during mechanical cleaning (e.g., aluminum and iron based alloys) is minimized.

5.6.1.1 Procedures shall be followed.

5.6.2 When abrasive blast techniques are used, off-set distances, times, pressures, and media shall be specified.

5.6.3 Roughness standards shall be used to maintain surface finish, as required by customer or supplier.

5.6.4 Hardware shall be visually inspected and documented to verify corrosion, oxides, scale, and abrasive media have been removed.

5.7 Chemical Cleaning Prior to Chemical Processing

5.7.1 Cathodic cleaning shall be prohibited with high strength steels over 180 ksi.

5.7.2 Hardware shall be maintained wet and a water break free surface shall be observed, except for barrel plating, after the cleaning cycle.

5.7.3 Activation chemical baths shall be in line for processing part immediately prior to plating and conversion operations.

5.7.4 Procedures shall be followed.

5.8 Masking

5.8.1 Planning shall specify areas to be masked.

5.8.2 Masking materials shall be generically specified on shop paper.

5.8.3 Masking material shall be compatible with hardware and process conditions.

5.8.4 Fixtures and masking shall be designed to assure part area to be processed is exposed and all other areas precluded as required by the customer.

5.8.5 Adhesives, masking material, markings, and residual chemicals shall be removed after processing and before further thermal processing or shipment.

5.8.6 Parts shall be suitably masked or protected to prevent attack of surfaces of the hardware that are not to be subsequently chemically processed.

5.8.7 Procedures shall be in place for masking prior to cleaning, for visual inspection of adequate masking before and after cleaning, and for remasking when damaged during mechanical cleaning.

5.8.8 Procedures shall be followed.

5.9 Power Supplies

5.9.1 Power supplies shall be equipped with calibrated ammeters and voltmeters.

5.9.1.1 Each tank shall have dedicated meters that are capable of reflecting actual power at the tank.

5.9.2 The resolution of the power meters shall be sufficient for the voltage and amperage range specified in the planning.

5.9.3 Rectifiers shall be uniquely identified to the tank which they service. If not, each tank shall have an individual rheostat.

5.9.4 Workbars and rectifiers shall be adequate to carry the current capacity specified in the planning.

5.9.5 If a power failure occurs, there shall be a mechanism that requires the operator to physically restart the power supply.

5.10 Timers

5.10.1 Timers shall be available, suitable to the purpose, and calibrated to traceable standards and visible from the tanks.

5.11 Etch Inspection Processes

5.11.1 Standards of known defects shall be processed periodically to assure process capability.

5.11.2 The inspection area shall be sufficiently lighted (200 ft candles minimum) as specified by customer requirements.

5.11.3 Parts shall be positioned during processing so as to preclude air entrapment.

5.11.4 Parts shall be rapidly transferred from etch tank to rinse to preclude local overetching.

5.12 Etching, Chemical Milling

5.12.1 Stock removal rates shall be determined by coupon prior to processing hardware.

5.12.2 Stock removal panels of the same alloy and in the same processed condition as the hardware shall be controlled for maximum number of uses.

5.12.3 Stock loss shall be determined by weight or dimensional change.

5.12.4 If micrometers are used, they shall be used with appropriate anvils.

5.12.5 If masking is used, the integrity shall be tested prior to milling.

5.13 Stripping

5.13.1 Chemical stripping baths shall be inhibited when required by specification and/or customer requirement.

5.13.2 The hardware shall receive an embrittlement relief bake prior to recoating as required by specification and/or customer requirement.

5.13.3 Galvanic coupling, by processing dissimilar hardware, shall be precluded.

5.13.3.1 The process shall be approved by the customer.

5.13.4 The number of strip cycles shall be approved and each documented and traceable to the hardware.

5.13.5 When stripping is not part of the standard process, the reason for each strip shall be recorded on the individual part/lot documentation. The rework shall be properly authorized and the need for corrective action considered.

5.13.6 The chemistry of the stripping solution shall be controlled.

5.13.7 There shall be a procedure for mechanical stripping when it is performed.

5.14 Selective Plating

5.14.1 Operators shall be certified to MIL-STD-865 or other specification as required.

5.14.2 Anodes shall be controlled and specific to each process solution to avoid cross contamination.

5.14.3 Masking shall be adequate to protect part from corrosion.

5.14.4 Equipment and solution shall be in compliance with MIL-STD-865 or other specification as required.

5.15 Nickel and Copper Electroforming

5.15.1 Reusable mandrills and fixtures shall be controlled for identification and condition.

5.15.2 Stress analysis shall be performed on deposited coating.

5.15.3 The composition of deposited material shall be controlled in accordance with customer requirements.

5.15.4 Mandrill removal procedures shall preclude part damage.

5.16 Titanium Cleaning and Handling

5.16.1 Anodic alkaline cleaning shall be prohibited with titanium alloys.

5.16.2 When required by the customer, procedures for cleaning titanium surfaces shall preclude using methanol or halogenated substances.

5.16.3 Water, used for final rinse or spray, shall be deionized or monitored for halogen content.

5.16.4 Procedures shall require that finished parts be handled with clean, white cotton gloves.

5.16.5 Procedures shall be followed.

6. COMPLIANCE

6.1 Compliance to the requirements contained herein shall be verified by auditing in-process or completed jobs. The number of jobs to be audited shall be determined by the NADCAP Chemical Processes Task Group.

APPENDIX A
STATISTICAL PROCESS CONTROL (SPC)

The requirements contained herein shall related to the milestone plan in A1.2 and implementation of SPC shall be in accordance with that milestone plan.

A1. SPC Plans

A1.1 There shall be a policy to support top-down management commitment to SPC.

A1.2 There shall be a formal milestone plan for implementation of the SPC program that includes control and response plans. It shall be updated periodically.

A1.3 There shall be a formal training program for all levels covering basic principles of statistical process control.

A1.4 The necessary tools such as SPC reference materials, charts, and measuring equipment shall be provided to perform SPC.

A1.5 There shall be a policy that describes functions/titles and responsibilities of those persons responsible for SPC system tasks.

A2. Development of Control Plan

A2.1 SPC training shall be specific for different levels of expertise and it shall incorporate full employee involvement.

A2.2 Procedures shall be established and maintained that specify data collection, determination of capabilities, and process monitoring.

A2.3 A steering committee (or central focal person) shall be identified to give direction and oversee activities.

A2.4 Teams shall be established for work centers or operations.

A2.5 Discussion with employees shall indicate management's commitment to process control.

A2.6 The gathering of data shall be the responsibility of production staff and operators.

A2.7 Teams shall conduct Pareto analysis of defects by percent of total, percent of cost, and severity.

A2.8 The supplier shall conduct "fish bone" analysis or equivalent to determine possible causes of defects.

A2.9 Teams shall conducted Failure Mode & Effects Analyses (FMEA's) for each process developing risk priority factors for each defect.

A2.10 A list of variables to be controlled (control plan) shall be developed based on risk priority factors derived from the FMEA's.

A3. Capability and Calculation of Control Limits

A3.1 Capability studies shall be conducted on measuring systems used for data collection.

A3.2 There shall be provisions to assure that capability studies are not conducted until assignable causes are identified.

A3.3 Machine capability studies shall be conducted.

A3.4 Process capability studies shall be conducted.

A3.5 Variable control charts shall be used where possible to measure key characteristics.

A3.6 A statistically valid sampling plan and frequency shall be defined.

A3.7 Control limits shall be calculated for process parameters and key characteristics.

A4. Process Control

A4.1 There shall be a written set of criteria for determining that a process or process variable is in control.

A4.2 There shall be a procedure to identify assignable and common cause.

A4.3 Out-of-control conditions shall be correctly identified and recorded on in-use charts and assignable causes shall be identified.