SQAR Supplement for the Control and Use of Digital Datasets

SQARSUP-0100

7/22/13

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## REVISIONS

<table>
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<th>Revision Date</th>
<th>Description</th>
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<tr>
<td>New February 10, 2003</td>
<td>Original Release</td>
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<tr>
<td>Rev. 1 September 16, 2003</td>
<td>Business Area Matrix updated. Deleted requirement that Supplier’s subcontractors require Northrop Grumman approval. Added supplier subcontractor audit requirement. Added requirement to document software installation.</td>
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<tr>
<td>Rev. 2. February 4, 2004</td>
<td>Clarified the use of inspection point verification is an element of the FAI process. Replaced ‘shall’ with ‘may’ as it relates to point sketches and solid model face extractions. Removed requirement for notification of software change. Removed mandate to have or have access to a Programmable CMM. CMM should be accessible if part complexity dictates. Noted that a QAP submittal may be requested prior to an onsite survey.</td>
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<tr>
<td>Rev. 3 March 23, 2004</td>
<td>Added July 1, 2004 affectivity date. Added AGS&amp;BMS to Quest definition.</td>
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<tr>
<td>January 3, 2011</td>
<td>Updated Sector and Department names</td>
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<tr>
<td>8/30/12</td>
<td>Update process owner; Changed to new prefix SG for Guide</td>
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<tr>
<td>7/22/13</td>
<td>Revised Title to remove Guide change document numbering for a supplement</td>
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1. **SCOPE**


2. **PURPOSE**

   This document establishes and defines the quality system requirements for suppliers control and use of Northrop Grumman Aerospace Systems digital data.

   This document is intended as a supplement to, not a replacement for other Supplier Quality Requirement documents, and for those procurements governed by them.

   Suppliers will be audited to the requirements in this document. Upon satisfactory completion of the audit, the supplier will be approved to receive and utilize Digital data for manufacturing and inspection purposes.

   As of July 1, 2004, Suppliers shall be compliant and approved by Northrop Grumman Aerospace Systems to the requirements of this document prior to manufacturing and/or inspection when using released digital datasets.

3. **ASSOCIATED DOCUMENTS**

   Supplier Quality Assurance Requirements Manual

4. **DEFINITIONS**

   **ACCOUNTABLE TOOLS** – These tools are subject to the accountability requirements of the affected contract and will be accounted for, or called out, on the purchasing documents. These tools must be available for the return to the customer upon request or contract completion / termination.

   **CAD** - Computer Aided Design - Any computer system or program that supports the computer graphic design process.

   **CAD/CAM/CAI** - Computer Aided Design/Computer Aided Manufacturing/Computer Aided Inspection. The integration of CAD, CAM, and CAI through the common sharing of part geometry definitions and other data jointly used in design, engineering, manufacturing, and inspection.

   **CAI** - Computer Aided Inspection - The use of computer data in the inspection of parts, assemblies, and installations.

   **CAM** - Computer Aided Manufacturing - The use of computer data in the development and production of a part (product) including fabrication, assembly, and installation.
CATIA - Computer-Aided Three-Dimensional Interactive Application

CMM – Coordinate Measuring Machine

CMS - Coordinate Measurement Systems - Measurement and test equipment used to support CAI activities. Including, but not limited to, Coordinate Measuring Machines, Theodolite, and Photogrammetry systems.

DATASET - A named compilation of related data made accessible to computerized system.

DMIS – Dimensional Measuring Interface Standard

DXF – A file extension that denotes an AutoCAD model.

EOP – End of Part

EnCapta – COTS software, which imbeds non-geometric engineering requirements in a CATIA model.

IGES - Initial Graphics Exchange Specification - The American National Standards Institute (ANSI) Data standard for the exchange of computer graphics generated product definition (text and geometry) between different manufacturer’s computer graphics systems.

IPT – Integrated Product Team

LDD - Limited Dimension Drawing –A part depicted in CATIA as an exact solid model in sufficient detail to enable downstream disciplines to analyze, inspect and fabricate the part.

REFERENCE DATA – Data used for information purposes only. This data is considered to be auxiliary information. This data shall not be used to produce inspection media for deliverable hardware (including accountable tooling and tooling used as a media of inspection).

QUEST – An AEW/EWS and AGS&BMS document management system. It is a web-based information management system, powered by a commercial off-the-shelf knowledge management product.

SURFACE PATCH – An area within a part or tool that defines the mold line/surface definition of a part or tool. Several surface patches can exist to define (1) part or tool mold line/surface or feature.

Vericut®, Valisys®, CATCMM® - software simulates NC machining to detect mistakes and inefficiency electronically. Compares “as machined” cut path with the original design model.
5. SPECIFIC REQUIREMENTS

A. CAD/CAM/CAI QUALITY ASSURANCE REQUIREMENTS

1. The Supplier shall maintain a CAD/CAM/CAI Quality Assurance Plan that illustrates how configuration control of digital data is maintained to an identifiable level throughout the Suppliers’ CAD/CAM/CAI system, from receipt of Northrop Grumman Aerospace Systems data to end item acceptance. This QA Plan shall specifically address the processes and techniques unique to the Supplier’s CAD/CAM/CAI mode of operation and bear acceptance by the appropriate level of management.

2. The QA Plan shall remain in effect throughout the life of the contract and shall define the CAD/CAM/CAI processes, systems and procedures to be used for software installation, data receipt, control, use for manufacture, in-process inspections, Supplier’s subcontractor control, and end item inspections of products produced for Northrop Grumman Aerospace Systems. The QA Plan will be part of the Northrop Grumman Aerospace Systems approval documentation records.

3. The supplier shall provide a description of the process used to develop inspection data from Northrop Grumman Aerospace Systems provided digital datasets. The description shall include the steps required to translate, develop inspection points and criteria, and to program the inspection devices. It shall also include the hardware and software used, the data formats used for transport and processing. Use of data without translation is preferred. Figures 1 and 2 are provided as examples of inspection data flow.
4. Northrop Grumman Aerospace Systems reserves the right to periodically test portions of the Suppliers' CAD/CAM/CAI system to verify effectiveness of the Suppliers' Quality Assurance Plan.
5. The authority and responsibility for each element of the CAD/CAM/CAI Quality Assurance Plan shall be defined and documented to assure consistent implementation.

6. Elements of the CAD/CAM/CAI Quality Assurance Plan shall include but not be limited to the requirements as outlined in the balance of the document.

7. Northrop Grumman Aerospace Systems may authorize the outsourcing of data translation. The process and source shall be documented in the QA Plan.

B. CONFIGURATION MANAGEMENT

1. All Digital Data must be received through Northrop Grumman Aerospace Systems as a controlled release. Any Digital Data received by other means shall be considered non-conforming.

2. The Supplier shall ensure that the configuration control of CAD/CAM/CAI systems, hardware, application software, product and data verification are identified, controlled and recorded.

3. A system for change accountability and traceability, for all datasets and dataset derivatives (including graphical/geometric electronic data), will be maintained by the Supplier.

C. REVIEW AND AUDIT

1. The Supplier shall implement policies and procedures for auditing all operations affecting CAD/CAM/CAI computer data and related documentation to assure compliance with the requirements of this document.

2. The audit plan shall include provisions for the Supplier’s evaluation and approval of their subcontractors that use digital data on Northrop Grumman Aerospace Systems products and tooling.

3. Results of all audits and subsequent corrective actions taken will be documented and maintained by the Supplier for review by Northrop Grumman Aerospace Systems if requested.

D. PROBLEM REPORTING

1. The Supplier shall assure that non-conforming CAD/CAM/CAI datasets, graphics or extractions are identified as discrepant, segregated and reviewed for disposition.

2. The Supplier shall describe the practices and procedures to be followed for reporting, tracking, and resolving all transmission, hardware, software and dataset problems and deficiencies.
E. MEDIA SECURITY

1. The Supplier shall describe the procedures and methods in place to ensure the integrity and security of Northrop Grumman Aerospace Systems supplied CAD/CAM/CAI data, Supplier extracted data and/or Supplier generated definition data. This shall include live storage of controlled data, read/write protection, passwords, access, and archiving. The Supplier shall include a procedure for a data backup system.

F. INSPECTION MEDIA

1. The Supplier shall describe the procedures established to provide CAD/CAM/CAI inspection media. This will include documented procedures and objective evidence showing data sources independent of manufacturing flows and assure that qualified personnel and required system/data access are available. The following paragraphs apply to datasets for inspection use.

2. Media that may be authorized for part inspection will include, but is not limited to, Limited Dimension Engineering Drawings (LDD’S), supplier generated dimensioned drawings, CMM with appropriate inspection planning software, and inspection checking fixtures.

3. Any data extracted from datasets used for product acceptance, must have visible evidence of Supplier’s Quality Assurance acceptance and be under configuration control. In addition, any data generated from CMS inspection processes must have evidence of Supplier’s Quality Assurance acceptance, be dated, and be under configuration control. Traceability of data back to the original dataset is required.

4. Data or datasets identified as "REFERENCE"/"UNCONTROLLED DATA" may not be used for inspection purposes.

5. When Northrop Grumman Aerospace Systems supplied Datasets are translated for the purpose of CAI (IGES, DXF, DWG, etc.), the supplier must provide a system that supports verification (through comparison) of the translated data to the original Model. The supplier may use an appropriate sampling plan to verify points. The CAI data shall be certified and approved by the Supplier's Quality Assurance process. Translations that deviate .0005 inches or less from the base geometry shall be deemed acceptable.

6. Any single point, which exceeds the specified acceptance criteria, contaminates the entire file rendering that file unacceptable for use.

7. Suppliers shall describe the procedure used to assure all part features have been inspected.

8. Supplier shall provide a “pictorial” of the matrix orientation (X, Y, Z origin) and data locations, if requested by Northrop Grumman Aerospace Systems, to
be used as a mapping guide to note where the points are in relationship to the part.

G. DATA EXCHANGE METHODS

1. All data exchange between Northrop Grumman Aerospace Systems and the Supplier shall be accomplished using a system with a version and release compatible with the design data as identified in contractual documents and/or engineering. If a discrepancy exists, the Supplier shall follow the steps in the Problem Reporting section of this document and formally contact NGIS.

2. Suppliers are responsible for any translation of the Northrop Grumman Aerospace Systems file into other formats for use with their equipment. Defective hardware, caused by a translation error is the sole responsibility of the supplier.

H. TOOLING

1. The CAD/CAM/CAI Quality Assurance Plan shall identify methods that assure accurate design and inspection dataset identification used for Accountable Tooling and inspection tools.

I. CAD/CAM/CAI COMPUTING EQUIPMENT

1. Supplier shall have software with the appropriate version to support specific program requirements.

2. Dependent on part complexity, the Supplier should have access to a CMM or other automated measuring device. The supplier shall identify inspection data flow for each device within the QA Plan, as applicable.

3. Supplier shall have and be able to demonstrate inspection programming software capable of the following, when applicable:
   a. Receiving solid model.
   b. Provide target points for inspection

4. A current Hardware/Software status document listing hardware model, software version, revision levels, addendums, etc. must be kept on file for review.

5. Authorized Northrop Grumman Aerospace Systems representatives may periodically review the CAD/CAM/CAI Quality Assurance Plan for compliance to Northrop Grumman Aerospace Systems specifications.
J. INSPECTION POINT VERIFICATION

1. The supplier shall create CMM inspection points to insure that features of the part have been verified as required in the First Article Inspection paragraph “L”, when applicable. Bench inspection methods shall be employed on the remaining features to substantiate that all engineering requirements have been verified.

2. The supplier shall create CMM inspection points using the definitions and the minimum number of points as described in the paragraphs below unless specified otherwise by the Engineering drawing. When authorized by Northrop Grumman Aerospace Systems, the number of inspection points required on certain designated surfaces may be reduced. All GD&T engineering design callouts must be addressed and made available for review. All applicable paragraphs must be considered.

   a. There will be a minimum of one point per inch (or any fraction) of curve for curves shorter than (5) inches. (Three (3) points minimum)

   b. If the curve is longer than five (5) inches, a minimum of five points are to be verified. Point spacing on the curve is not to exceed ten (10) inches depending on complexity of surface.

   c. Select a minimum of four (4) points per surface unless the surface area is less than two (2) square inches in which case, upon NORTHROP GRUMMAN AEROSPACE SYSTEMS approval, one to three (1 - 3) points may be adequate.

   d. Points will normally be .375 inch in from the nominal edges of the individual surfaces (this includes tangencies between surfaces).

   e. Points will be measured at inflections of surface tangency.

   f. A minimum of five points is to be verified if the surface is larger than five (5) inches by five (5) or twenty-five (25) square inches. Point spacing on the surface is not to exceed ten (10) inches.

   g. If the surface has a profile tolerance of .010 inch or less, a minimum of one point will be defined for each five (5) square inches or as specified on the drawing. Minimums of five (5) points per surface are to be verified. Point spacing on the surface is not to exceed five (5) inches.

   h. If the surface has a profile tolerance of greater that .010 inch but less than .030 inch, a minimum of one point will be defined for each ten (10) square inches. Minimums of five (5) points per surface are to be verified. Point spacing on the surface is not to exceed seven (7) inches.
i. Points should be located .10 to .25 from EOP of mold line (M/L) “surface patches”, and within .25 of changing M/L offset surfaces or from tangent points of transitions whenever possible.

j. All M/L beveled surfaces must have at least two points to define the bevel. Any surface three inches or longer must have a point near the center to define any curvature.

k. Rib and stiffener features must have at least two points with a maximum spacing of 12” on all straight surfaces. Any angled tee from the basic web surface must have two rows of points to define the angle.

l. Any tapered ribs/stiffeners, etc., will have points on both sides defining the taper.

m. Any radial defined area must have a minimum of three points to assure that it is dimensionally correct.

n. Any flange top feature will have two points minimum with a maximum spacing of 8 inches.

o. Any EOP that has a continuous straight-line surface must have a minimum of 1 point every 12 inches.

p. When possible, all points should be numbered starting from one end to form a continual chain to completely check one area (with like tolerances) with the least number of wasted moves before moving on to the next area or feature.
K. SIMULATION SOFTWARE/PROGRAMS

1. Simulation programs such as Vericut®, Valisys®, CATCMM®, etc., can be used to validate cutter/probe path and verify inspection point locations and densities. The simulation software shall be identified in the CAD/CAM/CAI QA Plan.

L. FIRST ARTICLE INSPECTION WITHIN A 3-D ENVIRONMENT

1. All part features shall be inspected and documented as part of the First Article Inspection in compliance with contract requirements. It is the responsibility of the Supplier to ensure product meets released engineering design, purchase order, and other applicable requirements that can be verified and validated via First Article Inspection Reports, CMM readouts, and process certifications. Verification of product nominal data within the 3-D model, and variable/actual data will be at the discretion of the Northrop Grumman Quality Field Engineer (QFE).

2. Northrop Grumman Aerospace Systems may request all applicable First Article Data Media prior to, during, and after the First Article Inspection. This data may include the FAI Reports/documents, CMM inspection points and sketches, LDD’s, and methodology documents.

3. The Northrop Grumman QFE may, at its discretion, request that re-inspection of the product take place in order to verify and corroborate report actuals with the presented first article specimen.

4. Each product requires a FAI documentation (records) as outlined in SQAR to ensure product meets or exceeds engineering specifications, drawing notes, parts list requirements, purchase order requirements, etc. In addition to the FAI requirements of SQAR, the supplier shall have, at a minimum, the following necessary documentation defining:

   a. Inspection Methodology, including:

      i. Features/Requirements Checked (Contoured surfaces, thickness, GD&T requirements, Key Characteristics, etc.).

      ii. Inspection Equipment Used (CMM’s, micrometers, hole/height gages, check fixtures, etc.)

      iii. Tolerance Type (Surface profile, GD&T requirements, thickness, etc.)

      iv. Part Restraining Attributes

   b. CMM Point Definitions and Locations.
i. If CMM inspection is utilized as part of the FAI, CMM point sequences, theoretical values (X, Y, Z, I, J, K), their graphical location may be depicted on the product (point sketch). CMM inspection datums, part datums, reference planes, tooling points, etc., should be depicted within this sketch.

c. Limited Dimension Drawing (LDD) Dimension Locations Coordinating with Bench Inspection Requirements.

i. For all other product features that cannot be verified by a CMM inspection program such as joggle breakouts, web transition areas, unique fillet radii, wall and web thickness, etc., a LDD may be created to establish dimensional inspection criteria and correspond to the First Article Inspection Report (FAIR).

d. Solid Model Face Extraction Listing.

i. Each feature within a solid model has its own unique attribute and identification. These features or “faces” can be extracted and can be compiled as a listing. Solid model feature listings may be cross-referenced with the FAIR to ensure all features of the product have been accounted for, verified, and documented.

M. SUPPLIER QUALIFICATION

1. As part of the approval process, if requested by the Northrop Grumman Aerospace Systems, a sample solid model may be sent to the supplier for inspection per paragraph J. At which point, the supplier shall submit the results to Northrop Grumman Aerospace Systems for evaluation.

2. Northrop Grumman Aerospace Systems shall conduct a supplier survey, performed to this procedure, for all first tier suppliers to be qualified for use of digital data sets. Suppliers may be requested to provide their QAP prior to the onsite evaluation to facilitate the surveys/evaluations. Approval must be granted prior to issuance of data sets for the manufacture and/or inspection of deliverable hardware. Suppliers are responsible for subcontractor control for use and control of digital data and/or product acceptance.