BY ORDER OF THE COMMANDER

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13 June 2008

Supersedes:
New issue

Air Force Space Command

SPACE AND MISSILE SYSTEMS CENTER STANDARD

QUALITY ASSURANCE FOR SPACE AND LAUNCH VEHICLES

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Report Documentation Page

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FOREWORD

1. This standard defines the Government's requirements and expectations for contractor performance in defense system acquisitions and technology developments.

2. This new-issue SMC standard comprises the text of The Aerospace Corporation report number TOR-2005(8583)-3859.

3. Beneficial comments (recommendations, changes, additions, deletions, etc.) and any pertinent data that may be of use in improving this standard should be forwarded to the following addressee using the Standardization Document Improvement Proposal appearing at the end of this document or by letter:

Division Chief, SMC/EAE
SPACE AND MISSILE SYSTEMS CENTER
Air Force Space Command
483 N. Aviation Blvd.
El Segundo, CA 90245

4. This standard has been approved for use on all Space and Missile Systems Center/Air Force Program Executive Office - Space development, acquisition, and sustainment contracts.

James Horejsi, Col, USAF
SMC Chief Engineer

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1.0 BACKGROUND

Because of the highly complex nature of satellites and launch vehicles, and the fact that they are usually not repairable on orbit, stringent quality and reliability requirements are levied on contractors to assure that these requirements can be met through the product's intended lifecycle.

This document delineates the quality system requirements over and above the aerospace industry quality standard, SAE AS 9100, deemed necessary for satellite and launch vehicle systems. As such, it is includes all the basic requirements of AS 9100. A matrix showing which paragraphs of this TOR correspond to the requirements of AS 9100 is included as Attachment 1.

2.0 APPLICATION

This document specifies quality assurance requirements that may be tailored by the procuring agency or proposed by the contractor. It is applicable to the prime contractors, subcontractors, and suppliers of space and launch vehicle equipment.

3.0 FLOW-DOWN TO SUBCONTRACTORS/SUPPLIERS

The requirements of this document either in full or as appropriately tailored shall be levied on subcontractors and their sub-tier suppliers.

4.0 APPLICABLE DOCUMENTS

The following documents are mandatory quality requirements documents. In the event of a conflict between this document and the following documents, this document takes precedence.

(1) TOR-2006(8583)-1, " Configuration Management", August 2006

(2) MIL-STD-45662A, "Calibration Systems Requirements", 1 August 1988.

5.0 GENERAL REQUIREMENTS

5.1 General Requirements for the Quality Program

The quality program for space and launch vehicles shall be in accordance with the requirements of this TOR. The detailed requirements of this TOR are organized in five sections. Section 5.2 outlines Quality Program Management requirements. Section 5.3 outlines overall quality controls during the design, manufacturing, and test phases of a program. Section 5.4 outlines quality control of purchases. Section 5.5 delineates specific controls for manufacturing. Finally, Section 5.6 delineates the specific requirements for the control of nonconforming material. Section 5.7 gives definitions for terms used in this TOR.

5.1.1 Quality Program Plan

The contractor shall describe in a Quality Program Plan the approach for managing and implementing the quality requirements of this TOR. If a Quality Program Plan is requested as a deliverable data item reference Attachment 2, Quality Program Plan, Data Item Description. Software quality is an important discipline that needs to be covered by a separate plan. A Software Quality Plan will be covered in the software requirements of the contract.

5.1.2 Policies and Procedures

The implementation of the quality program shall be in accordance with written policies and procedures typically included in a Quality Manual. To assure completeness, a requirements matrix for the quality program shall be prepared which cross-references each paragraph of this TOR, with the quality requirement paragraphs in the contractor's policy and procedure documents, Quality Manual, and/or Quality Assurance Plan, which may become part of the contract. All quality program policies and procedures shall be readily available to all affected contractor personnel.

5.1.3 Management Reviews

Project quality management shall conduct regular reviews for senior project management on the status of the project quality program, including audit results, failure/discrepancy data, trend data, problem status, scrap/rework/repair status, corrective actions implemented and costs and quality status for in-plant, intra-contractor operations, subcontractors, and major suppliers. Records shall be kept of these reviews and their recommendations. The frequency of these reviews shall be specified in the contractor's Quality Program Plan. Below is the rationale for conducting such reviews:

Basis for Management Reviews

- Prior audit results
- Customer Feedback
- Process trend data and discrepancy records
- Status of preventive and corrective actions

- Follow-up actions from previous reviews
- Recent changes that could affect the quality management system
- Improvement recommendations

5.1.4 Quality Audits

The contractor shall schedule and conduct audits of personnel, procedures, and operations, which implement the quality program plan. Audits shall include subcontractor and sub-tier supplier. Each audit shall include examination of selected operations and documentation; evaluation of actual operations as compared with established requirements; recommendations, as appropriate, for remedial and preventive action; and follow-up to assess results of action taken. Audits shall include examination of articles, materials, and products to verify the effectiveness of the contractor's effort and product conformance to technical and contractual requirements. The appropriate Government representative shall be informed of audits scheduled and be allowed to participate in the audits.

a. Audits shall be planned taking into consideration the importance of the processes and areas to be audited. The frequency of audits shall be based on criteria derived from the analysis of previous audit results. Audit plans, checklists, and other such tools shall be prepared to guide the audit. They shall be based on customer and contractor requirements.

b. The results of audits in each area shall be documented with appropriate recommendations for correction of deficiencies. Management action shall be taken to ensure effective correction of the reported deficiencies

5.1.5 Quality Program at Field Locations

The contractor quality program at field locations shall be guided by written policies and procedures. The responsibility and authority of the contractor quality assurance representatives shall be clearly defined. Controls over work performed at field locations shall be planned and executed with the same level of discipline as work performed in-plant.

5.1.6 Software Quality Program

For deliverable software the contractor's software quality program shall comply with a government approved Software Quality Plan. For contractor developed non-deliverable software used to manufacture or test deliverable hardware or software, the contractor shall implement a disciplined management system for the validation and maintenance of such non-deliverable software. The software quality program shall be managed as a part of, and be consistent with, the general requirements for the overall quality program.

5.2 QUALITY PROGRAM MANAGEMENT

5.2.1 Organization

The contractor shall make functional assignments to implement each element of the quality program. Personnel performing quality program functions shall have well-defined responsibility and authority. The quality assurance organization and function shall be independent of organizations responsible for producing contractually required products and services. Personnel performing quality program functions shall also have the organizational freedom to assess problems and to recommend and affect solutions. The

contractor shall designate one individual responsible for directing and managing the quality function. This quality manager shall report regularly to higher management on the status and adequacy of the overall quality program.

5.2.1.1 Quality Management System

The contractor and his subcontractors and suppliers shall have a well-documented Quality Management System that details the processes used to maintain and continually improve its effectiveness. The organization shall provide the appropriate infrastructure (buildings, workspaces, equipment, and supporting services) and work environment needed to achieve product quality conformance.

5.2.2 Responsibility

The contractor shall document the assignment of management responsibility and authority for each task of the quality program. Documentation shall include:

a. Organization charts depicting managerial levels, lines of communications, and personnel assignments.

b. Identification of the level of management having authority to review the status of the overall quality program and for assuring the adequacy of corrective actions including those between departments and projects.

c. Narrative statements describing the responsibility of each element of the contractor's organization (e. g., procurement, engineering, reliability, fabrication, test, safety, and quality assurance), which implement the quality program.

d. The approach to quality management and surveillance of subcontractors and major suppliers.

e. Analysis of customer requirements with the intent of ensuring they are met.

5.2.3 Initial Quality Planning

The contractor shall document the methodology used to review contract quality assurance tasks and identify required quality resources. Procedures shall describe quality information flow from contract administration personnel to those personnel assigned responsibility for performing contract tasks and requirements included in quality assurance procedures and documentation. Procedures shall also describe methods used for the review and dissemination of quality information contained in contract changes.

5.2.3.1 Skill Requirements

During initial quality planning, the contractor shall identify and provide for the physical requirements and skills needed to accomplish critical processing and manufacturing operations. Requirements for manufacturing and inspection personnel shall include the levels of visual acuity and color perception needed to perform operational functions.

5.2.3.2 Training

The contractor shall maintain a training program to provide adequate skill levels, including formal and on-the-job training. There shall be sufficient formal training to ensure proficiency of persons performing complex or critical operations. The training program shall include indoctrination regarding reliability and quality requirements of the product.

5.2.3.3 Certification of Personnel

Contractor personnel performing or verifying complex or critical operations, and processes requiring a high degree of skill, shall be certified. Certification shall be based upon objective criteria, which include work experience, training, and testing. Certified personnel shall be provided evidence of certification, which shall specify the period of effectivity.

5.2.3.4 Recertification

When certification expires, personnel shall be recertified by testing or review of objective evidence of continued satisfactory performance. The contractor shall also recertify each individual whenever significant changes are made in processes, techniques, or skill parameters, or when physical relocation or interruption of the work period would result in degradation of quality. Whenever inspections, tests, or quality audits identify that individual manufacturing or inspection personnel need additional training, they shall be removed from the operation, provided with additional training, and demonstrate the required proficiency.

5.2.3.5 Records

The contractor shall maintain records of the training, testing, and certification status of personnel.

5.2.4 Work Instructions

5.2.4.1 Manufacturing and Test Planning

The contractor shall develop manufacturing, inspection, and test instructions for all segments of the manufacturing cycle, which shall include flow charts or other effective alternative methods of identifying all inspection and test points. The contractor's quality assurance organization shall participate in the planning and shall review and approve the instructions prior to release. Instructions shall include or reference engineering requirements, such as drawings, material specifications, process specifications, and workmanship standards, to assure that necessary tests and inspections are effectively performed to verify that the product meets technical requirements. Test instructions shall identify the characteristics to be measured, the methods of measurement, and the point at which the test is to be performed. Any changes made to production processes, equipment and/or test equipment/tooling shall be documented. Results of such changes shall be assessed as soon as practicable. The contractor shall address the following in developing the required manufacturing inspection and test instructions:

a. Sequence of all manufacturing, inspection and test points to assure continuity and effectiveness of all operations.

b. Inspection and test performance at the optimum item indenture level to minimize repair or rework at higher indenture levels. All workmanship shall be inspected at least once and preferably twice before being covered up by subsequent operations.

c. Sufficient module level environmental testing and burn-in.

d. Cleanliness/contamination control to include foreign object control.

e. The adequacy of in-house handling and packaging, including provisions for protection of electrostatic discharge sensitive items.

f. Availability and utilization of applicable drawings, specifications, and standards.

g. Clearly defined acceptance or rejection criteria for each inspection or test.

h. Special attention to monitor and document critical items and their characteristics.

i. Visual aids for inspection and assembly personnel.

j. Appropriate selection, application, use, and control of substances, chemicals, shop aids, clothing, and expendable materials specified and used in the manufacturing process (cleaning materials, adhesives, joining material, solvents, rags, and etc.).

k. Test equipment, tooling, jigs, fixtures and other fabrication equipment to be utilized.

l. Insertion of appropriate mandatory inspection points for manufacturing and quality organizations.

m. Inclusion of Manufacturing Readiness Reviews (MRRs), Test Readiness Reviews (TRRs), and Hardware Acceptance Reviews (HARs) for units and other configuration items.

n. Provisions to record process data, e. g., start and stop times, temperatures, torque values, etc.

5.2.4.2 Workmanship.

The contractor shall develop methods to assure that workmanship is adequate to meet contract end item specified requirements.

5.2.4.2.1 Standards

The contractor shall establish workmanship standards. These standards can be part of design specifications, drawings, work instructions or other readily available specifications and standards. These standards shall be derived from industry accepted workmanship standards and also be based on the contractor's manufacturing experience. All standards shall be aimed at delivering the highest quality and most reliable hardware to the customer possible within the constraints of the contract. All standards shall define specific detailed acceptance or rejection criteria.

5.2.4.2.2 Visual Aids

When visual aids are used to support manufacturing or inspections, the contractor shall identify, maintain, and control the samples, graphics, or visual aids that show acceptable workmanship to ensure continued usability and proper configuration.

5.2.5 Records

The contractor shall maintain a system for the collection and analysis of quality records resulting from the procurement, manufacturing, inspection, test and use of articles and materials. Quality information shall be promptly disseminated to all concerned areas within the contractor's organization and to involved suppliers when problems or deficiencies are detected.

5.2.5.1 Analysis of Records

The contractor shall conduct analysis of quality records for the purpose of:

a. Identifying quality trends and taking appropriate corrective action.

b. Establishing confidence levels for products, processes and suppliers by the review of objective evidence of conformance.

c. Increasing the efficiency of inspection and manufacturing operations by the judicious consolidation of records or operations when it can be demonstrated that such records or operations are of no value to the program or can be combined in a more effective manner.

5.2.5.2 Completed Records

5.2.5.2.1 Identification and Traceability

The contractor shall establish a system for identification, traceability and control of parts, materials, and assemblies from acquisition (purchasing) including special screening tests through manufacturing, assembly and delivery. Flight units and specified critical items shall require individual identification and data retrieval, which includes design and manufacturing documentation traceable to their origin. This will provide the capability of tracing backward from fabricated hardware to the records or material from which the item, part and material originated. Identification and retrieval shall be required through all levels of higher assembly. The system shall provide for identification and suitable marking of flight hardware.

5.2.5.2.2 Recording and Retrieval

Provisions shall be made to record and retrieve information relating to the specific test performed, test results, and processes on each lot of parts including pre-screening or lot retests. When serialization is required, controls shall be established to ensure that identification serial numbers are assigned in a consecutive manner. Records shall indicate applicable part or type numbers and associated detailed information.

5.2.5.2.3 Unit Level Data Packages

The contractor shall establish and maintain data packages for all units including all subcontracted units. The packages shall contain the complete chronological history from the beginning of unit build through final acceptance of the component. The term unit, as used herein, means an assembly, subassembly, or combination of parts mounted together, normally capable of independent operation and performing a discrete function. Examples are: transmitter, power supply, or reaction control unit which are normally tested as separate units. A single part is not a unit. A fully integrated data package, which shall be

available for Government review, is required for each serial number of the flight and qualification items, including spares, and shall include as a minimum the following:

a. Complete unit build history starting at the lowest level of assembly.

b. Identification of manufacturing instructions and processes used to build the unit.

c. Complete build inspection and test records, including physical and functional discrepancies, their resolution, and repair and rework history.

d. MRB actions, waivers and deviations, where applicable.

e. Test history including environmental test exposure and related measurements, where applicable, trend data across the testing, accumulative trend data across family of units, failures and anomalies during unit test, resolution, and retest.

f. Identification of associated test equipment and test software, where applicable along with critical test calibration results.

g. Associated failure reports including failure analyses leading to identification of root cause, disposition and corrective action.

h. Identification of any unverified failure (a failure in which the root cause has not been clearly established) and analysis of worst-case repair if applicable. If in subsequent testing the failure never occurs again, rationale should be given for ascribing the failure to a cause other than flight hardware.

i. Cumulative operating time or number of cycles and accumulative vibration and temperature exposures when applicable.

j. Unit as-built configuration description including a configuration status accounting for the as-built versus as-designed configuration at the time of unit delivery.

k. Records reflecting traceability of parts, materials, and subassemblies installed.

l. Storage history.

m. History of the unit from the time it is first integrated into a higher assembly, to include: initial installation date; removal date(s); reason for removal; discrepancy and failure history; and traceability references to all inspection, discrepancy, failure, rework, repair and retest paperwork.

n. Product photographs when specified.

5.2.5.2.4 Vehicle Level Data Packages

The contractor shall establish and maintain a data package for each serial numbered vehicle. An end item data package shall be delivered in accordance with the Contract Data Requirements List (CDRL). The data package shall contain the complete integration and test history starting with subsystem integration and continuing through final acceptance test of the vehicle. The data package contents shall be available for review by the customer. Each package shall contain as a minimum the following principal data:

a. Build log.

b. Inspection history.

c. Chronological test history including all out-of-sequence operations.

d. Configuration status accounting of the as-built versus the as-designed configuration.

e. A record of failure, anomalies, variations, and deviations identified during vehicle level or system level test (including any retest) and their resolution including root cause determination and corrective action.

f. Identification of any unverified failure (a failure in which the root cause has not been clearly established) and analysis of worst-case repair, if applicable. If in subsequent testing the failure never occurs again, rationale should be given for ascribing the failure to a cause other than flight hardware.

g. Test history including environmental test exposure and related measurements, trend data across the testing, and accumulative trend data across family of vehicles, where applicable.

h. Applicable waivers, deviations and vehicle level MRB actions.

i. Component/equipment time recorded, status of on-time, or number of cycles for cycle sensitive items.

j. Modification history including a list and description on any modification approved and scheduled for retrofit.

k. Installation history of traceable components including removal and replacement history.

l. Connector mate/demate logs.

5.2.5.2.5 Data Package Review

The contractor shall conduct vehicle and unit data package reviews including the review of each critical hardware item and major hardware component of each space and launch vehicle. The reviews shall verify that all hardware, parts, materials, and units have been manufactured and tested in accordance with current design documentation, test procedures, and related documentation.

The review effort shall ensure that:

a. Discrepancies are documented, and dispositions and corrective actions are evaluated against appropriate criteria and previous history data.

b. Anomalies noted or observed during review are documented, analyzed, evaluated, and dispositioned.

c. Records are progressively reviewed and made part of the overall acceptance criteria.

5.2.6 Customer Furnished Equipment

The contractor shall exercise special care when handling customer furnished property (CFE). The contractor shall identify, protect, and safeguard CFE provided by the customer for use or incorporation into the deliverable items. If such property is lost, damaged, changed, or found unuseable, the customer shall be immediately notified. Records of all actions pertaining to CFE shall be maintained.

5.2.7 Packaging, Handling, Preservation and Transportation

The contractor shall protect all deliverable hardware at all stages of manufacture and test through delivery. Procedures shall be employed to:

a. Keep deliverable items clean and in a proper environment

b. Handled such that the possibility of damage during manufacture or test is minimized

c. Package to prevent damage during transit

d. Transported in such a manner as to minimize any risk to the deliverable item(s).

e. Deliverable items shall be marked indicating sensitivity to handling and transportation and safety considerations. Accompanying paperwork shall indicate the sensitivity of the items as well.

f. Deliverable items shall be stored in a manner to preclude degradation from aging effects as much as possible. Life limited items shall be identified and controlled.

5.3 DESIGN, MANUFACTURING AND TEST QUALITY CONTROL

5.3.1 Drawings, Documents, and Changes

The contractor shall ensure that drawings, specifications, and technical documents and changes thereto contain adequate requirements and criteria for determining and controlling the quality of all items purchased or produced by the contractor. A procedure shall be established to identify, analyze, and report engineering documentation errors. Corrective measures shall be initiated when analysis indicates errors are beyond the predetermined acceptable limits.

5.3.1.1 Control of Drawing, Documents, and Changes

The contractor and his subcontractors and suppliers shall conform to MIL-STD-973, Configuration Management or an equivalent set of requirements.

5.3.2 Design Reviews

The contractor's internal design review program shall include participation of Quality Assurance, Manufacturing, Engineering Specialty Organizations, and others that are users of design documentation. This should consist of review and approval of all design disclosure technical documentation, and changes thereto, prior to formal document release.

The review shall provide for independent evaluation by personnel knowledgeable and experienced in the quality assurance and control aspects of the manufacturing process. For all new and modified designs, at the unit level and above the appropriate Government representatives shall be notified of the design reviews and allowed to participate. As a minimum, the following characteristics shall be considered:

a. Features that enhance or diminish the practicality of inspection, measurement, and verification of conformance to design requirements, including acceptance requirements.

b. Qualified and demonstrated inspection and test techniques to verify the adequacy of the design.

c. Effectiveness of test points

d. Identification of unnecessary and unrealistic design complexity.

e. Evaluation of the extent to which single point failure modes and mechanisms have been eliminated, or compensating features included.

f. Features that enhance ease of manufacturing.

g. Unique or new tooling requirements.

h. Complete, clear, accurate, and unambiguous display of technical requirements in drawings, specifications, other engineering documentation, and process standards.

i. Specification of nominal useful life, and identification of limited life items, and storage limits.

j. Necessity and feasibility of special evaluation or inspection methods, including destructive and nondestructive evaluations.

5.3.3 Measuring and Testing Equipment

The contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that supplies conform to technical requirements. These devices shall be calibrated against certified measurement standards that have known valid relationships to national standards at established periods to assure continued accuracy. The contractor shall assure that inspection and test equipment is adjusted, replaced or repaired before it becomes inaccurate. In addition, the contractor shall ensure the use of only such subcontractor and vendor sources that have calibration systems that effectively control the accuracy of measuring and testing equipment. MIL-STD-45662A, Calibration Systems Requirements is applicable to the contractor and all subcontractors.

5.3.4 Production Tooling Used as a Media of Inspection

The contractor shall control production tooling used as a media of inspection to assure continued accuracy between periods of tool proofing.

5.3.4.1 Records

The contractor shall maintain records of tool proofing which provide for each tool the date last proofed, condition found, maintenance performed and date of next proofing.

5.3.4.2 Intervals

The contractor shall analyze the records of tool proofing in order to shorten intervals as required to assure continued accuracy, or to lengthen intervals when the results of previous tool proofing provide definite indications that such action does not adversely affect the accuracy of the tool.

5.3.5 Manufacturing Readiness Reviews (MRRs)

Before commencing manufacture of a unit or other contractually designated configuration items at the prime contractor, subcontractor or critical component supplier, the prime contractor shall conduct a MRR to ensure readiness to build a quality product. Representatives from the appropriate design, manufacturing, test, parts, material, processes, quality, and other responsible organizations shall participate as a minimum. The appropriate Government representatives shall be invited and allowed to participate. Topics covered shall include, but not limited to: drawing availability and acceptability, configuration status, producibility of parts and materials, adequacy of manufacturing processes/certifications, manufacturing planning, current manufacturing trend data, personnel experience and training/certifications, tooling, facilities, inspection points, test equipment availability and calibration status, corrective action status and manufacturing lessons learned from prior like hardware builds and schedule.

5.3.6 Test Readiness Reviews (TRRs)

Before commencing testing of a unit or other contractually designated configuration item at the prime contractor, subcontractor, or critical supplier, the prime contractor shall conduct a TRR to ensure readiness to adequately test the unit or other configuration item. Representatives from the appropriate systems engineering, design, test, manufacturing, quality and other responsible organizations shall participate as a minimum. The appropriate Government representatives shall be invited and allowed to participate. Topics covered shall include, but not be limited to: test requirements, test planning, test procedure availability and adequacy, test set-up, configuration status, test software availability and adequacy, personnel experience and training, facilities, test equipment and calibration status, test lessons learned from prior like hardware testing, and schedule. Also, open and closed anomalies or liens that may affect test shall be reviewed.

5.3.7 Hardware Acceptance Reviews (HARs)

Before integrating units or other configuration items into subsystems or systems at the prime contractor, subcontractor or other facility, the prime contractor shall conduct a HAR to ensure the quality and reliability of the hardware. Representatives from the appropriate systems engineering, design, test, manufacturing, quality, reliability, parts, materials and processes, shall participate as a minimum. The appropriate Government representatives shall be invited and allowed to participate. Topics covered shall include, but not be limited to: MRB actions, Test/Failure Review Board actions, resolution of any unverified failures, test results, out-of-family test results, environmental exposure, operating time or number of cycles, parts, materials, and process problems encountered, applicability of outstanding alerts from the government and the aerospace industry, configuration status, integration lessons learned from prior subsystems/systems, waivers/deviations approved or in process, readiness of the receiving organization, handling fixtures and procedures, integration procedures, transportation arrangements, hardware packaging, and schedule. The data package contents described in 5.2.5.2.3 shall be available for review prior to and during the HAR.

5.4 CONTROL OF PURCHASES

5.4.1 Definitions

See Section 5.7 of this TOR.

5.4.2 General Requirements

The contractor shall institute a program to control purchases of flight hardware and to flow down the requirements of the government contract to those suppliers and subcontractors.

5.4.2.1 Selection of Supplier

5.4.2.1.1 Determining the Supplier's Capability

The prime contractor's quality program shall include procedures for the determination, prior to issuance of the purchase document, of the capability of the prospective suppliers of flight hardware, whether existing or new, to produce the products in accordance with the contractual requirements. For each new supplier and existing suppliers of complex components that have not been surveyed by the prime contractor in over a year, the prime contractor shall perform a Pre-award Quality Survey as described in 5.4.2.1.2 below.

5.4.2.1.2 Pre-award Survey of Prospective Suppliers

When the prime contractor performs a pre-award survey of the supplier's facility, the results shall be documented, available for review, and serve as a basis for required corrective action upon receipt of the subcontract.

5.4.2.1.2.1 Survey Elements

The following factors, appropriate to the products or services to be furnished, should be considered for evaluation during the survey:

a. Management organization and approach.

b. Inspection planning, controls, capability, and management.

c. Product/commodity visibility and defect prevention program.

d. Product/commodity performance analysis.

e. Past experience with the type of product or service to be supplied.

f. Configuration Management System.

g. Procedural control of hardware/software design and development documents and associated changes.

h. Control of nonconforming products.

i. Corrective Action/Continuous Improvement Program.

j. Product Discipline.

k. Personnel availability/Qualifications/Certification.

l. Review/audit capabilities.

m. Calibration capability and resources.

5.4.2.1.2.2 Hardware Specific

The following factors apply only to hardware products:

a. Manufacturing facilities.

b. Capability/condition of manufacturing equipment.

c. Control and maintenance of inspection equipment and production tools used as a medium of inspection.

d. Material storage and handling.

e. Control of nondestructive testing and special processes.

5.4.2.1.2.3 Software Specific

The following factors apply to software/firmware products to the extent that they are specified in the Software Quality Assurance Program Plan:

a. Software media controls.

b. Software development standards and procedures.

c. Existing software development, test and support tools, methods and measurements.

d. Software validation/verification methodologies.

e. Software library controls.

f. Independence and qualification of evaluators.

5.4.2.1.2.4 Periodic Audit of Suppliers

Each active supplier of flight hardware shall be subjected to a periodic review/audit. The type and frequency shall be defined in the prime contractor's procedures. The purpose of the reviews/audits will be to determine the continued capability of the supplier to control the quality of the products or services specified by the contract. Should there be any significant changes at a supplier’s facility (e. g., top level management change) or any evidence of poor quality, that would be grounds for an immediate prime contractor audit. The contractor shall notify the Government Representative of the audit schedule for suppliers of major/critical items and any changes to those schedules.

5.4.2.2 Supplier Rating

5.4.2.2.1 Supplier Rating System

A supplier rating system shall be devised by the prime contractor and described in written procedures. Each supplier shall be rated for quality of performance for each type of commodity/product being purchased. The system shall consider applicable inspection and test results when available from sources such as field personnel, as well as receiving inspection, and subsequent supplier responsible line rejects. The system shall yield the necessary basic data to provide visibility of supplier quality performance and trends. These data shall be periodically updated to reflect current supplier ratings and shall be used by purchasing personnel.

5.4.2.2.2 Rating

The supplier quality rating system must provide adequate separation and identification of suppliers having a satisfactory rating from those having other than a satisfactory or acceptable rating. The rating shall be predicated on a history of quality performance. The supplier's quality rating shall be given consideration equal to other performance indicators when selecting suppliers. The prime contractor's program shall describe the precautions that shall be implemented when products are obtained from suppliers that are rated below the satisfactory level established in the contractor's rating system.

5.4.2.3 Purchasing Data

5.4.2.3.1 Responsibility

The prime contractor's supplier quality assurance program shall provide for a review of purchase documents to assure applicable quality requirements are included or referenced in the documentation for compliance by the supplier. The review shall be accomplished as early as possible in the procurement cycle to assure the incorporation of all requirements applicable to the specific purchase. The office responsible for this review shall be identified in the contractor's procedures.

5.4.2.3.2 Purchase Document Evaluation

Prime contractor evaluation of the purchase documents shall be accomplished under control of the quality organization to assure that an adequate description, appropriate for the products to be provided, is included in the documentation.

5.4.2.3.2.1 All Purchases

The evaluation shall assure instructions are included in all purchase documents for the following as appropriate:

a. Manufacturing requirements.

b. Inspection and testing.

c. Material specifications and standards/prohibited materials.

d. Control of critical components.

e. Special qualifications, approval, or certifications.

f. Nondestructive tests.

g. Control of hardware/computer software documentation and changes.

h. Applicable product and process specifications.

i. Reliability and maintainability.

j. Safety factors.

k. Preservation, packaging, marking, and packing.

l. Product storage and handling.

m. Contractor source quality control.

n. GIDEP participation.

o. Shipping instructions.

p. Age control/limited shelf life materials and products

q. Government-furnished equipment.

r. Contractor-furnished equipment.

s. Data retention.

t. Control of tool and test equipment.

u. Nonconforming products.

v. Control of manufacturing methods, materials and processes.

w. Applicable workmanship standards.

x. Reviews/audits.

y. Identification of hardware and software deliverables.

z. Statistical Process Control Program.

5.4.2.3.2.2 Software Purchases

In addition to 5.4.2.4.2.1, the following applies to computer software products as appropriate and in accordance with the contractors Software Quality Assurance Plan.

a. Software qualification/acceptance testing.

b. Traceability between requirements and qualification/ acceptance tests.

c. Software Development Plan.

d. Software Quality Program Plan.

e. Software specifications, standards, and programming conventions.

f. Software media control.

5.4.2.4 Prime Contractor Control at Supplier's Facility

5.4.2.4.1 Control of Quality

The prime contractor is responsible for assuring all products and services purchased from suppliers conform to the contract requirements. The prime contractor is responsible for the following functions at supplier's facilities:

a. Performing complete or sampling inspection of product characteristic.

b. Assuring the adequacy of, and conformance to, the controls for special manufacturing processes.

c. Assuring the adequacy of, and conformance to, the controls for inspection and test equipment.

d. Verifying conformance to configuration management procedures for engineering drawings and computer software.

e. Determining conformance to the supplier's established quality program/inspection system.

f. Evaluating the methods for controlling nonconforming products and assuring the correction of the cause of nonconformance.

g. Documenting results of evaluations and inspection performed.

h. Indicating acceptability of products contained in each shipment, as applicable.

i. Verify that qualification and acceptance tests are conducted to approved procedures.

j. Verifying compliance with applicable requirements to include timely notification to management when discrepancies/deficiencies are discovered.

5.4.2.4.2 Control of Critical Items

The prime contractor must maintain strict control of critical items and their processing regardless of manufacturing/process location. Purchase orders for critical items shall specify special transportation, handling, and storage requirements. The following documentation shall be submitted to the prime contractor as part of his Quality Assurance Plan or in a Critical Item Control Plan.

a. The methods and the type of critical processing to be used (subject to limitations imposed because of proprietary information).

b. The location within the processing cycle where inspections, audits, or walk throughs will take place.

c. The attributes of the products, which will be inspected at each inspection point.

d. The materials and methods of preservation and packaging to be used to protect the product.

e. The handling and transportation precautions necessary to protect the product. Revision or variation to any of the above listed controls shall not take place until the prime contractor has approved the revision.

5.4.2.5 Source Inspection

The contractor shall provide resident or itinerant quality assurance representative(s) at subcontractor and vendor facility(s) to provide surveillance of the contractor requirements. The requirement for a resident quality assurance representative shall be based on item design, mission criticality, subcontractor or supplier past performance, and other pertinent factors. The contractor shall have instructions for each resident or itinerant quality assurance representative to delineate their responsibility and authority at the subcontractor or vendor facility.

5.4.2.6 Unit Source Inspection

The contractor shall inspect all flight units and critical items at the source.

5.4.2.7 Intra-contractor Work Authorization

All intra-contractor work transferred between departments, divisions, or other organizational segments shall be controlled to assure compliance with the technical quality requirements of the contract in the same manner as if they were a supplier or subcontractor.

5.4.2.8 Compliance Matrix

The contractor shall develop and maintain a matrix of all the quality assurance requirements imposed by the item specification(s), this standard, and the contract versus the items being procured for the program. The matrix shall be used in the review of procurement documentation to provide a consistent and effective application of quality program requirements.

5.4.2.9 Receipt of Purchased Products

5.4.2.9.1 Receiving Inspection

Products and services produced by outside sources for incorporation in the contract end item shall be subject to inspection/audit at time of receipt prior to further processing within the prime contractor's plant or shipment to another location. A prime contractor, in lieu of receiving inspection/audit, may use objective quality evidence submitted by the supplier. The use of such evidence does not relieve the prime contractor of responsibility to meet all contract requirements. In addition to verifying that the products and services comply with requirements of the purchase document, the products and services will also be verified against the latest applicable engineering changes or software specifications.

5.4.2.9.2 Discrepancy Reporting

5.4.2.9.2.1 Discrepant Products

Nonconforming products shall be identified and processed in accordance with the prime contractor's procedures for controlling nonconforming products. See section 5.6 of this document for the specific requirements that these procedures shall be based upon. The prime contractor shall report the receipt of any nonconforming products to the responsible supplier.

5.4.2.9.2.2 Discrepant Purchase Documents

Products received that conform to requirements of the purchase document, but fail to conform to the latest applicable engineering revision, will be placed in "hold status" pending resolution of the conflicting purchase/engineering documents. Subsequent handling of the product, if nonconforming, shall be in accordance with the prime contractor's established procedures. The prime contractor shall notify the Government Representative when he has elected to continue processing nonconforming items.

5.5 MANUFACTURING CONTROL

5.5.1 Production Processing and Fabrication

5.5.1.1 Certification

The contractor shall establish a method to certify the qualification of the machines, equipment, and procedures used in complex, critical operations. Records shall be maintained of the qualifying tests performed and the results of such tests. Validation prior to production shall include measurements made on the first article produced to a given design. Machines, equipment and procedures shall be recertified as indicated necessary by the results of quality trends or when major process changes are made (i.e., such items as material thickness, design, power source, capacity, voltage, or density).

5.5.1.2 Cleanliness, Contamination and Corrosion Control

The contractor shall review and identify the cleanliness, contamination and corrosion control requirements derived from hardware specifications and ensure that procedures are developed to adequately protect the hardware during manufacturing, test, storage and transportation. Implementation of controls shall be monitored by quality assurance on a regular basis.

5.5.1.3 Control of Physical Environment

The contractor shall ensure through periodic audit that the physical environment (such as temperature, humidity, light, arrangement of work areas, or arrangement of machines and equipment) is controlled to preclude inadvertent damage to hardware and to prevent unsafe conditions in all work and storage areas.

5.5.1.4 Critical Item Quality Control Requirements

The contractor shall establish and maintain appropriate critical item control. Manufacturing shall include any special instructions in the appropriate planning shop folders, process plans, log books, and related documents controlling the manufacturing and movement applicable to in-house manufacturing. Components or materials selected for preferential treatment shall be conspicuously marked or tagged to

alert personnel of special requirements. These items shall be segregated or have distinctively marked fixtures and locations in all stock rooms, holding and staging areas. Such items shall be regularly and systematically inspected for condition of expired time, cycle, or calendar life. Items with expired time, cycle, or calendar life shall be identified as nonconforming and properly dispositioned. Reviews of selected critical components shall be periodically conducted to verify the adequacy of work instructions and standards being used.

5.5.1.4.1 Critical Item Verification

For each critical item, beginning at the start of assembly and at progressive levels of assembly and test, the contractor's quality organization shall verify that the contract, drawing, and specification requirements have been met on all such articles and materials, procured or produced. Anomalies, including trends, deviations from expected norms, and marginal conditions shall be identified. Detailed assessment of the quality of these items and their manufacture shall include:

a. Identification of potential design and layout problems which could cause latent defects or marginal performance.

b. Verification that current manufacturing test methods and controls are producing repeatable products.

c. A review of manufacturing problems, if any, which could be alleviated by additional (or revision of) engineering information.

d. Verification that critical parameters are measured and verified by applicable test procedures.

e. Decisions, dispositions, corrective actions, or recommendations are evaluated against appropriate criteria and previous history data.

f. Anomalies noted or observed during review are analyzed, evaluated and dispositioned.

g. Records are progressively reviewed and made part of the overall acceptance criteria.

h. Identification and resolution of the differences between as-built and design documentation.

i. A review of failure and discrepancy reports to identify underlying causes (symptoms or manifestations) and a summary of overstress and induced secondary failures.

5.5.1.5 Electrostatic Discharge Control (ESD) Program

Procedures shall be established for the surveillance of the electrostatic discharge control program implementation. This shall include identification of items susceptible to electrostatic discharge and protective features to prevent such damage. As a minimum this should include:

a. Design criteria.

b. Protected work areas and protective clothing.

c. Process controls and workmanship standards.

d. Handling, packaging, transportation and storage.

e. Training.

f. Marking of documentation and hardware.

g. Audit plan for certified ESD workstations.

5.5.1.6 Nondestructive Evaluation

Nondestructive evaluation methods, verification techniques (and attendant equipment and facilities), which are used to perform quantitative measurements, integrity analysis, and nondestructive testing, shall be controlled and integrated into the contractor's qualification, calibration, certification and standards procedures. Nondestructive evaluations for hardware flight configurations shall be performed by personnel proficient and certified in the scientific field involved.

5.5.2 Completed Item Inspection and Test

Prior to shipment or storage of a contract end item, the contractor shall review objective evidence generated during manufacturing and test of the item to assure that all work sequences have been satisfactorily completed and that all nonconformances have been resolved. The contractor shall maintain records and findings of final review.

5.5.3 Statistical Process Control

The contractor's quality assurance organization shall participate in development of techniques used to control process variability. This should consist of the independent evaluations of design disclosure technical documentation and manufacturing processes by qualified personnel. As a minimum, consider that:

a. Critical quality characteristics are identified, measured, and verified.

b. Data is collected from points of measurement.

c. Control limits and tolerance variations are maintained within product specification limits.

d. Procedures and methods are established for preventive and corrective actions, and feedback is provided to design and manufacturing.

5.6 NONCONFORMING MATERIAL CONTROL

5.6.1 Definitions

See Section 5.7 of this TOR .

5.6.2 General Requirements

5.6.2.1 Corrective Action and Disposition System

The contractor shall establish and maintain a system which shall identify, segregate (or control if segregation is not practical), and properly dispose of nonconforming material and shall ensure that cost-effective, positive corrective action is taken to prevent, minimize, or eliminate nonconformances. The

system shall work toward continual improvement of quality and productivity through the initiation and monitoring of Quality Improvement Programs (QIPs).

5.6.2.2 Statistical Process Control (SPC)

SPC techniques including control limits and control charts shall be used when appropriate. Control limits must be established statistically or by other methods and be based upon the documented history of the process capability.

5.6.2.2.1 Control Limit Standards

Contractor recommended standards shall specify the control limits at which corrective action must be taken; describe criteria for determining the control limits; and provide for the accumulation and maintenance of data for monitoring processes and obtaining corrective actions as dictated by collective analyses, trend reviews, or other means acceptable to the Government.

5.6.2.3 Quality Improvement

The contractor shall institute actions to prevent nonconformances and initiate QIPs throughout the contractor's organizations. The contractor shall assign organizational elements, teams, or individuals to investigate technology, methods, and procedures to increase efficiency and conformance to requirements.

5.6.2.4 Preventive Action

The contractor shall determine actions to eliminate the potential causes of nonconformances where cost effective and deemed appropriate by the contractor’s Corrective Action Board (CAB).

5.6.2.5 Contractor's Written Procedures

The requirements of this standard shall be implemented by the contractor through the preparation, publication, and maintenance of detailed written procedures. The contractor shall identify personnel appointed PR authority and those to act on the MRB and CAB, and shall indicate in the procedures the scope or extent of their authority. The contractor's procedures shall also indicate the manner in which documentation is maintained.

5.6.2.6 Material Review Board (MRB)

The MRB shall be chaired by a representative of the contractor's Quality organization and shall include, as required, personnel representing other contractor organizations necessary to determine appropriate disposition of nonconforming material. As a minimum, the MRB shall include the chairman and a representative of the contractor's engineering organization responsible for product design. Failure Review Boards (FRBs) shall operate essentially the same as MRBs with the exception that they may be chaired by other organizations.

MRB members may call upon other contractor personnel and government representatives for technical advice. If warranted by the volume of nonconforming material or the diversity of work operations, more than one MRB may be established. A designated Government Representative is considered a member of the MRB. The appropriate Government Representative shall be notified of all MRB meetings.

5.6.2.6.1 MRB Authority and Responsibilities

The MRB shall:

a. investigate, in a timely manner, all nonconforming material (except material previously disposed of in PR authorized in paragraphs 5.6.3.2 a, b, c, or d) in sufficient depth to determine proper disposition.

b. review and concur in all proposed use-as-is and repair dispositions and justifications.

c. review and concur in all proposed Standard Repair Procedures (SRPs).

d. assure that a written engineering analysis accompanies proposed use-as-is and repair (excluding SRP) dispositions. The MRB shall ensure that the Government is kept informed of its investigation and deliberations on these potential dispositions so that the Government may act upon the MRB recommendations in a timely manner.

e. dispose of nonconforming material in accordance with paragraph 5.6.3.3.

f. reviews hardware rework and repair histories to ensure that hardware is still fit for use.

5.6.2.7 Corrective Action Board (CAB)

The CAB shall ensure that an effective corrective action system is in place to improve product quality. This function shall be performed through review and analysis of nonconformance data. The CAB shall ensure that records of causes of nonconformances, trends, and individual causes acted upon are maintained and that individual records and summaries of actions taken are prepared. The appropriate Government Representative shall be notified of all CAB meetings and be invited to attend.

5.6.2.7.1 CAB Authority and Responsibilities

The CAB shall:

a. have authority to ensure implementation of corrective actions to all contractor operations affecting product quality.

b. have the authority to require investigations and studies by other contractor organizations necessary to define essential corrective actions that will result in reducing nonconformance costs and reducing the amount of nonconformances.

c. ensure that documentation required by paragraphs 5.6.3.7 and 5.6.3.8 is maintained.

d. ensure that summary data of nonconformances and associated costs are analyzed and areas of high potential payoff, adverse trends, exceeding control limits, or out-of-control recurrence of nonconformances are thoroughly investigated to identify appropriate corrective actions and to identify potential QIPs.

e. be responsible for ensuring that follow-up systems are maintained to ensure that timely and effective corrective actions are taken.

f. ensure that reviews of nonconformance data and PR and MRB disposition decisions are conducted periodically to determine that PR and MRB actions are effective and in compliance with the requirements of this standard.

g. ensure that a process evaluation is accomplished and that specific corrective actions are taken to bring the process back into acceptable limits when control limit techniques are used and analysis of cumulative data for an applicable nonconformance reveals that the established limits are being or will be exceeded.

h. ensure that the contractor documents nonconformances and monitors: yield requirement development, documentation, and evaluation; the process control system for compliance; process improvement activity as it relates to trends; and recurrences of nonconformances when corrective action is required due to inadequate process controls or control limit techniques and until such time as it has been demonstrated that the corrective action has been effective.

5.6.2.8 Government Rights

The Government reserves the right to: review all contractor procedures developed to implement this standard; observe PR, CAB, and QIP activities; participate in MRB activities; and review documents or other data required by this standard.

5.6.3 Detailed Requirements

5.6.3.1 Identification and Segregation of Nonconforming Material

When material is found to be nonconforming, nonconforming items shall be conspicuously marked or tagged (or otherwise identified if marking or tagging is not practical) and positively controlled to preclude its unauthorized use in production. Nonconforming material to be submitted to the MRB shall be moved to a controlled area designated for storage of nonconforming material unless not practical due to size, configuration, environmental requirements, or other conditions authorized by the Government. The designated area shall be protected to preclude unauthorized removal of nonconforming material.

5.6.3.2 PR Disposition

When material is initially found to be nonconforming, it shall be examined by contractor-appointed Quality personnel, assisted by other contractor personnel if necessary, to determine if the nonconformance:

a. Requires scrapping of the material because it is obviously unfit for use and cannot be economically reworked or repaired.

b. Can be eliminated by rework.

c. Requires return of the material to the supplier.

d. Can be repaired using SRPs that have been concurred on by the MRB and approved by the Government.

e. Meets none of the above criteria and shall be referred to the MRB. PR action does not negate the requirement for identification, documentation, and corrective action associated with

nonconformances. It does recognize that some nonconformances do not warrant referral to the MRB and can be handled more economically at the location of initial detection.

5.6.3.3 MRB Disposition

All nonconforming material not disposed of in PR shall be disposed of by an MRB decision to:

a. Scrap.

b. Rework.

c. Return to supplier.

d. Repair by an approved SRP.

e. Repair by other than an SRP.

f. Use-as-is.

g. Request a waiver from the contracting officer.

5.6.3.4 Use-As-Is Dispositions

Requirements pertaining to use-as-is dispositions are as follows:

a. When a designated Government technical representative resides at the prime, subcontractor, or supplier's facility, the shall participate in all use-as-is dispositions as a member of the MRB. If no designated Government technical representative is on site, the Government reserves the right to subsequently review such dispositions.

b. All use-as-is dispositions shall include a determination of the appropriateness of a documentation change and the method for accomplishing any recommended change (i.e., design change, changes to technical documentation including drawings, specifications, and technical orders, or recommended changes to government specifications).

5.6.3.5 Repair Dispositions

Requirements pertaining to repair dispositions are as follows:

a. When a designated Government technical representative resides at the prime, subcontract, or supplier's facility, the Government shall participate in all – repair dispositions as a member of the MRB. If no designated Government technical representative is on site, the Government reserves the right to subsequently review such dispositions.

b. Instructions for reprocessing of material after completion of repair and before its release shall be included in the SRP or other repair procedure. These procedures shall include the requirement for contractor inspection and test as required.

c. The contractor shall maintain records detailing the dates of use and number of applications of SRPs.

d. The contractor shall review SRPs periodically to ensure that they are complete, up-to-date relative to current process capability and state-of-the-art, and are being properly applied under the conditions defined for their use.

5.6.3.6 Scrapped Material

Scrapped material shall be conspicuously identified and controlled to preclude its subsequent use in a contract item unless approved by the Government.

5.6.3.7 Nonconforming Material Documentation

The contractor system shall maintain records of all nonconforming material, dispositions, assignable causes, corrective actions, and effectiveness of corrective actions. These records shall be organized to permit efficient retrieval for summarization required by paragraph 5.6.3.8, knowledge of previous dispositions, and corrective action monitoring. The contractor shall ensure that documentation of nonconformances includes the following:

a. Contract number.

b. Initiator of the document.

c. Date of the initiation.

d. Identification of the document for traceability purposes.

e. Specific identification (e. g., part number, name, National Stock Number) of the nonconforming material.

f. Quantity of items involved.

g. Number of occurrences.

h. The place in the manufacturing process where the nonconformance was detected.

i. A detailed description of the nonconformance.

j. Identification of the affected specification, drawing, or other document.

k. A description of the cause(s).

l. Disposition of the nonconforming item (return to supplier, rework, use of an SRP, scrap, or refer to MRB).

m. Identification of personnel responsible for making the disposition decision.

5.6.3.8 Minimum Data Summarization Requirements

Nonconformance data shall be recorded to enable summarization of the quantity of nonconforming items, number of recurrences, cause determinations, corrective actions, dispositions, and nonconformance costs

as described in paragraph 5.6.3.11. Nonconformance data shall be used by the CAB to determine the need for and effectiveness of corrective action. The format of the data and the frequency of preparation shall be at the discretion of the contractor but in no case shall the preparation be less frequent than quarterly. As a minimum, the following data shall be included:

a. Quantity of nonconforming items.

b. Number and type of nonconformances.

c. Number and type of dispositions.

d. Cause determinations.

e. Type of corrective actions and status.

f. Delinquent corrective actions.

g. Nonconformance costs.

h. Trend information and analysis thereof.

5.6.3.9 Audits

The contractor shall periodically audit, or have audited, the corrective action and disposition system for nonconforming material (both in-house and at suppliers where appropriate).

5.6.3.10 Nonconforming Material Disposition

The Material Review Board is the only contractor constituted board authorized to determine, or recommend disposition of nonconforming material.

5.6.3.11 Cost of Quality

The contractor and his subcontractors shall collect nonconformance cost data consisting of a minimum of scrap, rework, and repair costs. The cost data will be used by management to establish measurement parameters for evaluation of manufacturing planning and manufacturing process in attaining suitable yield and product quality.

5.7 DEFINITIONS

Control Charts. A graphic representation of data used to detect, identify, analyze, and eliminate unacceptable variation in a given characteristic, process, or product. Computer software programs may be used for this purpose without a need to display the control chart itself. Commonly used control charts include variables or attributes process data and associated control limits, scatter plots of trends, histograms, and graphic displays of nonconformances by category. Control charts facilitate analysis of the process yield leading to potential changes in processes, methods, machines, and requirements documentation; evaluation of defect distributions to focus on significant causes of nonconformance; analysis to distinguish between chance and assignable causes of variation; and monitoring of the effectiveness of corrective action.

Control Limits. Criteria that establish maximum variation beyond which action must be taken to investigate and when feasible correct the cause(s) of nonconformance. Control limits do not preclude corrective action when abnormal patterns of variation occur without any individual data exceeding the control limits. Control limits are developed using standard statistical methods or other approved techniques and are based on documented process history. They are established to assist in fulfilling the contractor's responsibility for submitting a conforming item, identifying necessary corrective actions, and reducing nonconformance levels.

Corrective Action. Changes to processes, work instructions, workmanship practices, training, inspections, tests, procedures, specifications, drawings, tools, equipment, facilities, resources, or material that result in preventing, minimizing, or eliminating the causes of nonconformances.

Corrective Action Board (CAB). A board consisting of management representatives of appropriate contractor organizations with the level of responsibility and authority necessary to ensure the prevention of nonconformances, to manage quality improvement efforts as appropriate, to assess and manage nonconformance cost elimination, to ensure that causes of nonconformances are identified, and that corrective actions are effected throughout the contractor's organization.

Critical Items. A flight item whose failure in operation would seriously degrade or result in mission failure.

Material Review Board (MRB). A board consisting of representatives of contractor departments necessary to review, evaluate, and determine or recommend disposition of nonconforming material referred to it. Failure Review Boards (FRBs) are essentially the same as MRBs.

Nonconformance. The failure of a characteristic to conform to the requirements specified in the contract, drawings, specifications, or other approved product description.

Minor Nonconformance. A nonconformance that does not adversely affect any of the following:

a. Health or safety.

b. Performance.

c. Interchangeability, reliability, or maintainability.

d. Effective use or operation.

e. Weight or appearance (when a factor).

f. Significant program cost.

g. Contractual requirements.

NOTE: Multiple minor nonconformances, when considered collectively, may raise the category to a major/critical nonconformance.

Major/Critical Nonconformances. A nonconformance other than minor that cannot be completely eliminated by rework or reduced to a minor nonconfomance by repair.

NOTE: Where a classification of defects exists, minor defects are minor nonconformances. Major and critical defects which cannot be completely eliminated by rework or reduced to a minor nonconformance by repair are major/critical nonconformances.

Nonconforming Material. Any item, part, supplies, or product containing one or more nonconformances.

Occurrence. The first time a nonconfomance is detected on a specific characteristic of a part or process. All nonconformances attributed to the same cause and identified before the assignment of corrective action are also considered occurrences.

Pre-award Survey. An evaluation of a prospective supplier's capability to perform under the terms of a proposed contract

Preventive Action. Same as corrective action except that changes are made to prevent nonconformances from occurring.

Recurrence. A repeat of a nonconformance.

Preliminary Review (PR). An evaluation by contractor-appointed Quality personnel, assisted by other personnel as required, to determine the disposition of nonconforming material after its initial discovery and prior to referral to the MRB. PR may result in an authorized disposition of the nonconforming material without referral to the MRB for final disposition.

Quality Improvement Project (QIP). An activity chartered and monitored by the CAB (or other contractor group senior to the CAB) to investigate technology, methods, and procedures, which is aimed at finding more efficient and effective means of carrying out contractual responsibilities with the objective of enhancing quality and productivity.

Redundant Inspection/Test. Any verification of a quality characteristic performed by a higher-tiered supplier or prime contractor when the sub-tiered suppliers have properly verified that quality characteristic.

Repair. A procedure that reduces but not completely eliminates a nonconformance and which has been reviewed and concurred in by the MRB and approved for use by the Government. The purpose of repair is to reduce the effect of the nonconformance. Repair is distinguished from rework in that the characteristic after repair still does not completely conform to the applicable drawings, specifications, or contract requirements. Except for SRPs (see paragraph 5.6.1.16 below), proposed repairs approved by the Government are authorized for use on a one-time basis only.

Rework. A procedure applied to a nonconformance that will completely eliminate it and result in a characteristic that conforms completely to the drawings, specifications, or contract requirements.

Scrap. Nonconforming material that is not usable for its intended purpose and which cannot be economically reworked or cannot be repaired in a manner acceptable to the contractor and/or government.

Standard Repair Procedure (SRP). A documented technique for repair of a type of nonconformance which has been demonstrated to be an adequate and cost-effective method for repair when properly applied. SRPs are developed by the contractor, reviewed and concurred by the MRB, and approved by the Government for recurrent use under defined conditions. Defined conditions shall include an expiration date or a finite limit on the number of applications, or both.

Statistical Process Control (SPC). A methodology used to measure the average and variability of any given characteristic within a contractor area, department, part, or process, including but not limited to, machine shop, bonding process, heat treat, and assembly. SPC techniques include control charts and control limits. Properly implemented, SPC offers the ability to improve manufacturing yield and lower production, inspection, and nonconformance costs.

Supplier. The terms subcontractor, supplier, vendor, seller, or any other term used to identify the source from which the prime contractor obtains support are considered to be synonymous for the purpose of this standard.

Use-As-Is. A disposition of material with one or more minor nonconformances determined to be usable for its intended purpose in its existing condition.

Attachment 1: AS 9100B vs. TOR Requirements Matrix

Paragraph Number	AS9100B Requirement Paragraph	TOR-2005(8583)-3859 Requirement Paragraph
4.	**QUALITY MANAGEMENT SYSTEM**	
4.1	General Requirements	5.1, 5.1.2, 5.1.3, 5.1.4, 5.2.1
4.2	Documentation Requirements	5.1.2
4.2.1	General	5.1.2
4.2.2	Quality Manual	5.1.2, 5.2.2
4.2.3	Control of Documents	5.2.2 and 5.3.1
4.2.4	Control of Records	5.2.5
4.3	Configuration Management	4.0 TOR-2006(8583)-1
5.	**MANAGEMENT RESPONSIBILITY**	
5.1	Management Commitment	5.2.1, 5.2.2
5.2	Customer Focus	5.2.2.e
5.3	Quality Policy	5.1.2, 5.2.1.3
5.4	Planning	Title only
5.4.1	Quality Objectives	5.2.2
5.4.2	Quality Management System Planning	5.2.3
5.5	Responsibility, Authority and Communication	5.2.1
5.5.1	Responsibility and Authority	5.2.1, 5.2.2
5.5.2	Management Representative	5.2.1, 5.2.2
5.5.3	Internal Communication	5.2.1, 5.2.2
5.6	Management Review	5.1.3
5.6.1	General	5.1.3
5.6.2	Review Input	5.1.3
5.6.3	Review Output	5.1.3
6.	**RESOURCE MANAGEMENT**	
6.1	Provision of Resources	5.2.1.1
6.2	Human Resources	Title only
6.2.1	General	5.2.3.1, 5.2.3.2
6.2.2	Competence, Awareness and Training	5.2.3.1, 5.2.3.2
6.3	Infrastructure	5.2.1.1
6.4	Work Environment	5.2.1.1

7.	PRODUCT REALIZATION	
7.1	Planning of Product Realization	5.2.4.1
7.2	Customer-Related Processes	Title only
7.2.1	Determination of Requirements Related to the Product	N/A for TOR
7.2.2	Review of Requirements Related to the Product	N/A for TOR
7.2.3	Customer Communication	N/A for TOR
7.3	Design and Development	N/A for TOR
7.3.1	Design and Development Planning	N/A for TOR
7.3.2	Design and Development Inputs	N/A for TOR
7.3.3	Design and Development Outputs	5.2.4.1 (Mostly N/A for TOR)
7.3.4	Design and Development Review	5.3.2 (Partially N/A for TOR)
7.3.5	Design and Development Verification	N/A for TOR
7.3.6	Design and Development Validation	5.3.7
7.3.6.1	Documentation of Design and/or Development Verification and Validation	5.3.7
7.3.6.2	Design and/or Development Verification and Validation Testing	5.3.6
7.3.7	Control of Design and Development Changes	5.3.1 and TOR-2006(8583)-1
7.4	Purchasing	Title only
7.4.1	Purchasing Process	5.4
7.4.2	Purchasing Information	5.4
7.4.3	Verification of Purchased Product	5.4
7.5	Production and Service Provision	Title only
7.5.1	Control of Production and Service Provision	5.2.4.1, 5.2.4.2, 5.5.2
7.5.1.1	Production Documentation	5.4.2.1, 5.3.1
7.5.1.2	Control of Production Process Changes	5.2.4.1
7.5.1.3	Control of Production Equipment, Tools and Numerical Control (NC) Machine Programs	5.5.1.1
7.5.1.4	Control of Work Transferred, on a Temporary Basis, Outside the Organization's Facilities	5.4.2.8
7.5.1.5	Control of Service Operations	Title only
7.5.2	Validation of Processes for Production and Service Provision	5.5.1.1
7.5.3	Identification and Traceability	5.2.5.2.1
7.5.4	Customer Property	5.2.6
7.5.5	Preservation of Product	5.2.7
7.6	Control of Monitoring and Measuring Devices	5.3.3

8.	**MEASUREMENT, ANALYSIS AND IMPROVEMENT**	
8.1	General	5.3.3
8.2	Monitoring and Measurement	5.3.3, 5.3.4
8.2.1	Customer Satisfaction	5.3.3
8.2.2	Internal Audit	5.1.4
8.2.3	Monitoring and Measurement of Processes	5.5.3, 5.6.2.2, 5.6.2.7
8.2.4	Monitoring and Measurement of Product	5.3.3, 5.3.7, 5.6.2.2, 5.6.2.7
8.2.4.1	Inspection Documentation	5.2.5.2
8.2.4.2	First Article Inspection	5.5.1.7, 5.5.2
8.3	Control of Nonconforming Product	5.6
8.4	Analysis of Data	5.6.2.2.1
8.5	Improvement	Title only
8.5.1	Continual Improvement	5.6.2.3, 5.6.2.7
8.5.2	Corrective Action	5.6.2.3, 5.6.2.7
8.5.3	Preventive Action	5.6.2.4
BIBLIOGRAPHY		

Attachment 2: Quality Program Plan Data Item Description (DID)

DATA ITEM DESCRIPTION	
Title QUALITY PROGRAM PLAN	Identification Number TBD
Description/Purpose 3.1 This plan describes how the Quality Program will be conducted. It describes the specific techniques and activities to be performed and their integration and development in conjunction with other specified related plans. The principal use of this item is to provide a detailed description of a contractor's program to be accomplished under the contract.	
Approval Date (YYMMDD) TBD	Office of Primary Responsibility (OPR) SMC/NRO
Application/Interrelationship 7.1 This DID contains the format and content preparation instructions for the Quality Program Plan required by Paragraph 5.1.1 of the Supplemental Quality Requirements document. 7.2 This data item is provided to permit preparation of a separate Quality Program plan or integration of the plan within a consolidated Product Assurance/System Effectiveness Program Plan (PA/SEPP) which normally includes Software Quality, Reliability, Parts, Materials and Processes, and other related disciplines. Cost, system integration and methods of contracting are prime considerations in preparation of a single PA/SEPP or separate Coordinated Plans.	
Approval	
Preparation Instructions 10.1 Reference Documents. Aerospace TOR-20005(8583)-3859/SAE AS 9100 . 10.2 Methods and Techniques. The plan shall outline the methods and techniques for incorporating quality into design and for conducting a comprehensive quality program in accordance with the contract scope of work and specifications as listed in the contract. It shall portray how quality will be achieved in sufficient detail to include schedule, technique, procedures and responsibilities for each specific task. 10.3 Program Definition. The plan shall define the scope and depth of the contractor's efforts, including the management, organization, staffing, planning and technical aspects, and the relationship of the Quality Program to the contractor's other administrative and technical programs. The plan shall include a statement that it does not take precedence over AS 9100, Supplemental Quality Requirements document, or other contractual requirements. 10.4 Special Considerations. The plan shall identify unusual or special areas of hardware and data products requiring unique quality assurance considerations; and detail or reference the unique quality assurance procedures that will be utilized to assure a quality product. The plan shall detail the inspection work in process to substantiate compliance of critical and major attributes which will not be substantiated by subsequent inspections. 10.5 Flow Chart Requirements. The plan shall contain flow charts showing the flow of supplies, materials, and data together with the quality assurance functions performed. All areas of contract performance shall be specified; for example, design, development, fabrication, processing, assembly, inspection, test, maintenance, packaging, shipping, storage and site installation. 10.6 Matrix Requirements. The plan shall contain a cross-index (Matrix) which identifies the relationship between the program plan, applicable contract specifications and standards, and contractor policies, procedures, instructions, and controls used to implement the requirements. 10.7 Detailed Requirements. The Quality Program Plan shall address the requirements of AS 9100, Revision B and the Supplemental Quality Requirements document.	

SMC Standard Improvement Proposal

INSTRUCTIONS

1. Complete blocks 1 through 7. All blocks must be completed.
2. Send to the Preparing Activity specified in block 8.

NOTE: Do not be used to request copies of documents, or to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Comments submitted on this form do not constitute a commitment by the Preparing Activity to implement the suggestion; the Preparing Authority will coordinate a review of the comment and provide disposition to the comment submitter specified in Block 6.

SMC STANDARD CHANGE RECOMMENDATION:	**1. Document Number**	**2. Document Date**
3. Document Title		

4. Nature of Change
(Identify paragraph number; include proposed revision language and supporting data. Attach extra sheets as needed.)

5. Reason for Recommendation

6. Submitter Information

a. Name	**b. Organization**
c. Address	**d. Telephone**
e. E-mail address	**7. Date Submitted**

8. Preparing Activity

Space and Missile Systems Center
AIR FORCE SPACE COMMAND
483 N. Aviation Blvd.
El Segundo, CA 91245
Attention: SMC/EAE