QUALITY REQUIREMENTS FOR PURCHASE ORDER

Prepared By
ATK Tactical Propulsion and Controls Division
Cage Code: 3BJAO

ES-110

REVISION HISTORY

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The following ATK Tactical Propulsion and Controls Division Quality Assurance Provisions (QAP) apply to this purchase order.

GROUP 2
This purchase order line item is classified as a Group 2 procurement by ATK Elkton, LLC Quality Assurance.

CLAUSE 1
This document establishes general requirements for product assurance that are applicable to items ordered under the purchase order of which these provisions form a part. These provisions are intended to assure that the procured items meet the quality and reliability requirements of ATK Elkton and our customer, and apply unless expressly excluded or superseded in the purchase order. Additional Quality Assurance Provisions (QAPs) may also apply as designated in the purchase order.

1. CORRESPONDENCE

All correspondence relating to particular articles shall reference the specification(s) and/or drawings(s) (including number and revision) and the purchase order number. All correspondence shall be directed to the procurement division of ATK Elkton.

2. CONFLICT IN INSTRUCTIONS

In the event of apparent conflict among the purchase order provisions, the supplier shall obtain clarification from the procurement division of ATK Elkton as to the exact interpretation of requirements. Failure to obtain clarification may subject the procured articles to rejection.

3. RESPONSIBILITY FOR COMPLIANCE

The inspections set forth in the drawings and specifications shall become part of the supplier's overall inspection system or quality program. The absence of any inspection requirements in the drawings or specifications shall not relieve the supplier of the responsibility of assuring that all products or supplies submitted to ATK Elkton for acceptance comply with all requirements of the purchase order. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit ATK Elkton to acceptance of such defective material.

5. SPECIAL TOOLING AND SPECIAL GAGES AND EQUIPMENT

Special tools and special gages and equipment which are used for dimensional control and acceptance in lieu of inspection by standard methods or standard gages and equipment shall be
designed and maintained to assure repetitive compliance to governing drawings within the specified tolerance zone(s) of the dimension(s) being controlled or accepted.

6. **FINAL ACCEPTANCE AT ATK ELKTON**

Acceptance will be based on inspections performed at ATK Elkton facilities. ATK Elkton reserves the right to reject shipments that are found defective as a result of sampling.

9. **RESUBMISSION OF REJECTED ARTICLES**

All articles, including associated documentation, rejected by ATK Elkton and subsequently reworked to drawings, specifications, etc., shall bear indication of each resubmission. The accompanying documentation (discrepancy report, corrective action report, reinspection data, etc.), as required, shall be identified in the same manner as the article. The supplier shall contact the ATK Elkton procurement division for identification of articles submitted as replacement(s) for ATK Elkton rejected and supplier scrapped articles.

10. **PACKAGING**

When the drawing, specification, or purchase order lacks specific packaging instructions, the supplier shall use best commercial practices to ensure that the quality of the delivered part(s) is maintained and that damage, deterioration, and loss in transit are prevented.

Packaged items shall be free of dirt and other contaminants that would contribute to deterioration of the item or which would require cleaning by ATK Elkton prior to use. Items susceptible to corrosion or deterioration shall be provided protection such as preservative coatings, volatile corrosion inhibitors, or a desiccated environment. Items requiring protection from physical and mechanical damage, or which are fragile, will be protected by wrapping, cushioning, cartonizing, or other means to mitigate shock and vibration, and to prevent damage during handling and storage. Cushioning or wrap can be any suitable, appropriate material; except newspapers may not be used when painted surfaces are involved. Partitions or divisions must be used when necessary.

Items susceptible to damage by ESD shall be packaged in antistatic bags of conductive carbon (“black poly”) or antistatic bags per MIL-B-81705 Type III. All external and internal packaging shall be properly identified with “ESD Sensitive Item” labels. Transparent “pink poly” bags or material shall not be used where the material can come into direct contact with the product.

11. **FOREIGN OBJECT DAMAGE PREVENTION**

The supplier shall ensure that Foreign Object Debris (FOD) is controlled with the aim of preventing damage or degradation of the deliverable item, or of creating a hazardous condition to users of the deliverable item. Techniques that have been proven effective for control of FOD include: proper housekeeping; control of tools, personal items, and facilities; control of in-process hardware and consumables, including in-process scrap; kitting; and use of parts protective equipment.
12. FAILURE REPORT

ATK will be notified within 24 hours of any material, component, tooling, or motor case failure during manufacturing or testing. In addition, the supplier will submit to ATK written failure reports within 72 hours of any failure. Failure reports will identify the failed item by serial number, part number and applicable revision letter. The supplier will submit a failure analysis and corrective action report to ATK within 15 days of any failure. The report will include, as a minimum, the mode of failure, cause of failure, corrective action to be initiated, and a list of other parts affected.

CLAUSE 2

The supplier will, in the performance of this order, provide and maintain a quality assurance program that complies with or is equivalent to MIL-Q-9858, ANSI/ASQC Q9001:1994, or ANSI/ASQC Q9001:2000. ATK Elkton reserves the right to conduct a survey/audit of the supplier's facilities to determine the adequacy of the supplier's quality assurance system.

CLAUSE 3

ATK Elkton reserves the right to place quality assurance representatives (QARs) in the supplier's facilities, as deemed necessary, to ensure conformance with contractual requirements in any phase of design, processing, fabrication, testing, and inspection of the article(s) being produced. The supplier will provide all reasonable facilities and assistance for the safety and convenience of such personnel in the performance of their duties. Such representatives will be allowed full access to witness all operations involved in the fulfillment of this contract.

The supplier will grant the same access to representatives of the buyer’s customer, when accompanied by ATK Elkton personnel.

The supplier will secure the same privileges from lower-tier subcontractors.

CLAUSE 4

Products or services furnished under this purchase order will be inspected for compliance with quality and technical requirements of the purchase order at the supplier’s facility prior to shipment. Notwithstanding the results of source inspection, final acceptance will occur at destination. The buyer’s procurement representative must be notified 5 working days in advance of the shipment. If an ATK Elkton QAR is in residence at the facility, notification through procurement is not required.

The supplier will grant the same access to representatives of the buyer's customer, when accompanied by ATK Elkton personnel.
CLAUSE 5

The supplier is responsible for compliance with all quality and technical requirements imposed by ATK Elkton even when the supplier subcontracts part of the work. The supplier’s responsibilities with respect to subcontracted work include:

- Selection and control of subtier suppliers, unless otherwise specified in the purchase document.
- Transmission (flow down) of applicable quality and technical requirements to subtier suppliers.
- Assuring traceability of items processed through subtier suppliers.

It is the supplier's responsibility to assure that the purchase order to the subtier supplier requires sufficient acceptance data to clearly fulfill the requirements imposed by the ATK Elkton purchase order to the supplier.

CLAUSE 6

The supplier will submit, for ATK Elkton approval, plans for performing tests on raw, semi-finished, and/or finished materials, including proof pressure test. The data obtained from these approved tests will be made available to buyer and Government representatives upon request.

(NOTE: Approval of inspection planning applies to acceptance and qualification test procedures only at this time)

Any changes subsequent to the start of fabrication must be submitted for approval. Changes that affect the stated requirements of the part (Class I changes) shall be approved by the buyer prior to implementation. All other changes (Class II changes) may be submitted concurrently with implementation.

Buyer approval of plans referenced above will not be required if the plans have been approved on a previous contract. A list of the previously approved documents that will be used, including the document title, name, revision, and approval reference, must be submitted to the QAR, if in residence, and to the buyer prior to use.

CLAUSE 7

Prior to fabrication of any deliverable item, the supplier will provide, for buyer approval, the planned manufacturing, testing, and inspection procedures to be used in the fulfillment of this purchase order/subcontract. These procedures will include, as applicable, drawings of special tooling that may be used for dimensional acceptance and plans for performing tests on raw, semi-finished, and/or finished materials, including special process techniques to be approved by a
Level III at ATK. These procedures must document all operations that will be performed in conjunction with the fulfillment of this contract.

Buyer approval of plans referenced above will not be required if the plans have been approved on a previous contract. A list of the previously approved documents that will be used, including the document title, name, revision, and approval reference, must be submitted to the QAR, if in residence, and to the buyer prior to use.

Any changes to the approved planning must be submitted to the buyer. Changes that affect the stated requirements of the part (Class I changes) shall be approved by the buyer prior to implementation. All other changes (Class II changes) shall be submitted for concurrence in classification, and may be implemented immediately at the supplier's risk.

The supplier is responsible for meeting all drawing/specification and approved fabrication process requirements. Seller shall immediately notify the buyer of any change to seller's facility location(s) for the production of the material herein.

**CLAUSE 8**

First Article Inspection is required on this purchase order. One-hundred-percent inspection of all dimensions, including tool-controlled dimensions, drawing notes, material callouts, and specification requirements, will be performed on the first part produced.

Notify the buyer 5 working days in advance of anticipated FAI. ATK Elkton will either send a quality assurance representative to participate, or waive participation.

In the event FAI is waived, the supplier shall forward results to the buyer for concurrence. Shipment may not be made until either 1) concurrence is received, or 2) five working days have passed since receipt of FAI data at buyer’s facility.

If any of the below listed changes occur after FAI, notify the buyer so that ATK Elkton may determine if another FAI is required.

- A significant design or process change has been made that affects the original first article. An incremental first article will be performed, which will be applicable only to those characteristics affected by the change.
- A change in facilities or materials utilized to produce the article has taken place.
- New, reworked or revised special tools, gages or equipment, are introduced, when dimensional control of manufactured articles is affected.
- The supplier has not produced the item for a period of 12 months or longer.
**CLAUSE 9**

Nondestructive inspection, and inspection of critical and major characteristics as defined on the drawing, will be performed on each piece. Minor characteristics may be inspected 100% or may be sample inspected in accordance with ANSI Z1.4, Single sampling, General Inspection Level II, Normal Inspection. The AQL shall be chosen such that AC=0, RE=1. An attribute that is sample inspected and found discrepant shall be 100% screened.

The supplier is to perform dimensional inspection and record the results. Actual dimensions are to be recorded and reported for each piece inspected.

The supplier is responsible for meeting all dimensional requirements of the drawing.

**CLAUSE 10**

The subcontractor shall establish procedures to implement a Foreign Object Damage (FOD) Prevention program using NAS412 as a guideline. The program shall be proportional to the sensitivity of the product(s) design to FOD, as well as, to the FOD generating potential of the manufacturing methods.

Existing subcontractor practices and procedures that meet specific requirements shall be documented and submitted to the buyer for review and concurrence. The procedures shall include the following elements as a minimum:

- Guidance on practices that, when followed, will eliminate damage caused by foreign objects during manufacturing, rework, and assembly and test, including but not limited to:
  - Inspection of materials and components on receipt at the work station for cleanliness and damage, and ensuring that they are clearly and properly identified;
  - Continual cleaning of finished and in-process materials and the surrounding work area as part of the normal in-process work effort;
  - Steps in shop documentation to check for the presence of FOD;
  - Wearing attire that is appropriate for the specific work area – by both operators and transients – including removal of all personal items, including jewelry (e.g., rings, watches, necklaces, earrings, badges), and restraining of all eyewear and ear protection;
  - Elimination or limiting FOD-causing processes;
  - A program to prevent tools, accompanying documents, and other items necessary to the manufacture of the item from becoming foreign objects; and
• Ensuring that items not necessary to the manufacture of the item are not introduced into the work area
• Establishment and maintenance of a training program for the FOD program.
• Identification of those categories of employees who require FOD training.

**CLAUSE 11**

The supplier is responsible for assigning serial numbers as specified on the drawing, subject to the following:

• Serial numbers shall not be duplicated on this purchase order.
• Serial numbers shall not duplicate serial numbers delivered against prior purchase orders.
• If material is rejected, the serial number of the rejected part will not be used again.

Serial numbers shall be in the following format: Supplier’s CAGE code, followed by a dash, followed by the supplier-assigned serial number. Example: 3BJA0-00001. Total length of the serial number shall not exceed 20 characters.

**CLAUSE 12**

The supplier will maintain records necessary to show conformance with all requirements of the purchase order/subcontract. These records include dimensional inspection records, process control charts, temperature recorder charts, x-ray film, nondestructive testing records, personnel certification documentation, nonconformance reports, process qualification data, hydrostatic test records, and certifications of materials and special processes. These records will be maintained for the greatest of:

• A period as required by the contract;
• Five (5) years; or
• The shelf/use life specified by the drawing or procurement specification.

**CLAUSE 13**

A Certification of Conformance is required with shipment. The certification must include, for each part covered by the certification, the following minimum information:

• Purchase order number
• Part number and revision of the item supplied, as specified on the purchase order
- Drawing or specification number, with revision, for subtier documents
- Serial numbers covered by the certification (if serialized)
- A statement that the certified part meets all drawing, specification, and purchase order requirements
- Signature of the quality assurance manager or other responsible member of the supplier’s company
- The title of the person signing.

Material received without certification is subject to rejection and return to the supplier at the supplier's expense.

**CLAUSE 14**

The supplier must signify conformance to requirements of drawings and specifications by submitting a certification package containing, as a minimum, the information described on the attached “Certification Requirements” page. The certifications must be included with each shipment unless otherwise specified on the purchase order. Initialed data corrections are permitted. ATK Elkton cannot accept material unless the certifications are complete and correctly executed.

The supplier and subtier supplier through the supplier, if applicable, shall be responsible for meeting all requirements of drawing(s) and specifications. Actual acceptance inspection and test results must be maintained in supplier's files, subject to examination, indicating inspection, acceptance, and traceability of materials incorporated in the end item in accordance with governing drawings and specifications.

Records of inspections and tests must be maintained in supplier's files for a minimum of five (5) years from date of last shipment.

**CLAUSE 15**

Dimensional inspection and electrical test results per drawing requirements will be supplied with the certification package for each serial number (S/N). All certification package documentation and reports shall be traceable to the unit S/N. Actual dimensions and electrical test data/values must be recorded for each unit inspected and or tested. A range of dimensions or electrical values representing all units delivered is not acceptable.

All dimensional and electrical test reports and data that are required for the FAI per Clause 8 of this contract will be consistent and/or identical for subsequent S/Ns in the lot of a drawing/part number. Below is a list of inspection and test reports to meet this provision.
A. Certificate of Compliance

B. First Article Inspection (FAI)

C. Supplemental inspection report of the rest of lot S/Ns that contain the same characteristics as the First Article Inspection

D. Material certifications for all bill of material and alternate material items on the drawing

E. Product accountability sheet identifying all materials used in the cable assembly. Alternative materials shall be documented on this sheet as a separate section. These sheets must be traceable to the material certification. (All sections of this sheet that are left “blank” shall be filled out as “N/A”)

F. Electrical Test Report (FAI)

G. Electrical Test Report (S/NS after the FAI)

H. Pull Test Reports

**CLAUSE 16**

A Certification of Conformance to the special process(es) specified on the purchase order or drawing or specification is required with shipment. Material received without certification(s) is subject to rejection and return to the supplier at the supplier's expense.

The certification will contain, as a minimum, the following:

- Purchase order number, part number, revision, and serial number(s) of the part(s) covered by the certification;

  Applicable specification including, as applicable: revision, notice, amendment, type, grade, class, method, or other qualifier, as specified on the purchase order, drawing or specification;

- Signature of the quality assurance manager or other responsible member of the supplier’s company

- The title of the person signing.

Test data, radiographs, and/or residual test specimens prepared in compliance with the specification or purchase order will be supplied with the delivered parts.
CLAUSE 17

The supplier shall comply with all technical, quality assurance, certification, and packaging requirements of the specification to which this item is procured.

CLAUSE 18

All Material including material from “subtier” suppliers provided under this purchase order shall be supplied and certified to the exact drawing requirements, specification, revision, amendment, type, grade, etc. specified in the purchase order.

Marking shall be in accordance with purchase order, drawing requirements, and specification requirements and shall include traceability to the manufacturer’s records identifier (heat number, or other identifier).

A Certificate of Conformance shall be included with the shipment with the product certification package, and shall include:

- A statement that the material shipped meets purchase order requirements, including a listing of the specification, revision, amendment, type, grade, etc. as specified in the purchase order.
- Manufacturer of the material. Distributers shall not be an acceptable substitute for the manufacturer.
- Mechanical, electrical, and chemical test data supporting the conformance statement.
- The signature and title of the quality assurance manager or other responsible member of the supplier’s company who signs the certification.

Material received without certification is subject to rejection and return to the supplier at the supplier's expense.

Any change in processing techniques, materials, or other factors affecting the quality of the product shall be immediately brought to the attention of ATK Elkton.

CLAUSE 19

The supplier will certify that ATK-supplied material was used in the fabrication of part(s), listing ATK shipping document number, part number, lot number(s), and/or serial number(s) as applicable. ATK-furnished material will be handled and controlled so as to ensure its proper use in conformance to all requirements. The supplier will not in any way be relieved of the responsibility for compliance to traceability, identification, and certification requirements.
ATK Supplied Material Certification

Supplier is required to **complete and return** this certification to ATK, with the purchased product, to provide traceability of ATK supplied material to the purchased product. Failure to return this certification may result in rejection of the purchased product at ATK inspection.

**ATK Supplied Material Data**

ATK Shipping Document Number _____________________________

ATK Material Part Number _____________________________

Material Specifications (if applicable) _____________________________

**Purchased Product Data**

ATK Purchase Order Number _____________________________

ATK Part Number from Purchase Order _____________________________

Supplier Lot Number (if applicable) _____________________________

Supplier Serial Number (if applicable) _____________________________
**CLAUSE 20**

**Manned Space:**
Articles ordered in this contract are for use in Manned Space Flight. Materials, manufacturing, and workmanship of the highest quality standards are essential to astronaut safety. If you are able to supply the desired items with a quality which is higher than that of the items specified or proposed, you are requested to bring this fact to the immediate attention of the purchaser. This clause will be inserted in all subcontracts and purchase orders for such items down to the lowest tier.

**Right of Access:**
All work on this purchase order is subject to inspection and test by ATK Elkton and their customers, when accompanied by ATK personnel.

Over the life of the program, the Subcontractor shall recognize the right of ATK, its customers and/or the appointed Government representatives to participate in or perform audits, reviews, Mandatory Inspection Points (MIPs), source inspections and witness tests at the Subcontractor or their supplier’s facilities as appropriate. The Subcontractor shall provide a minimum of five working days advance notice prior to upcoming MIPs. The Subcontractor shall arrange facilities and accommodations with access to necessary work tools (desk, telephone, and internet access) for any ATK visitors and/or residents. ATK may wish to have on-site residents where the Subcontractor’s work is performed. The responsibilities of ATK representatives will be clearly defined by ATK.

**CLAUSE 21**

The Seller shall obtain the Buyer's approval of detailed plans and procedures for accomplishing all acceptance test required by the Buyer's drawings and specifications. Approval must be obtained prior to the Seller presenting hardware for acceptance. The witnessing of a demonstration of the procedures and equipment by the Seller is at the option of the Buyer. The detailed plans and procedures will contain as a minimum:

A. A list of all instrumentation, non-standard instrumentation calibration procedures, points of measurement and accuracy of measuring system.

B. Test conditions.

C. Test sequence.

D. Test Methods including a detailed step-by-step procedure of each test using instruments listed according to Item A. above. Supporting data for critical parameters or special equipment, such as: error analysis, schematic diagrams and panel layouts, which are not necessarily part of the procedure, but are required to adequately evaluate the procedure, shall be submitted as supplemental information.
E. Sample data sheets.

F. Quantity of test samples.
   a. 100% testing
   b. Lot acceptance
      i. Definition of lot
      ii. Determination of lot sample size

Buyer's approval must be obtained prior to Seller's implementation of subsequent changes to the acceptance test plan. Buyer approval of the test plan does not relieve the Seller of the obligation of meeting all requirements as listed in the Buyer's drawings and specifications.

NOTE: this requirement also applies to any qualification testing to be performed.
The following section is being flowed down as part of Orbital’s Subcontractor Product Assurance Requirements (SPAR) document 6029-GR2100, Revision -. Noted paragraph numbers are those corresponding to Orbital’s document.

2.0 APPLICABLE DOCUMENTS
The following documents provide guidelines from which the Orion Launch Abort System (LAS) program requirements are established. These documents form a part of this plan to the extent specified herein. Unless otherwise indicated, the latest revision in effect shall apply. In the event that specifications are obsolete or not maintained, the last active revision shall be used. In the event of conflict between requirements specified herein and other contractual documents, the following order of precedence shall apply: the applicable Subcontract, SOW, Performance Specification, and this Subcontractor Product Assurance Requirements document.

2.3 GOVERNMENT / INDUSTRY DOCUMENTS
ANSI/ASQC Z1.4 Sampling Procedure and Tables for Inspection by Attributes
ANSI-ESD S20.20 Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)
ANSI/NCSL Z450-1 Calibration Laboratories, Measuring and Test Equipment- General Requirements
ASTM-A967 Passivation Treatments for Corrosion Resistant Steel
ASTM-E595 Standard Test Method for Total Mass Loss (TML) and Collected Volatile Condensable Materials (CVCM) from Outgassing in a Vacuum Environment
ASTM-E1742 Standard Practice for Radiographic Examination
ASTM E8 Standard Test Methods for Tension Testing
ASTM-E1417 Inspection, Liquid Penetrant
AWS-C-3.3 Design, Manufacture and Inspection of Critical Brazed Components
CXP-02012 Methodology for Conduct of Project Constellation Hazard Analyses
CXP-02019 Constellation Program Requirements for Preparation of Hardware FMEA/CIL
IPC/EIA/J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies (Performance Class 3 with Space Addendum)
IPC-610 Acceptability of Electronic Assemblies
IPC-2221 Generic Standard on Printed Board Design, Amendment 1
IPC-6011(Class 3) Generic Performance Specification for Printed Boards
IPC-6012 Qualification and Performance of Rigid Printed Wiring Boards
IPC-6013 Qualification and Performance Specification for Flexible Printed Boards, Amendment 1
ISO-10012 Measurement Management Systems Requirements for Measurement Processes and Measuring Equipment
JPR 8080.5, E7 JSC Design and Procedural Standards, Section E-7, Electrical Components-restrictions on Use
JPR 8080.5, E22 JSC Design and Procedural Standards, Section E22, Ionizing Radiation Effects
JSC-49774A Standard Manned Spacecraft Requirements for Materials and Processes
MIL-C-5541 Chemical Conversion Coating
MIL-HDBK-61A Configuration Management Guidance
MIL-HDBK-103 List of Standard Microcircuit Drawings
MIL-HDBK-217 Reliability Predictions of Electronic Equipment
MIL-M-35810 Microcircuits, General Specification for
MIL-P-116 Preservation, Methods of
MIL-PRF-31032 Printed Circuit Board/Printed Wiring Board, General Specification
MIL-PRF-35835 Integrated Circuits (Microcircuits) Manufacturing, General Specification for
MIL-PRF-38534 Hybrid Microcircuits, General Specification
MIL-PRF-39003/10B Capacitors, Fixed Electrolytic (Solid Electrolyte), Tantalum (Polarized, Sintered Slug), Established reliability, Styles CSS13 and CSS33, (High Reliability Applications)
MIL-PRF-49470 Capacitor, Fixed, Ceramic Dielectric, Switch Mode Power Supply (General Purpose and Temperature Stable), Standard Reliability and High Reliability General Specification For,
MIL-STD-129 Marking for Shipment and Storage
MIL-STD-883 Test method of Standard Microcircuits
MIL-STD-889 Dissimilar Metals
MS20003 Indicator, Humidity, Card, Three Spot, Impregnated Areas
MSFC-STD-557 (1980) Threaded Fasteners, 6 Al-4V Titanium Alloy, Usage Criteria for Spacecraft Applications
NAS-412 Foreign Object Damage/Foreign Object Debris (FOD) Prevention
NASA-EEE-INST-002 Instructions for EEE Parts Selection, screening, Qualification and Derating
NASA-HDBK-7005 Dynamic Environment Criteria
NASA-STD-5006 General Fusion Welding Requirements for Aerospace Materials Used in Flight Hardware
NASA-STD-6001 Flammability, Odor, Offgassing and Compatibility Requirements and test Procedures for Materials in Environments that Support Combustion
NASA-STD-8739.1 Workmanship standard for Staking and Conformal Coating of Printed Wiring Boards and Electrical Assemblies
NASA-STD-8739.3 Soldered Electrical Connections
NASA-STD-8739.7 Electrostatic Discharge (ESD)
NASA-STD-8739.8 NASA Software Assurance Standard (Chapters 6 and 7)
NHB-8060.1 Office of Safety and Mission Quality Flammability, Odor, Offgassing, and Compatibility Requirements
NPR 8580.1 Implementing the National Environmental Policy Act and Executive Order 12114 QML-19500 Semiconductor Services, General Specification
SAE AS9100B Quality Management System- Aerospace-Requirements
SAE AS9003 Inspection and Test Quality System

2.4 GOVERNMENT / INDUSTRY REFERENCE DOCUMENTS
SAE-AMS-2759C Heat Treatment of Steel Parts, General Requirements
3.1.2 Product Assurance Reporting
Safety & Mission Assurance reporting shall be submitted as part of other subcontractor reporting requirements as specified in the SOW. The topics to be covered are non-conformances for the most recent period, significant changes or activities that affect assurance of flight hardware or software, progress on analyses that verify assurance activities, progress with environmental testing or any other concern that may impact product assurance. The format of this reporting activity shall be in subcontractor standard format, with ATK approval.

3.1.3 Right of Access
All work on the Orion Program is subject to inspection and test by ATK, Orbital, Lockheed Martin and the Government. Over the life of the program, the Subcontractor shall recognize the right of ATK, its customers and/or the appointed Government representatives to participate in or perform audits, reviews, Mandatory Inspection Points (MIPs), source inspections and witness tests at the Subcontractor or their supplier's facilities as appropriate. The Subcontractor shall provide a minimum of five working days advance notice prior to upcoming MIPs. The Subcontractor shall arrange facilities and accommodations with access to necessary work tools (desk, telephone, and internet access) for any ATK visitors and/or residents. ATK may wish to have on-site residents where the Subcontractor's work is performed. The responsibilities of ATK's S & MA representative will be clearly defined by ATK.

3.3.6 Service Life
All parts and materials shall be selected and qualified to support the required mission lifetime as defined in the Performance Specification or SOW. Specified environments and ground storage conditions are defined in the SOW or component's Performance Specification. For parts and assemblies having life characteristics defined by operation cycles (e.g., electro-mechanical devices such as relays, switches, etc.), the life assessment shall consider the expected number of cycles during ground test followed by normal operation over the life of the mission. Any limitations on ground test cycles shall be defined by the Subcontractor and shall be included in the Contract End Item (CEI) Interface Control Document (ICD). As a minimum, components that have cycle lifetime limitations shall be qualified to at least two times their expected lifetime.

3.3.8 Mishap and Safety Statistics Report
The Subcontractor shall perform mishap investigations, generate mishap reports and provide monthly mishap and safety statistics report in accordance with the SOW. Mishap Reporting shall start with the manufacturing of hardware.
The objective of the mishap and close call investigation is to improve safety by identifying what happened, where it happened, when it happened, why it happened and what should be done to prevent reoccurrence and reduce the number and severity of mishaps.
The supplier shall report unplanned events that result in the following:
1. Injury to non-NASA personnel caused by NASA ops
2. Damage to public or private property caused by NASA ops or NASA funded development or research projects
3. Occupational injury or illness of NASA personnel
4. Damage or destruction of NASA property

Test failures involving damage to equipment or property as a result of testing are not considered mishaps if:
1. The test article is not flight hardware
2. The testing is part of an authorized research/development/qualification certification program
3. Damage is limited to the test article and test instrumentation
4. Risk of damage to the test article was accepted explicitly by Program/Project management
5. The test team performs a test failure analysis and generates a technical report instead of treating it as a mishap

3.4.7 Failure Reporting and Analysis
The Subcontractor shall define and implement a failure reporting system that addresses both flight hardware and flight software including critical GSE that interfaces with the flight hardware. Failure reporting and analysis shall begin at the time of first application of power to a space flight circuit card assembly or first application of software into the flight hardware system, or first actuation of a flight mechanical element. The Subcontractor shall notify ATK within 24 hours of problem/failure/anomaly occurrence. Problem identification and failure analysis shall be initiated, documented, and continued until resolved to successively lower levels of assembly, ending with, if necessary, a Destructive Physical Analysis (DPA) at the piece-part level. The scope of the analysis shall be to identify the source (i.e., root cause) of the failure, any potential overstress conditions on other EEE parts in the circuit, and develop a positive corrective action to eliminate failure recurrence.

3.4.8 Traceability
The Subcontractor shall maintain traceability of installed flight parts by part number, manufacturer, lot number, and date code (including individual part serialization when provided via the certificate of compliance), and to the data supplied through the as-built configuration documentation (i.e., manufacturing records for each deliverable item). The Subcontractor’s traceability system shall ensure the capability to correlate historical records from initial procurement and receipt of items through storage, kitting, fabrication, assembly, test, and final acceptance of deliverable qualification and flight hardware. The system shall permit the tracing of the quality histories of assemblies, components, parts, and materials to the procurement document and shall provide for (1) cross-referencing of traceability data to assembly documentation, and (2) the storage of accumulated history and traceability data. The Subcontractor shall use photographic records to supplement manufacturing records on part number and lot date code traceability.

3.4.9 Industry Alerts (GIDEP)
The Subcontractor shall participate in the Government/Industry Data Exchange Program (GIDEP) throughout the program duration. The subcontractor shall review all GIDEP Alerts, GIDEP Safe-Alerts, GIDEP Problem Advisories, GIDEP Agency Action notices, NASA Advisories, ESA Alerts (if applicable), and any informally documented component issues presented by NASA/Lockheed Martin through ATK to determine if they affect the subcontractor products produced for ATK. The Subcontractor shall monitor part procurements and parts drawn from stock for impacts of any of the above alerts or advisories. Parts traceable to date codes and manufacturers listed in alerts shall not be used without additional analysis and ATK’s consent.
In lieu of participation in the GIDEP program, European subcontractors shall be active participants in the ESA Alert System. Participation shall include the assignment of an Alert Coordinator who shall serve as the ESA Alert focal point. The subcontractor shall review all ESA Alerts to determine if any are applicable to hardware in process or delivered for use on the flight system. The subcontractor shall notify the hardware user of any applicable Alerts. Upon request, subcontractors shall provide their internal procedures that describe how participation in the ESA Alert Program shall be performed.
3.5.2 **Procurement Specifications**
Material intended for flight usage shall be procured to controlled procurement specifications. These specifications or drawings shall describe the physical, electrical and environmental requirements and shall identify the Quality Assurance provisions that control the manufacture and acceptance of the material.

3.5.4 **Source Surveillance, Inspection, Audits and Survey**
Source inspection and surveillance requirements shall be imposed on suppliers of critical or complex materials and sub-tier suppliers whose process controls are considered to be marginal or program risk is a concern. Audits and surveys shall be performed to monitor conformance to procurement documents and product specifications.

3.5.5 **Traceability**
Flight equipment material shall be traceable by part number, manufacturer and batch/lot code and to the data supplied in accordance with its specification through the as-built configuration documentation (i.e., manufacturing records for each deliverable item). Any shelf life extension data/info shall be maintained with this traceability.

3.5.9 **Materials Selection**
Material selection shall be controlled in order to meet the quality, reliability and cleanliness (i.e., contamination control) requirements of the Orion Program. Materials or processes shall be suitable and adequate to perform their intended function over the range of environments as specified in the Performance Specification during the storage and operational life of the hardware. Suitability may be established by heritage design in similar space flight applications, environments, durations, or by test and analysis. Processing criteria shall be selected to assure that all necessary technical and quality assurance requirements exist to control materials processing, hardware assembly, and integration operations.

a. **Vacuum stability (Applies to Inhabitable Flight Components, Only):** Materials shall contain a minimum of volatile components that are susceptible to outgassing in a space environment. Organic material selected for flight hardware shall meet outgassing requirements in accordance with ASTM-E-595 for total mass loss (TML) shall be less than 1.0% and for collected volatile condensable material (CVCM) shall be less than 0.10%, when tested in accordance with ASTM-E-595. The Subcontractor shall document the outgassing data source. If data are unavailable for the material being used or the materials do not meet these guidelines, the following criteria shall be used to determine if an exception to the vacuum stability requirements is allowed:
1. TML greater than 1.00% is attributable to desorbed water vapor while meeting the %CVCM requirements
2. Using Arrhenius rate equations, the material’s out-gassing properties shall be less than 1.0% TML and 0.1% CVCM at maximum use temperature.
3. The material is hermetically sealed by metallurgical joints or other means.
4. For components/parts using organic materials not meeting the 125°C out-gassing criteria, tests at vacuum of at least 10⁻⁶ and temperatures 10°C above maximum component/part application temperatures may be utilized to determine if the 1% TML and/or 0.1% CVCM criteria shall be satisfied. No change in 0°C witness plates' thermal optical properties (α or ε) shall also suffice as proof that no deleterious out-gassing has occurred at +10°C over application temperatures.

b. **Inorganic materials:** All exposed inorganic materials shall have a specified surface treatment such that no bare (basis) metal surface is exposed. Selection of proper surface treatments, finish materials, and application methods shall be governed by the type of material used, environment, functional design, handling and storage conditions.
Metallic plating and thickness shall be chosen with consideration for the specific application to ensure protection against wear, corrosion, metallic migration, objectionable intermetallics, etc. Component’s mounting surface shall be free from paint or other non-conducting finishes.

c. Propellant compatibility: Metallic and nonmetallic materials that are exposed to propellants for the fluid system or may be exposed to the propellant(s) will not catalyze or accelerate fluid decomposition when tested in accordance with NHB-8060.1. Metallic materials directly exposed to propellants shall not exhibit surface corrosion in excess of a rate of 1 mil per year when tested in accordance with ASTM A279.

d. Corrosion: Metallic materials selected for use on flight hardware shall be corrosion resistant or protected from corrosive environments by finishing per MSFC-SPEC-250A, and prevention of moisture condensation on corrosion susceptible hardware by environmental control or using seals and metallurgical joints. When selecting materials, ground based and flight environments shall be considered. Incompatible couples defined by MIL-STD-889 shall be avoided. Such dissimilar metals may be used in intimate contact, but only if the assembly is protected against galvanic corrosion by a method listed in MIL-STD-889 and in such a manner as to preclude moisture.

e. Stress corrosion: Metals and alloys that are susceptible to stress corrosion cracking shall be avoided in sustained tensile applications. Applications that use susceptible materials shall be designed such that long term, sustained tensile stress levels experienced are at least 10% below threshold for initiation of stress corrosion cracking. MSFC-STD-3029 or other approved method shall be used as a guide in determining susceptibility.

f. Non-magnetic materials shall be used for all metallic parts except where magnetic parts are essential. All hard magnets such as solenoid cores, motor poles, and any spring steel parts shall be approved by ATK prior to incorporation into the design.

g. Lubricants: used in an intermediate assembly step will be avoided, where possible. For example, silicone spray mold release agents applied to press-fit connectors for ease of assembly shall be avoided for contamination control reasons. All lubricants used, including "temporary" or "secondary" lubricants, must be specified on the organic materials list. Lubricants shall be stable under vacuum environments, shall be stable over the temperature range of operation, shall meet minimum out-gassing rate requirements, shall not degrade in their application and shall not be allowed to contact another lubricant in any application. All fasteners and hardware used in integration/assembly shall be free of all contaminants, especially oils and grease.

h. Composite materials containing graphite fibers shall be treated as graphite in MIL-STD-889. Exterior and exposed materials (primarily thermal control materials) shall be capable of functioning as intended in the ATK charged particle radiation environment predicted for the orbit and mission lifetime.

i. Fasteners shall be procured and managed per JSC-49774A.

j. Flammability: Organic materials for flight use shall be nonflammable or self-extinguishing in air in the application configuration when tested in accordance with NASA-STD-6001. In the event that a material does not meet flammability requirements, the material may be used, if it can be demonstrated that a minimal hazard exists based upon propagation rate, surface area, and degree of containment.

k. Radiation sensitivity and Electrostatic Charging: Exterior and exposed materials shall be capable of functioning as intended in the orbital charged particle radiation environment.

3.5.10 Prohibited Materials
The following materials are prohibited from use in any flight hardware application, unless explicitly approved in writing by ATK:
b. Cadmium (Cd) and/or Zinc (Zn) plating and silver brazing alloys containing cadmium and/or zinc,
c. Any hardware utilizing pure tin (Sn), (i.e., with a purity level higher than 95%),
d. Any hardware containing pure bismuth (Bi) or pure lead (Pb),
e. Corrosive solder fluxes,
f. Corrosive generating silicone sealants,
g. Silicone based thermal grease is to be avoided unless used on heritage hardware and with an explicit method of removal of silicon residue,
h. Silicone materials usage shall be avoided to the greatest extent possible,
i. Use of mercury and mercury compounds,
j. Polyvinyl chloride (PVC).
k. Polyimide (Kapton) tape with silicon adhesive. and
l. Teflon (PTFE or FEP) coatings or insulations shall not be used without appropriate review of the application due to potential cold flow, charging, and radiation effects.
m. Silver cased wet slug tantalum capacitors
n. Any non-hermetically sealed part that contains a fluid, such as an aluminum electrolytic capacitor

o. Solid tantalum capacitors used in a low impedance application of less than 1 ohm/volt unless each part has been surge current tested to the test procedure defined in MILPRF-39003/10B
p. Sealed parts with internal voltages greater than 200 volts that are used in a vacuum environment and have a maximum leak rate which will allow the internal cavity pressure to reach 50 torr over the parts mission life
q. Parts with internal plating of pure tin
r. Use of cartridge style fuses in a vacuum environment with greater than 50 volts DC applied
s. Switches, relays bimetallic thermostats, and other mechanical contact devices:
t. Used in a voltage application for which they were not specifically qualified and proven
u. With higher rated contacts used in a low voltage or current application unless specifically recommended by the device manufacturer

3.5.11 Process Criteria
The Subcontractor shall assure that the technical and quality assurance requirements necessary to control materials processing, assembly, and integration operations exist and are implemented. The selection and use of processes shall be subject to the applicable guidelines specified herein.

a. Heat Treatment: Heat treatment of metallic parts shall be in accordance with the following specifications, as applicable, and subject to the applicable guidelines specified herein:
1. Aluminum Alloys: SAE-AMS-2770, SAE-AMS-2772
2. Nickel Alloys: SAE-AMS-2774
3. Steels: SAE-AMS-2759
4. Titanium Alloys: SAE-AMS-H-81200A

Heat treatments not included in these specifications may be used, provided sufficient test data are available to substantiate that the heat treatment process improves the properties of the specific alloy without increasing any susceptibility to degradation and is approved by ATK. Test coupons shall be heat-treated at the same time and in the same furnace as the heat treated production parts and maintained for reference. Control records shall be maintained for the time and temperature of processing the heat-treated
parts. Ferrous materials heat treated to high tensile strengths (>160ksi) and then cleaned in an acid bath or which require plating shall be baked for 24 hours at 132°C ±2°C to alleviate hydrogen embrittlement. Total decarburization shall not be present on any machined finish surface. Partial decarburization may be present to a maximum depth of 0.003 inch unless otherwise specified.

b. Metallurgical Joining: Suitability of the equipment, processes, supplies, and supplementary treatments and procedures selected shall be demonstrated by qualification testing of welded or brazed specimens that are representative of the materials and joint configurations used for production.

c. Dissimilar Metals: Dissimilar metals shall not be welded unless approved by ATK.

d. Brazing: Brazing operations shall be performed in accordance with AWS-C-3.3 or to an equivalent Subcontractor procedure. Fluxes shall be thoroughly cleaned from all brazed joints. A silver nitrate test in accordance with AWS-C-3.3 or an equivalent Subcontractor procedure shall be performed to verify joint cleanliness. Representative brazed joint test coupons shall be processed in the same manner as the production part joint and maintained for reference.

e. Joint Inspection: All welded joints and repair welds shall be dye penetrant inspected in accordance with ASTM-E1417 or magnetic particle inspected in accordance with MILSTD-1949 or equivalent Subcontractor procedures. All structural welded joints (including pressure system weld joints), or repair welds, and brazed joints shall be dye penetrant inspected or radiograph inspected in accordance with ASTM-E1742 or equivalent Subcontractor procedures. Welding shall be in accordance with NASA-STD-5006.

f. Surface Preparation: All surfaces to be bonded, coated, or sealed shall be properly prepared and cleaned to defined and proven process methods to assure adequate adhesion of adhesive, thermal control coatings, or sealant to the designated surfaces.

g. Soldering and Electronic Assembly: Soldering and electronic assembly shall be performed to IPC/EIA J-STD-001 (Class 3 with Space Addendum), NASA-STD-8739.3, or ATK-approved equivalent.

h. Crimping and Wire Harnesses: Crimping and Wire Harnesses shall be per JPR-8080.5 (with the exception that NASA-STD8739.4 is not required), or an ATK-approved equivalent.

i. Printed Circuit Boards: Printed Circuit Board Qualification and Performance shall be per IPC-6011 (Class 3) and IPC-6012.

j. Conformal Coating and Staking: Conformal Coating and Staking shall be per NASASTD-8739.1, or ATK-approved equivalent.

k. Electro-Static Discharge (ESD): See Section Electrostatic Discharge (ESD) Protection.

l. Fasteners: The installation of titanium fasteners and associated parts shall meet the requirements of MSFC-STD-557. Fastener locking requirements are specified in JSC-49774A section 4.6.4.1.

3.5.12 Corrosion Control - Compatibility of Process Materials

The Subcontractor shall insure that processes or materials will not have any deleterious effects on metallic materials or their properties. As an example, chlorinated and sulfonated fluids and solvents shall not be used with titanium and nickel alloys. All flux materials used for soldering operations on printed circuit board assemblies shall be removed to prevent corrosion and/or contamination.

3.5.13 Adhesive Bonding

Structural Adhesive Bonding shall meet the requirements of MSFC-SPEC-445A; with the exception of paragraph 3.1.1.1.

a. Surface Preparation: The Subcontractor shall insure all surfaces to be bonded, coated,
sealed shall be properly prepared and cleaned to defined and proven process methods to assure adequate adhesion of adhesive, thermal control coatings, or sealant to the designated surfaces.
b. Curing: Processes shall allow for adhesives and coatings to cure at ambient conditions. An accelerated cure for materials is generally not recommended unless previously proven and standardized for a certain material.
c. The supplier shall document the mix ratio and cure times of all adhesive mixes used on deliverable hardware.

3.5.14 Age Sensitive Material
Limited shelf life materials shall be so marked with expiration date and controlled in accordance with Subcontractor’s standard procedures. These materials shall not be processed beyond the stated shelf life expiration date unless based on test information supplied by the manufacturer and/or obtained from Subcontractor internal test methods. Test information used to extend the shelf life of any material used shall be maintained by the subcontractor as a quality record. Appropriate mix, cure, and batch information is retained with the product build documentation for traceability purposes.

3.6 SAFETY PROGRAM
The purpose of the Safety Program is to assure that the equipment is designed, manufactured, tested, stored, delivered, and operated in such a manner that the risk of hazards to personnel, flight hardware, and facilities during all manufacturing, test, launch and mission phases are minimized to an acceptable level.

3.6.1 Safety Requirements
The subcontractor’s products shall be compliant with applicable requirements with respect to the hardware and software supplied by them for the program. Design Safety requirements shall be established and followed to minimize hazards.

3.6.2 Safety Responsibilities
The equipment designs and procedures shall be examined to identify hazardous operations (including those initiated by inadvertent software commands), hazardous equipment (GSE), assemblies, or materials, initiate hazard reports, monitor the resolution of deficiencies, and ensure that results of safety and hazard analyses are implemented in the designs.

3.6.3 System Safety Hazard Analyses
Safety analyses as described in the SOW shall be performed in accordance CxP-02012 to systematically analyze the conditions, which may create and/or propagate hazards. The safety and hazard analyses shall be initiated early in the design phase and kept current throughout the development phase. Identified hazards which result in a Critical or Catastrophic risk to personnel, the Crew Exploration Vehicle (CEV), the flight equipment, the test equipment or facilities shall be modified to reduce the risk to Marginal or Negligible severity or be so unlikely that it can be assumed the hazard will not occur. The Subcontractor shall document all hazards in a hazard analysis and shall submit the hazard analysis to ATK for review and approval in accordance with the Statement of Work. Any changes to design or operation which impact safety shall cause the analysis to be updated and resubmitted to ATK.
3.7.3 Acceptance Data Package
For each Contract End Item (CEI) the Subcontractor shall submit an Acceptance Data Package (ADP) to ATK upon satisfactory completion of final acceptance testing and inspection in accordance with the requirements of the SOW. A comparison of the As-Designed versus As-Built configuration shall be performed and the differences shall comprise a portion of the ADP. The ADP shall also contain all Acceptance, Proto-flight, and Qualification Test data and reports, as-run test procedures, Certificates of Compliance/Conformance, Material Review Board (MRB) Reports, Failure Analysis Reports, Deviations, and Waivers, version control history of software, requirements verification matrix, test hours at box level, and any Open Items hardware shortages and any data that serves as objective evidence of requirements compliance. The supplier shall take multiple photographs of all interior/exterior workmanship of each flight unit, and these photos shall be included with the ADP. The photos shall be of sufficient resolution to show workmanship quality detail.

3.8.2 Purchasing Control and Incoming Inspection
The Orion Program is a Manned NASA Space Program. The following Quality Clause statement shall be added to all procurements, in addition to the regular Quality Clauses that define the scope of work:

“Manned Space Flight-
Articles ordered in this contract are for use in Manned Space Flight. Materials, manufacturing, and workmanship of the highest quality standards are essential to astronaut safety. If you are able to supply the desired items with a quality which is higher than that of the items specified or proposed, you are requested to bring this fact to the immediate attention of the purchaser. This clause will be inserted in all subcontracts and purchase orders for such items down to the lowest tier.”

Procedures and responsibility for controlling the quality of procured components, parts, material, and services are defined and implemented in accordance with the Subcontractor’s Quality System Manual and Procedures. The overall objective is that each procurement from outside sources be planned, reviewed, and approved by Source Acceptance personnel, and controlled utilizing the following requirements as a minimum:

a. Assure clear definition of requirements in source control documents, specifications, engineering drawings;
b. Purchase requisitions and purchase orders include all appropriate drawings, specifications, requirements, special handling instructions, and proper receiving inspection codes/instructions;
c. Selection, control, and review of qualified subcontractors and suppliers through site surveys, audits, and maintenance of a supplier rating system utilizing previous performance history results;
d. Agreement on quality assurance and verification methods (i.e., source inspections, test data review, DPA, etc.);
e. Plans, controls, and records for verification of purchased components; parts, materials, and services provide acceptable product quality and reliability for mission success.

Incoming items shall not be accepted for use on the Program unless they meet the requirements of the technical documents, the subcontract or purchase order, or other program requirements. The Subcontractor shall maintain records of inspections performed on parts and materials received from suppliers.
3.8.3 Contractor Furnished Equipment (CFE)/Government Furnished Equipment (GFE)
The Subcontractor shall establish and maintain documented procedures for controlling
equipment and material supplied either by ATK and/or ATK's customers or suppliers for
incorporation/test of the deliverable products. Any nonconforming CFE/GFE shall be subject to
MRB action. The Government can review the subcontractor's procedures for GFE. The
procedure shall include the following provisions:
  a. Examination of the item and its packaging to detect any damage in transit,
  b. Determine correct quantity, completeness, and identity as specified in the shipping
documents,
  c. Check for presence and completeness of any required documentation,
  d. Verify any required ATK or customer/Government certification,
  e. Report on any damages at receipt or during use,
  f. Verify ATK or customer/Government inspection,
  g. Appropriate inventory, storage and handling.

3.8.4 Control of Inspection, Measuring, and Test Equipment
The Subcontractor shall maintain objective evidence for certification of calibration for inspection
devices and measurement and test equipment used to produce, inspect, and test deliverable
flight hardware. Records certifying that tests have been performed as well as the parametric
results of such tests are maintained for each piece of equipment and are made available to
ATK, upon request. The Subcontractor shall maintain a documented metrology system
compliant to U.S. or International standards to validate equipment for conformance to
specifications. The Subcontractor's system shall meet the requirements of ISO10012 or
ANSI/NCSL-Z540-1. Traceability to the recognized national and/or international calibration
standards is maintained and recorded. The system provides for the selection, approval,
calibration, maintenance, control, and recall of inspection and test measuring equipment on an
on-going basis.

3.8.4.1 Control of Accuracy
Inspection, Measuring, and Test Equipment (IM&TE) is controlled to assure that supplies and
services presented to ATK for acceptance have been tested with equipment of sufficient
accuracy to verify conformance to prescribed performance requirements. Subcontractor
maintains a calibration system in accordance with their Quality System Procedures with controls
to assure accuracy and traceability to National or International measurement standards. Test
readiness documentation or test procedures shall include measurement tolerances, a listing of
required equipment, whether that equipment requires calibration, and provisions for listing
actual equipment used. Measuring equipment shall have precision nominally an order of
magnitude or greater than that required for the measurement data, not less than a factor of four
for typical measurements, and five for critical measurements.

3.8.4.2 Indication of Calibration Status
Individual measurement and test equipment will be periodically recalled to verify dimensional
and operational characteristics as required by the Metrology Department. The calibration status
of each measurement tool or piece of test equipment is identified by a readily visible label that
includes the re-calibration due date, the assigned control number used for identification and
traceability purposes, and the name of the Metrology technician who performed the calibration.

3.8.4.3 Production Tooling Used as Media of Inspection
Production tooling used as a medium of inspection is initially proven for accuracy at the time of
receipt (or manufacture, if produced by Subcontractor) and prior to release to production.
Accuracy is proven by tryout of the tool in the designated work area with subsequent Product
Assurance inspection using an independent, previously calibrated instrument. When acceptable, the tool is assigned an identification control number, a calibration record is prepared, a calibration status label is attached, and the tool is released to the work area for usage. Unacceptable tools are rejected by the Product Assurance inspection. All tooling used as a media of inspection is subject to periodic recall and re-verification of accuracy. The periodic verifications are controlled through calibration due dates established by the Metrology Department.

3.8.5 Foreign Object Debris (FOD) Controls
The subcontractor shall maintain a Foreign Object Debris (FOD) Control Program in accordance with NAS-412. Process control requirements for metallurgical, chemical, cleaning, bonding, welding, brazing, coating, plating, painting, soldering, radiography, ultrasonic, magnetic particle detection, and other special processes shall be developed and reflected in the Subcontractor process specifications. Processes, including electrostatic discharge (ESD) protection/prevention, contamination control, and special environmental control shall be specified in design drawings and specifications. The Subcontractor shall maintain the deliverable hardware and lower level components during all phases of manufacture, inspection, test, and storage in an environmentally controlled area with temperature, humidity, cleanliness, and ESD prevention controls in-place. The area used for temporary storage of the flight parts/material shall prevent mechanical and electrical degradation of the items. Full traceability shall be maintained and special attention given to those items requiring special storage conditions, (e.g. electrostatic discharge sensitive components, nitrogen storage, etc). A quarantine item shall be segregated from conforming items in order to allow the segregation of discrepant/failed items. The traceability of the quarantined items to the corresponding discrepancy or nonconformance reports shall be maintained.

Flight hardware shall be maintained in visibly clean assembly areas. Handling shall be minimized after final testing, and then only with clean, lint-free gloves. Product packaging shall also maintain cleanliness.

3.8.9 Workmanship Standards
The subcontractor shall document its Workmanship Standards, and they shall be available for review (on-site) by ATK, ATK’s Customer, and the Government. Standards of workmanship shall be defined directly in hardware specifications and/or assembly drawings or by reference to Subcontractor, Industry, or Government documents. Soldering workmanship standards shall be as defined in the documents IPC/EIA J-STD-001C (With Space Addendum, Performance Class 3), NASA-STD-8739.3, or ATK-approved equivalent. Cabling and harness workmanship standards shall be defined in JPR-8080.5 or equivalent. General workmanship shall meet the requirements of MIL-HDBK-454 or equivalent. Rigid PWBs must be procured and manufactured to MIL-PRF-31032 or IPC-6012B Class 3/A, and rigid-flex PWBs shall comply with MIL-PRF-31032 or IPC 6013 or equivalent. PWB design shall be in accordance with IPC-2221 or equivalent Circuit cards and other electronic assemblies shall be conformal coated per NASA-STD-8739.1 using a low outgassing material such as Parylene, Arathane (Uralane) or equivalent; any exceptions to the conformal-coating requirement must be approved by ATK. Deviations to this requirement may be acceptable with ATK approval. The conformal coating shall allow reasonable repair or rework. Subcontractor and supplier workmanship standards and procedures employed on the program shall be made available to ATK, upon request, for review. The supplier shall take multiple photographs of all interior/exterior workmanship of each flight unit, and these photos shall be included with the EIDP. The photos shall be of sufficient resolution to show workmanship quality detail.
3.8.11 Manufacturing and Test Operations
Fabrication, assembly, and test operations shall be performed in accordance with manufacturing planning documentation. ATK reserves the right to add Mandatory Inspection Points (MIPs), Test Readiness Reviews (TRRs), and Pre-Shipment Review (PSR) as defined in the SOW. Subcontractor personnel responsible for performing special processes shall be certified. Records of certified individuals shall be maintained. Inspection personnel shall be thoroughly familiar with the requirements to be met in order for the process to be properly accomplished. Mate/de-mate logs shall be maintained for all flight connectors showing dates, operator, torque. Connector savers shall be used, wherever practical. Final mates and torquing of fasteners shall be witnessed by QA, shall be clearly documented, and torque-stripping or lockwiring shall be used on all torqued fasteners.

3.8.12 Final Acceptance Test
Acceptance, protoflight, or qualification tests (environmental and functional) shall be carried out as required by Subcontract documentation (SOW, Performance Specification) and shall be implemented according to procedures reviewed and approved by ATK in advance of their performance. A minimum of 200 operating hours shall be achieved on each electronic flight article prior to delivery, and the last 100 hours shall be failure-free. Compliance with this metric shall be clearly documented in the End Item Data Package (EIDP).
Subcontractor Quality Assurance shall ensure that test operations are performed in compliance with these plans and procedures by the following methods:

a. Work area surveillance,

b. Test surveillance.

The Subcontractor shall notify ATK of Qualification testing and final acceptance test activities prior to the beginning of the tests. The Subcontractor test conductor shall initiate a Nonconformance/Test Failure Report as described in section 3.9 and notify the cognizant ATK engineer within 24 hours in the event that an out-of-specification condition, anomaly, or variation/deviation to the test procedure occurs. Subcontractor Quality Assurance personnel shall review the test documentation to ensure that such occurrences have been noted and test failure reports and analyses are generated.

3.8.13 Test Specifications, Procedures, and Data Sheets
Final acceptance test procedures shall indicate the parameters to be tested, the calibrated equipment to be used, the environment in which the test is to be conducted, the test conditions and levels, and the acceptance criteria. Test data sheets shall become part of the EIDP documentation and shall be retained as objective evidence of conformance to the requirements.

3.8.14 CEI Nameplate and Product Marking
The Contract End-Item (CEI) shall be marked for identification. The marking method shall be permanent and shall remain legible after exposure to the test environments of the Performance Specification. Materials and processes used for marking shall comply with the requirements of section MATERIALS AND PROCESSES PROGRAM. Paper decals shall not be used. The identification shall include the following as a minimum:

a. Nomenclature:
b. ATK Product Specification Number:
c. Serial number
d. Contract Number:
e. Manufacturer’s Name or Trademark and CAGE Code.
f. Date of Manufacture (month/year). The date of manufacture is typically the delivery date.
g. Manufacturer’s Part Number, Serial Number, and Revision Level.
Hardware or equipment that is not suitable for use in flight and that could accidentally be substituted for flight or flight spares shall be red striped with material compatible red paint to prevent such substitution. In the event the hardware is too small to be easily striped, or if test performance would be affected by striping, a conspicuous red tag marked “NOT FOR FLIGHT USE” shall be attached. Wires and cables for hardware shall not be identified by hot stamping directly onto primary or secondary (shielded) insulation.

3.8.15 Protection, Packing, Handling, Marking, and Shipment
Engineering drawings, procedures, or specifications shall be generated which define the instructions and requirements for the preservation, packaging, handling, cleanliness preservation, storage, and shipping of flight articles and materials. These requirements, or special requirements invoked via the subcontract SOW, shall be incorporated into work authorizations, planning documents, and operating procedures to ensure that delivered products are protected against damage and deterioration as well as meet the environmental control and contamination control requirements.

3.8.15.1 Protection and Preservation
Items subject to deterioration or corrosion by contact with air, humidity, or other factors during handling, construction, temporary storage periods, or transportation shall be cleaned and protected by a process designed to minimize exposure to the detrimental condition. Storage areas shall be well lit and suitably environmentally controlled.
Electrical connectors shall be closed with suitable ESD protective caps or plugs, or connector savers with end caps. During test operations (or other activities requiring electrical connection to flight interfaces) use of connector savers is required to the maximum extent possible.
The Subcontractor shall be responsible for the preservation and packaging of the deliverable items in a manner that shall prevent contamination, corrosion, deterioration, and physical damage and insure safe delivery in good condition in accordance with MIL-STD-129 or equivalent. Packaging of the unit for shipping and storage shall insure that condensation on the unit does not occur. Do not use “pink poly” (polyethylene) for bagging or packaging.

3.8.15.2 Electrostatic Discharge (ESD) Protection
The Subcontractor shall maintain a NASA-STD-8739.7, ANSI/ESD-S20.20 or equivalent ESD program to protect electronic parts, assemblies, components, subsystems, systems, and spacecraft from electrostatic discharge during handling, storage, and transportation that could damage or degrade the reliability of the deliverable items including critical ground support test equipment. Electrical connectors shall be closed with suitable ESD static dissipative dust caps or plugs, or connector savers with ESD end caps.

3.8.15.3 Contamination Control, Cleanliness Control, and Clean Room Requirements
To comply with strict contamination and cleanliness controls, more stringent clean room requirements may be imposed for specific components in accordance with the applicable SOW and Performance Specification.

3.8.15.5 Packing and Shipment
Shipping containers shall identify the location of the documentation package. Items shipped shall be subject to final packaging and inspection, which shall ensure that:
a. Articles are complete and assembled as required, and have satisfactorily passed applicable inspection and test,
b. Accompanying documents are complete, are properly identified, indicate the inspection status, and contain traceability information,
c. Article have preserved and packaged in accordance with the applicable procedures and requirements which fully protect the unit during transport,
d. Packaged articles have been identified and marked in accordance with the requirements to ensure safe arrival and ready identification at the destination,
e. “Pink Poly” material shall not be used with delivered hardware,
f. Approved metallized ESD-protective bags shall be used for all EEE hardware,
g. Handling devices, shipping containers, and transportation vehicles are suitable for the articles involved,
h. Loading and transportation methods conform to the applicable requirements.
i. Moisture indicators that shall provide evidence of humidity levels beyond the specification level allowed,
j. Gaseous nitrogen (N2) purge systems for equipment that require such cleanliness or contamination control, and
k. Heat from foam-in-place packaging material shall not exceed temperature rating of deliverable hardware.

3.8.15.6 Marking and Identification
The outside of the container shall show arrows indicating the correct “up” orientation of the container and, where applicable, markings of “ESD”, “Clean Room Open”, and/or “Fragile” warnings. If it is required that the container be opened in a clean room, a Notice shall be marked clearly on the top face of the shipping papers attached to the container. The shipping packages/containers shall contain documents with the following information:
   a. Addressee at ATK,
   b. Content (part number, serial number, description, and quantity),
   c. Measured Weight (gross and net) in kilograms (on container),
   d. Overall size (on container),
   e. Contract number and purchase order,
   f. “Fragile” (when applicable) on container,
   g. ATK Address,
   h. “Flight” or “Nonflight” indication, and
   i. ATK Authorization to ship or reference number.

3.8.17 Training
Personnel working in fabrication, assembly, inspection, test, and integration operations at the Subcontractor shall be properly trained, either formally, on-the-job, or a combination of both. Subcontractor employee training records shall be maintained as part of personnel records and shall be available for review. Performance is monitored periodically to identify and remedy training issues when the quality trends of the hardware becomes unacceptable, when new technology is being implemented, when technical job skills require upgrading to effectively perform a job function, and when cross-training an employee to perform a new job function is requested.

3.8.18 Servicing
Post-delivery service, operation, training, and/or maintenance of delivered hardware and software products shall be handled through the original contract award, an amendment to the contract, or through a separate contract SOW. The scope of the work activities to be performed is negotiated to ensure Subcontractor and ATK agreement and understanding. Product Assurance activities ensure that service processes are performed under defined and controlled guidelines as described in the Subcontractor’s Quality System Manual.
3.9 NONCONFORMANCE AND FAILURE CONTROL PROGRAM
The Subcontractor shall have an effective closed loop system for failure reporting on both hardware and software anomalies. The system shall, as a minimum, provide for:

a. Timely recognition, documentation, and processing of suspected and confirmed failures and anomalies,
b. Timely notification and involvement of ATK (within 24 hours of occurrence),
c. Notification of failures at Subcontractors,
d. QA approval of all troubleshooting plans prior to implementation,
e. Precise determination of root cause of failures,
f. Effective review function by associated Subcontractor disciplines,
g. Appropriate disposition of flight article,
h. Proper documentation and physical analysis,
i. Adequate corrective action to prevent similar failures,
j. Customer involvement as a voting Class I MRB and FRB member and approval authority for all failures after first power-on, and
k. A rigorous methodology to address the risks of unverified or “ghost” failures. An unverified or “ghost” failure is an anomaly that cannot be reproduced, and thus cannot be critically analyzed to determine root cause. Orbital shall be a voting FRB member in dispositioning all unverified failures, regardless of severity or perceived importance.

3.9.1 Nonconformance Control
A nonconforming item has one or more proven characteristics that departs from its requirements, performance specifications, assembly drawings, parts list, or any other approved engineering documentation. Nonconformance control shall provide for the segregation and identification of nonconforming items. The inspection status and identification of such nonconforming items shall be documented at the point and time of discovery in the item’s document folder and shall be immediately subject to review. Non-conformances shall be reported to ATK within 24 hours of their occurrence; return receipt email to ATK Quality Engineer and the Subcontract technical manager is an acceptable form of this communication. ATK shall maintain Class 1 approval authority on MRB/FRB actions. Class 2 MRB/Authority is granted to the supplier. Nonconforming items dispositioned by ATK as acceptable, or accepted after corrective actions have been implemented, may be subsequently treated as conforming items.

3.9.1.1 Material Review Board (MRB)
The Subcontractor’s shall use their own database for tracking MRB/FRB activity, and shall review each nonconforming item and classify the disposition as either Class 1 or 2 MRB.

Class 1 MRB Requires ATK Approval. Class 2 MRB Requires the Supplier Approval only, but must be available for review, and must be included in the End Item Data Package.

Class 1 Material Review Board Authority
The supplier shall submit all Class 1 MRB’s to ATK for approval. Class 1 Material Review authority is for articles or characteristics contained in supplier drawings, specifications or Purchase Agreements that are requirements of ATK, Orbital, Lockheed Martin or NASA, and do have a direct effect on the specified requirements. If the supplier is uncertain as to the effect on specified requirements, the concurrence of the ATK Quality Representative shall be obtained. Material Review records shall be made available to ATK Quality Assurance upon request, and shall be included in the End Item data Package. Class 1 MRB Reports require Government concurrence prior to submittal to ATK.
**Class 2 Material Review Board Authority**
The supplier is delegated Class 2 Material Review authority for all article characteristics contained in supplier drawings and specifications that are not specified requirements of ATK, Orbital, Lockheed Martin or NASA drawings or Purchase Agreements; and do not have a direct effect on the specified requirements. If the supplier is uncertain as to the effect on specified requirements, the concurrence of the ATK Quality Representative shall be obtained. This authority does not extend to the use of Material Review Board (MRB) for the purpose of changing engineering criteria, which can be accomplished by drawing change. This delegation is subject to change at any time by ATK, and can be rescinded at any time by written notification from ATK. Material Review records shall be made available to ATK Quality Assurance upon request.

All nonconforming material for Customer and Government Furnished Material (Regardless of Classification) requires Approval by ATK or the Government prior to any MRB disposition.

If during hardware review ATK deems that an incorrect delegation of Class has been made to a nonconformance which results in the unacceptable use and subsequent replacement of said part(s), the Subcontractor will be responsible for all costs associated with replacement and any testing.

**3.9.2 Failure Review Boards (FRB)**
A failure is any test anomaly, regardless of apparent magnitude. ATK approval shall be required for resolution of any failures during or after acceptance, protoflight, or qualification testing, including retest requirements. The Subcontractor shall conduct Failure Review Board (FRB) meetings to review failure reports and to decide the appropriate corrective action. The FRB shall ensure the following:

a. Status of failure investigation is reported bi-monthly, and more frequently as shipment of hardware nears, and a plan of action for open reports is established and carried out,
b. Root cause of failure is determined or, if an exact cause cannot be determined, that a rigorous failure analysis has been conducted,
c. Effectivity or other impact upon the hardware (e.g., over-stressed parts) is determined and actions are initiated as appropriate,
d. Each failure report and failure analysis report shall be reviewed by ATK.

If the Subcontractor experiences failures during qualification, protoflight, or acceptance testing, the Subcontractor shall generate a failure report and notify ATK within 24 hours of the failure occurrence. Presence of an ATK representative during testing shall constitute notification. ATK shall have approval authority of final FRB results. ATK concurrence with cause and corrective action findings is required.

All unverified failures (exact cause is not known) during acceptance, protoflight, or qualification testing at board level and above shall be reviewed and evaluated by the Subcontractor. Unverified failures at board level and above shall be reported to ATK. Actions regarding any unverified failures at the unit level shall be submitted to ATK for review and approval.

**3.9.2.1 Failure Investigation**
Each failure/anomaly shall require an investigation as to root cause, rework or repair action, and corrective action. The investigation shall be performed at the lowest level necessary to identify the failure mode. Supporting documentation resulting from each analysis and investigation shall
be attached to and made a part of the failure report. Copies of each completed failure report and supporting documentation shall be furnished to ATK. ATK’s approval shall be required for final disposition, re-entrance into acceptance, protoflight, or qualification test and test re-start location.

3.9.3 Corrective and Preventive Action
The Subcontractor shall aggressively correct and proactively approach any item adversely affecting performance, cost, or schedule. The Subcontractor shall establish and maintain documented procedures for implementing corrective and preventive action.

Any corrective or preventive action taken to eliminate the causes of an actual or potential nonconformance shall be to a degree appropriate to the magnitude of problems and commensurate with the risks encountered.

The Subcontractor shall implement and record any changes to the documented procedures resulting from corrective and preventive action.

3.9.3.1 Corrective Action
The procedures for corrective action shall include:

a. Effective handling of customer complaints and reports of the nonconformance,

b. Investigation into the cause of the nonconformance relating to product, process, and quality system and recording the results of the investigation,

c. Determination of the corrective action needed to eliminate the cause of the nonconformance,

d. Application of controls to ensure that the corrective action is taken and that it is effective.

3.9.3.2 Preventive Action
The procedures for preventive action shall include:

a. The use of appropriate sources of information such as processes and work operations which affect product quality, concessions, audit results, quality records, service reports, and customer complaints to detect, analyze, and eliminate potential causes of the nonconformance,

b. Determination of the steps needed to deal with any problems requiring preventive action,

c. Initiation of preventive action and application of controls to ensure that it is effective,

d. Ensuring that relevant information on actions is submitted for management review.