Quality Management System Procedure
Integrated Components Inc.

Procedure Number	**QMS 23**	**Title**	Digital Product Definition (DPD)/Model Based Definition (MBD) Quality Assurance Plan
Approval	Josh Shorter, signature on file	**Title**	Quality Assurance Manager

Revision History

Revision	Date	Paragraph(s)	Description of Changes(s)
New	10/19/16	All	Initial issue
A	5/18/17	1.3	Added more detail regarding changes to the DPD/MBD processes
		8.2	Added creation of 2D media from 3D models
		8.2.1	Added reference to the use of models and digital data for FAI
B	5/18/18	All	Changed name of document and references were renamed/renumbered for new QMS documents
C	6/18/19	12 d)	Added competence

Introduction

This document describes the requirements for control of digital data at Integrated Components. This plan applies to all phases of design and inspection when customer furnished DPD/MBD data is used to produce product(s) or digital data for product acceptance (including accountable tooling and tooling used for inspection).

These requirements provide the basis for implementation and maintenance of plans, processes, work instructions and other related documentation. This plan is designed to maintain the integrity of DPD/MBD type design through all operations including quality assurance as new DPD/MBD methods are deployed. The goal of this plan is to continuously improve the quality of products provided to customers.

Customer representatives will be given access to the Integrated Components DPD/MBD QA plan, related documentation, operations and objective evidence to verify compliance and document Integrated Components DPD/MBD capabilities.

1.0 Digital Product Definition Quality Assurance Plan and Processes

1.1 Integrated Components has developed and maintains this DPD/MBD Quality Assurance Plan to assure integrity of product engineering and/or tooling configuration is maintained throughout the company's DPD/MBD system from receipt of customer digital data, development of derivatives and product acceptance.

1.2 This plan addresses processes and techniques unique to DPD/MBD processes including the delivery of authority data to measurement users in programming, production, and quality departments for product acceptance and process control.

1.3 Any changes made to the DPD/MBD quality assurance plan will be communicated to the customer(s) requiring this. This notification will be performed within 30 days of the change. Annually, the customers will be informed of "no change" after a review of the plan is made by management or internal audit. Notification occurs for changes that include:

a) DPD/MBD process changes
b) CATIA synchronization,
c) CAD, CAM and CAI software changes and
d) Addition of new measurement equipment.

1.4 The DPD/MBD Quality Assurance Plan describes the configuration management and QA process to meet all DPD/MBD requirements (customer and/or regulatory agency).

1.5 Overall authority for the DPD/MBD Quality Assurance Plan is the company Quality Assurance Manager (System Administrator), who has authority for document control. The authority and responsibility for each element of the DPD/MBD Quality Assurance Plan is defined and documented in this plan or referenced documents to assure consistent maintenance of the plan.

1.6 A flow diagram (Integrated Components DPD/MBD Digital Data Flow) graphically depicts the flow of data through the DPD/MBD system from receipt of customer provided DPD/MBD data, through all departments creating and using derivatives, to product validation, and analysis of measurements for process improvements.

1.7 Reference is made to the following documents in this plan:

MAA1-10009-1	Quality Assurance Standard for Digital Product Definition at Spirit Aerosystems, Inc. Suppliers
D6-51991	Quality Assurance Standard for Digital Product Definition at Boeing
QMS 13 and 14	Quality System Documented Information (documents and records)
QMS 19	Configuration Management
Authority/Competence Matrix	Competence
QMS 07	Purchasing Process map
QMS 08	First Article Inspection referenced in Production Process Map
Calibration records	Monitoring and Measuring Resources
QMS 15	Internal Audits
Inspection references	Monitoring and Measurement of Product in QMS 08 Production Process Map
QMS 16	Control of Nonconforming Outputs

2.0 Configuration Management and Media Security

2.0 Integrated Components maintains quality management system documents as required by AS9100D to ensure the configuration of customer DPD/MBD controlled production hardware and tooling. Documented information are in place that ensure that configuration of the following DPD/MBD systems are identified, controlled, and recorded:

a. Product Acceptance Software (PAS)
b. Computerized Measurement Systems (CMS)
c. CAD/CAM Software
d. Data Analysis Software

e. Datasets generated by Integrated Components
f. Datasets flowed to suppliers of Integrated Components

2.1 The company maintains configuration identification and control of software datasets. The following process is used:

- Files are placed in the master server when received by the QA Manager
- Files needed by the Programmer will be accessible from the company's main server by the QA Manager.
- Files for operation of the CNC machines will be developed.
- These files will be named to facilitate relationship to the master file.
- Proven files (validated by first article inspection) will be placed in a folder.
- All electronic derivatives are placed in the same folder.
- Files of previous revisions, if applicable, will be archived. If kept, hard-copy derivatives will be marked "Obsolete" and filed in the central files under the customer name and/or part number.

2.2 Objective evidence for verification of datasets is obtained with the first article inspection in the first production use. An acceptable first article inspection is required before the file can be released for the remaining production requirements.

2.3 Datasets may be provided by the customer in CATIA and IGES or other digital formats.

2.4 When the company requires translation of the dataset from the native (received) format to another format for use, the procedure for the creation and utilization of dataset translations for manufacturing and inspection operations is as follows:

- Files that are encrypted are returned to the customer for un-encryption.
- Files that do not require unencryption are placed in the customer folder on the Server. This includes CATIA models.
- A copy of the required files is provided to the Programmer.
- The Programmer uses CATIA to open the file, including annotation.
- CATIA is the only software used to work with CATIA files.
- Files are created for use on the Production equipment.
- Translated files are verified by the programmer using tool path verification.
- Any problems are corrected and verified before the file is released for production.
- The files are then made available to Production (write-protected).
- Prints may also be made available.
- Files that produce good product are placed in a folder on the network.
- Traceability of the translated dataset to the original customer is provided by using the same part number, dash number and revision. This numbering assures dataset relationship throughout the production and inspection processes and through delivery of the completed product.

2.4.1 When a program needs to be changed after issue to Production, the file is overwritten creating a new revision and then provided to Production.

2.4.2 The company does not use a third party to program, unencrypt data and/or translate data.

2.5 The company maintains a process to insure the integrity and security of customer supplied DPD/MBD data, supplier extracted data and/or supplier generated definition data. These process are as follows:

a. Controlled data is stored as follows:
   - Unencrypted files, and other files received from customers, are stored in the master server controlled by the QA Manager. Access is controlled by password.
   - Files created by Programming are stored in the customer's folder in the Programming folders on the secondary server. Access is controlled by password.
   - Files that have been proven to produce good parts are stored in the Programming folders. Passwords control access.

b. Access and archiving process with read/write protection, including passwords which ensure access control.
c. Encryption software is not yet owned by the company.
d. File back-up is as follows:
   - All files are backed-up monthly. New files are backed-up daily.
   - Media used for back-up are stored by the QA Manager.
   - Each month, the previous month's back-up is taken off-site by the QA Manager.

2.6 Integrated Components dataset control uses the network Programming folders. This provides for formal release of DPD/MBD datasets and ensures that only approved datasets are available for use in production and inspection. Dataset derivatives made by the company are readily available during measurement, verification, and data analysis processes for product acceptance by the company, their suppliers and their customer QA representatives.

a. The system for change accountability and configuration management for all models, datasets and derivatives is as follows:
   - CATIA files are viewed by Programming using CATIA and MasterCam software. Any changes in the configuration are communicated to the Programmer and the change is made as required. The change is also communicated to Inspection if required.
   - Programming datasets/files are changed if the customer provides a change. A new file and filename will be created and stored as required.
   - Any hardcopy print, drawing or report, if created is changed, will be maintained by Integrated Components. Changes will result in the creation of a new drawing, print or report.
   - Dataset derivatives are traceable to the master dataset/model.
   - The company complies with applicable customer document(s) defining the authority status of models/datasets within customer furnished DPD/MBD datasets.

2.7 Obsolete datasets, if kept, are maintained in a folder marked "Obsolete Datasets".

3.0 Product Acceptance Software

3.1 There is no software used for inspection and product acceptance.

3.2 In addition, no software is developed by the company for use in production or inspection.

4.0 Internal Quality Audits

4.1 The company has a process for auditing all operations of the company including customer DPD/MBD data and related documentation to assure compliance with contractual requirements, software and production part quality standards, including the observance of security restrictions. Refer to QMS 15, Internal Quality Audits.

4.2 The audit plan includes provisions for audit of suppliers using DPD/MBD data on customer products and tooling. Refer to the Internal Audit Schedule for the current year in the Quality System Control folder in the Quality System folder on the network.

4.3 Results of all audits will be documented and maintained for review by an authorized customer representative per contract requirements. Refer to QMS 15, Internal Quality Audits, for records of audits.

5.0 Problem Reporting and Corrective Action

5.1 The company assures that non-conforming DPD/MBD datasets are identified as discrepant, segregated, and reviewed for disposition. In some cases, the customer is contacted for resolution of a problem.

5.2 Non-conforming PAS will have the deficient equipment identified and removed from service until discrepant items are resolved. Refer to section 3.1.

5.3 The company utilizes the corrective action process for reporting, tracking, and resolving all transmission, hardware, software, and dataset problems and deficiencies. Refer to QMS 17, Corrective Action.

6.0 Procurement Control

6.1 Integrated Components assures the capabilities of their suppliers to be able to work with datasets and models.

6.2 The company flows down the requirements of the controlling document (Spirit Aerosystems/MAA1-10009-1, Boeing/D6-51991, etc.) to suppliers and document supplier compliance when customer authority dataset derivatives are used for product acceptance. . Refer to QMS 07 Purchasing Process Map.

6.3 Integrated Components is responsible to the customer for the maintenance, change incorporation, use of datasets and observance of security restrictions by their suppliers for design, manufacturing, and inspection as applicable.

6.4 As required by contracts, the customer is given the right to survey and/or review the DPD/MBD quality assurance and configuration management systems of these Integrated Components suppliers.

7.0 Control of Measurement Equipment

7.1 The company maintains a system for of periodic certification of digital measurement equipment. These controls provide records of dates of certification, acceptance/rejection, and next certification due date. Measurement equipment is physically identified in accordance with certification records. This includes all inspection equipment whether digital or not. Refer to calibration records maintained.

7.2 The company has an inventory of all components used for measurements that affect the integrity of data collection. The company documents and has implemented periodic calibration and certification of these components. All calibration is traceable to NIST or equivalent standard and meets original equipment manufacturer requirements.

8.0 Inspection Media

8.1 All digital measurement operations performed on each part or tool are planned using the Work Order to coordinate the plan. Integrated Components' QA department is responsible, at a minimum, for digital inspection media, measurement instructions and analysis of data for product acceptance. Measurement planning gives consideration to the following activities, as appropriate, in meeting the specified design requirements:

- Description of method and instructions for validation of each product feature for first article inspection, and documentation of the analysis of inspection and test results used as a basis for all quality/inspection adjustments. To validate product features with methods other than dimensional measurement, the company documents the media and/or process used.
- Selections of specific stages of production to perform feature measurements to monitor production capability, ensure validation of all specified requirements, and integrate manufacturing and measurement processes.
- Analysis and delivery of measurement data for process control and defect reduction.

8.2 The company has the following process to extract inspection media and other measurement data from datasets, including delivery and control of the media:

- Programming is the only personnel who can create inspection media from datasets.
- Programming personnel open CATIA files/models using CATIA or MasterCam software to extract a print for a part. The print may not contain all dimensions and tolerances so personnel must review the model and obtain all acceptance criteria and enter these on the print.

- CATIA or MasterCam may be used to extract inspection criteria for use by inspection. This will be performed by the Programmer and given to inspection personnel. Flat patterns are developed by Programming as required for use in Production.
- In both cases, the part number, dash number and revision are included on the media.
- 2D prints, drawings and flat patterns used in Production are included in the Job Traveler packet or given to affected personnel. These are developed from 3D models when applicable. 3D models are available for Programming only.
- If media is provided to suppliers, it is mailed or emailed.
- Control of the media is performed using the part numbers, dash numbers and revision to the original dataset. A Work Order or Purchase Order is used as required to maintain control through production or supplier offloaded processes.
- Derivative datasets are stored on the network and are readily comparable to the authority source.

8.2.1 The company performs first article inspection (FAI) based on models and other digital data, AS9102 (current revision) and the related FAI documents/forms. In some cases Net Inspect (on-line) is used to submit FAI.

8.2.2 When the company uses authority databases for inspection purposes, the data extracted from those datasets used for product acceptance will be under configuration control using part numbers, dash numbers and revisions.

8.2.3 Data or datasets identified as “reference only” are not used for inspection purposes.

8.2.4 The company may use the IGES format as authority for product acceptance.

8.3 DPD/MBD datasets with reduced content may require the company personnel to extract information from dataset to instruct and document manufacturing and inspection activity for the product.

8.3.1 When planning measurements for product acceptance, QA verifies that all product design requirements are identified and planned for inspection/validation.

8.4 Accuracy of plots used for inspection media are verified prior to use.

9.0 Data Exchange Methods

9.1 The company documents the current level of hardware, software, and other digital system information required to maintain synchronization with customer supplier datasets and/or data exchange formats per applicable customer system(s) compatibility requirement documents. This includes LEV, data exchange, and other computing equipment that receives authority data and/or is installed/tested by customer. Integrated Components complies, as required, with the applicable synchronization documents in their DPD/MBD quality plan.

10.0 Tooling

10.1 The company has the following process to ensure release, acceptance, identification, security, access and change control of tool design and tool inspection datasets:

- Programming will develop the programs needed to develop the tooling.
- Once developed, the files will be made available to Production in conjunction with Work Orders.
- File names will provide identification of the tooling files to the part.
- Files are read-only, password protected by Programming.
- First Article Inspection will verify the tooling.
- Once verified the tooling is released for use in Production. ERS datasets will be available, if applicable.
- Tooling datasets have traceability to current authority and derivative tooling dataset sources.
- The engineering authority dataset(s) will be identified on the tool design when applicable.

- Periodic validation may be performed if required by QA.
- Any changes must be approved by the customer prior to release, unless generated by the customer.

10.2 Periodic inspection of digitally defined tools will meet the requirements of section 8.0 of this document as applicable.

11.0 Training and Process Performer

11.1 The company ensures that QA personnel have DPD/MBD system access and training adequate to perform digital product acceptance activities. Training requirements are covered by job descriptions.

11.2 If these activities are performed by individuals other than Integrated Components' quality assurance personnel, the company will define the specific tasks and responsibilities that are authorized and the corresponding requirements and training necessary to perform those tasks.

11.3 The company maintains records of the instruction syllabus and employee training records, including on the job training, for all DPD/MBD system users.

12.0 Attachments

A. Equipment Inventory
B. Data Exchange Formats
C. Installed Software
D. Authority-Competence Matrix
E. Glossary

ATTACHMENT A
EQUIPMENT INVENTORY

The following list of equipment is used by Integrated Components in the DPD/MBD program.

MACHINE	CONTROLLER	DATE OF LAST CERTIFICATION
CNC Mills (7)	Fanuc Control	Not performed/No buy-off at machines
CNC Lathe (3)	Fanuc Control	Not performed/No buy-off at machines

ATTCAHMENT B
DATA TRANSFER FORMAT

The following table lists the various formats currently in use by different customers.

Customer	Format
Cox Machine	CATIA
Exacta Aerospace	CATIA
Textron	CATIA
Dynamic NC	CATIA

ATTACHMENT C
INSTALLED SOFTWARE

The following table lists the software being utilized by Integrated Components during the DPD/MBD process.

SOFTWARE	WHERE USED	CURRENT REVISION
CATIA	NC Programming	V5

ATTACHMENT D
WRITE AUTHORITY

Department	File type	Employee
Programming	CATIA	Gary Byerlee (Contractor)
Programming	CATIA	Erick Shorter (Contractor)

Attachment E. Definitions (May or may not be applicable to the DPD/MBD data control system)

AUTHORITY
Undisputed source of customer approved type design used for product manufacture and Quality Assurance acceptance with communication, access, release and change control process in place to ensure source integrity.

CAD
Computer Aided Design – (1) Any computer system or program that supports the design process. (2) The use of computers to assist Engineering Design in developing, producing, and evaluating design, data and drawings. (For brevity CAD is also referred to as the organization engaged in computer-aided design).

CAE
Computer Aided Engineering – The use of computers to develop Engineering data to supplement Engineering Designs, used in product production and inspection.

CAM
Computer Aided Manufacturing – Also known as numerical control (NC). The use of computers and computer data in the development and production of a part (product) including fabrication, assembly, and installation.

CATIA
Computer-graphics Aided Three-Dimensional Interactive Application. A CAD system with interactive graphics design software modules used to create 3D and 2D geometric designs of products.

CMS
Coordinate Measurement Systems – Also known as computer-aided inspection (CAI) and computer Aided Measurement Systems (CAMS). Measurement equipment such as Coordinate Measuring Machines (CMM), Laser Tracker, and Numerical Controlled machinery with inspection probe capability which are used to support inspection activity. (Note: All portable, three dimensional measuring systems, including Portable Arm Measuring Machines, Computer-aided Theodolites, Laser Tracker, and Photogrammetry (including videogrammetry) systems require Integrated Components to be approved per section 7.2 of this document.

CUSTOMER
The originator of a purchase order or contract for goods and/or services.

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

DERIVATIVE
A reproduction of all or part of an authority dataset. Derivatives include paper and Mylar plots, tool designs, inspection datasets created to analyze as-built designs, check templates, numerical control (N/C) datasets/media, datasets with nominal values for CMS use, QA inspection plans and other extractions (dimensions, views, etc.) for inspection/measurement use.

DPD/MBD
Digital Product Definition – The electronic data elements that specify the geometry and all design requirements for a product (including notation and parts lists), and the use of this data throughout an integrated CAD/CAM and CMS system.

DPD/MBD QUALITY ASSURANCE PLAN
A comprehensive document describing the Quality System for management of digital data and DPD/MBD processes throughout a supplier's production facility. The requirements, processes, and process references described in the plan provide the basis for supplier organizations to implement user-level processes and documentation.

ERS

Enhanced Reference System – A permanent reference system, established for the life of a tool, which is transferred from an existing reference system or created specifically for CMS. It is designed to provide a large number of established coordinates. This allows rapid and accurate measurement in all areas of the tool.

FEATURE
Feature – Any hardware design attribute or characteristic. This includes physical portions of hardware such as surface, face, edge, radius, hole, tab, slot, pin, etc, and requirements such as non –destructive testing (NDI) and Interchangeability and Replaceability (I&R). All features require validation to conform the product to the design authority. All features have associated notes and/or Geometric Dimensioning and Tolerancing Feature Control Frames (FCF), but one note or FCF may refer to several features.

IGES
Initial Graphics Exchange Specification – The American National Standards Institute (ANSI) Data standard for the exchange of computer graphics generated product definition (no solids) between different manufacturers CAD/CAM systems.

INSPECTION PLAN
A description of 2D and/or 3D computer generated inspection media/methods, derived from authority DPD/MBD datasets, used to communicate inspection requirements and media usage to manufacturing and inspection areas. Typical plans include engineering and plan configuration/ traceability, overlay/setup instructions, and a list and/or graphic representation of the features to be inspected.

LEV
Low End Viewer – An entry level, visualization CAD system used to view, analyze, extract, and print dimensional and other required data from the DPD/MBD dataset.

MBD
Model Based Definition – A dataset containing the exact solid, its associated3d Geometry, and 3D annotation of the products dimensions and tolerances to specify a complete product definition. This dataset does not contain a conventional 2D drawing.

MDD
Master Dimension Definition – A mathematically-controlled surface definition which is computer generated. This definition consists of control curves defining the surface in two planes and the information in a logical form necessary to develop the third plane and/or any cross section. Each surface is uniquely identified by number.

MDI
Master Dimensions Identifier – A number identifying an array of coordinate data used by design, manufacturing and inspection to describe an element of a surface or product configuration. The data may be an extraction from an MDD or any CATIA/APT-designed surface.

MDR
Master Dimension Request – A process used by suppliers without demonstrated DPD/MBD capability(s) per requirements of this document, to request and receive 3D surface definitions and/or inspection media extractions from customer. Data format may be printouts, disks, plots, etc. with evidence of customer QA acceptance and traceability. Supplier shall contact customer Procurement Agent for process instructions.

MDS
Master Dimension Surface – A computer generated, mathematically-controlled CATIA 3D surface definition. Each surface is uniquely identified by number.

MEASUREMENT PLANNING
Process to control all measurement activity for parts, assemblies or tooling products. A team including design, manufacturing and measurement (QA) specialists determine the measurement and/or validation methods and stage in

production for all specified product features. Data is collected for both process control and product acceptance. Measurement planning seeks continuous improvement and innovative validation methods, including integration of manufacturing and measurement operations to reduce defects and cycle time.

PAS
Product Acceptance Software – DPD/MBD software (including CAD, LEV, data exchange, and CMS systems) used to inspect and accept parts, assemblies, tooling, and systems.
(Note: Not embedded or loadable airborne software.)

PDM STEP
Product Data Manager (PDM) dataset(s) in STEP format with Bill of Material (BOM) information (Parts Lists, Picture Sheet Data Lists, Tool Parts Lists, etc.) used by customer to define CAE requirements. This dataset can be communicated to suppliers in a digital format.

PTF
CATIA Program Temporary Fixes – software changes or additions, released by the software manufacturer, to correct user application problems before the next major software version is available.

PROCESS CONTROL
Use of in-process checks to determine performance parameters of manufacturing operations. Data Collected is used to determine when adjustment is needed to reduce manufacturing variability.

PQAA
Procurement Quality Assurance Automation – The on-line record of approved suppliers, with information about supplier quality systems, manufacturing processes, DPD/MBD, and airborne software capabilities.

REDUCED CONTENT DRAWING/DATASET
Any DPD/MBD design dataset without full dimensioning of product features on a 2D sheet. This includes Reduced Dimension Drawings and "Simplified Drawings" which contain 2D sheets, and Model Based Definition which (typically) does not.

REFERENCE ONLY (REF)
Notation indicating features or datasets whose definition is not reliable and not authorized for design, manufacture, or inspection.

REDARS
Reference Engineering Data Automated Retrieval System

SNET
Supplier Network – A network/telecommunication method for exchanging secure data with suppliers.

STEP
Standard for the Exchange of Product model data. Standard developed by International Standards Organization for exchange of digital product data. It seeks to improve upon IGES by increasing the ability to transfer entire product life-cycle data.

SUPPLIER
A manufacturer working under Integrated Components contract(s)..

SUB-TIER SUPPLIER
A manufacturer working under Integrated Components's supplier contract(s), producing products for Integrated Components's customers.

MASTERCAM

A CAD system software with interactive graphics design modules for creating 3D and 2D geometric designs of products.