GKN-SC QUALITY ASSURANCE STANDARD -
DIGITAL PRODUCT DEFINITION FOR SUPPLIERS

Approval of this document is captured on the associated Form 1 Document Request Form maintained on file by the BMS Document Coordinator (Gatekeeper).
If you have a query concerning the implementation or updating of this document, please contact the document owner.
1. Purpose

This standard establishes requirements for GKN-SC suppliers DPD / MBD quality assurance/quality control system. The requirements contained in this document are intended to facilitate supplier deployment of DPD / MBD processes and to achieve technical coordination between GKN-SC, supplier, and sub-tier supplier.

2. Scope

This document is a supplement to the GKN-SC Business Management System (BMS) Requirements for suppliers, and describes the requirements for supplier digital data system controls. To use GKN-SC (or customer) furnished datasets as authority for design, manufacture or inspection of product and/or tooling, a supplier must comply with this document. GKN-SC shall document supplier compliance as approved in the GKN-SC Supplier Quality System.

These requirements provide the basis for suppliers to create and implement plans, user level procedures and process documentation for the use of DPD / MBD. Individual GKN-SC divisions, sites or programs may provide additional requirements. The supplier shall have defined and reliable configuration management and Quality Assurance (QA) processes in place reflecting its methods of operation. Supplier is required to maintain integrity of DPD / MBD through all operations when new DPD / MBD methods are deployed. It is expected that suppliers will utilize DPD / MBD processes to continuously improve the quality of delivered product.

The application of this document is required for all phases of ISO9001 as supplemented by AS9100 or the suppliers BMS when GKN-SC (or customer) DPD / MBD data is used in Supplier’s computing systems and procedures to produce product(s) or digital data for product acceptance (including accountability of tooling and tooling used for inspection).

If a supplier is sending digital product definition data to GKN-SC, the requirements are obtained from the

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procurement agent and the purchase order, and the supplier must meet applicable data exchange requirements.

3. Associated References

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4. Definitions

**3D-PDF**
Converting 3D designs including text, flag notes, symbols and GD&T from CAD applications. Allows suppliers to provide screen captures with 3D viewing (rotation, panning, zooming) capability to their downstream users. *No 3D geometry interrogation allowed only 3D viewing capabilities.*

**ANNOTATION**
Dimensions, tolerances, notes, text and symbology visible without any interrogation of the model.

**AUTHORITY**
Undisputed source of GKN-SC (or customer) approved dataset used for product manufacture and quality assurance acceptance.

**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. (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 for use in product production and inspection.

**CAI**
Computer Aided Inspection - Also known as Coordinate Measurement Systems (CMS) and Computer Aided Measurement Systems (CAMS). Measurement equipment such as Coordinate Measuring Machines (CMM), Laser Tracker, and numerical controlled machinery with inspection probe capability used to support inspection activity.
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<tr>
<td>CAM</td>
<td>Computer Aided Manufacturing – Also known as numerical control (NC). The use of computers and computer data in the development and production of all part types (products) including fabrication, assembly and installation.</td>
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<tr>
<td>CATIA</td>
<td>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.</td>
</tr>
<tr>
<td>CMS</td>
<td>Coordinate Measurement Systems - Also known as Computer Aided Inspection (CAI) and Computer Aided Measurement Systems (CAMS). Measurement equipment such as Coordinate Measuring Machines (CMM), Portable Coordinate Measurement Machine (PCMM), Laser Tracker, Laser Radar, Photogrammetry and numerical controlled machinery which are used to support inspection activity.</td>
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<tr>
<td>Common Points</td>
<td>A minimum of seven measured points with X, Y &amp; Z coordinate values used to assist in the orientation of additional measurement instruments into the instrument network such as theodolites, laser tracker, PCMM, laser radar, scanners and photogrammetry camera stations.</td>
</tr>
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<td>CUSTOMER</td>
<td>The party (individual, project, or organization internal to or external to the company) responsible for accepting the product or for authorizing payment. Customers may or may not be users.</td>
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<tr>
<td>DATASET</td>
<td>Information prepared and maintained by electronic means (CAD/CAM), and provided by electronic data access, interchange, transfer, or on electronic media.</td>
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<td>DERIVATIVE</td>
<td>The 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, Planning (i.e. Manufacturing, Inspection, etc...), and other extractions (dimensions, views, etc.) for inspection/measurement use.</td>
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<td>DRIFT POINT(S)</td>
<td>A point or set of points, measured at least twice (at a minimum, at the start and finish of a measurement survey) used to determine the relative stability between the device performing the measurements and the object being measured. When the distance between a pair of drift points is analyzed a very small distance indicates stability, where as a larger distance indicates instability</td>
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<td>DPD</td>
<td>Digital Product Definition – The electronic data elements that specify the 3D Computer Aided Design (CAD) geometry and all design requirements for a product (including notation and parts lists), and the use of this data throughout an integrated CAD/Computer Aided Manufacturing (CAM) and Coordinate Measurement Systems (CMS).</td>
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<tr>
<td>EAR</td>
<td>Export Administration Regulations. This is the Dep’t of Commerce agency, (Commercial or Dual Use)</td>
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Enhanced Reference System

- A permanent reference system, established for the life of a tool, which is documented from a design reference system or created specifically for CMS. The ERS is used to provide a large number of known points coordinate for use in tool transformations; 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 a surface, face, edge, radius, hole, tab, slot, pin, etc., and requirements such as nondestructive inspection (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) and one note or FCF may refer to several features.

HMBD

- Hybrid Model Based Definition - A complete product definition that includes a 3D model, without the use of or recourse to two dimensional drawings or projected orthographic views.

IGES


INSPECTION PLAN (Criteria)

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

ITAR

- International Traffic in Arms Regulations - Dep't of State (Military)

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.

MA

- Manufacturing Agreement - an agreement whereby a US person grants a foreign person an authorization to manufacture defense articles abroad and which involves or contemplates:
  1. The export of technical data or defense articles or the performance of a defense service: or
  2. The use by the foreign person of technical data or defense articles previously exported by the US person

MBD

- Model Based Definition – A GKN-SC (or customer) dataset containing the exact solid, it’s associated 3D geometry and 3D annotation of the product’s dimensions and tolerances (and may include parts/notes list) to specify a complete product definition. This dataset does not contain a conventional 2D drawing. MBD is one possible format of DPD / MBD.
  (Note: Model Based Definition is the undisputed source of definition)
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 digital product definition capability(s) per requirements of this document, to request and receives 3D surface definitions and/or inspection media extractions from GKN-SC (or customer). Data format may be printouts, disks, plots, etc. with evidence of GKN-SC (or customer) QA acceptance and traceability. Supplier shall contact GKN-SC procurement agent for process instructions.

MDS
Master Dimension Surface - A mathematically defined 3D surface generated using computer aided design. Each surface is uniquely identified by number.

MLA
Manufacturing License Agreements - Authorizes a US manufacturer to supply manufacturing knowledge (related to defense) to a foreign party. All foreign recipients must be named as parties to (or as “authorized sub licensees” under) the agreement.

PAS
PAS is considered software that performs product or tooling acceptance without subsequent inspection. Common PAS applications include: CMS software (CMM, Laser Trackers, Laser Radar, PCMM’s), CAD translators, and CAD Analysis Software.

NOTE: Not embedded or loadable Airborne S/W

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 List, etc.) used by GKN-SC (or customer) to define CAE requirements. This dataset can be communicated to GKN-SC (or customer) suppliers in a digital format.

PDT
Product Data Manager (PDM) dataset(s) in STEP format with bill of material (BOM) information (Parts Lists, Picture Sheet Data Lists, Tool Parts List, etc.) used by GKN-SC (or customer) to define CAE requirements. This dataset can be communicated to GKN-SC (or customer) suppliers in a digital format.

PTF
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.
REDUCED CONTENT DRAWINGS

Any DPD / MBD design dataset without full dimensioning of product features on a 2D sheet. This includes Reduced Dimension Drawings (RDD), Minimally Dimension Drawings (MDD), and Simplified Dimension Drawings (SDD) which contain reference to 3D surface definition or CAD geometry.

REFERENCE ONLY (REF)

1. Notation indicating which layers or features of a design are not reliable or authorized for manufacturing and inspection use.
2. Marked “Reference Only” datasets whose definition is not reliable and not authorized for design, manufacture or inspection.

SCALE BAR

A device used to verify that the proper scale factor has been applied to a three-dimensional measurement survey. The device generally consists of a bar with at least two or more fixed points. The distance between point pairs is determined, certified and is traceable to an international standard. In some metrology applications the Scale Bar may also be used to set scale (e.g. theodolite, photogrammetry).

SCD

Specification Control Drawing - A type of picture sheet geometry or book which depicts functional and physical interfaces, performance requirements, and quality assurance requirements to enable development and procurement of an Item (assembly or system) by an outside supplier.

Soak Time

A defined and documented process to insure product or tool has reached the required/ target temperature prior to measurement. The defined and documented process must take into account CTE influenced parameters appropriate to their actual products in production: A Plan should analyze and plan-for specific soak times based upon part number/family dimensional CTE characteristics (thickness’s, cross-sections, over-all lengths, etc), setting either prescribed time or minimum acceptable soak time appropriate to parts/ part families under review with adjustments possible with part size and other calculated CTE risks.

SPECIAL TOOLING

Tools of such a specialized nature that, without modification or alteration, their use is limited to the development and/or manufacture of production parts and assemblies. Examples of these tools include jigs, fixtures, molds, patterns and gages as identified by site specific documentation. See Boeing’s D33200-1 and D950- 11059-1 (Defense work only).

STEP


SUB-TIER SUPPLIER

An entity of the prime contracted company and not directly contracted by GKN-SC (or customer), providing products or services for GKN-SC (or customer) programs.

SUPPLIER

An entity delivering products or performing services being acquired. (2) An individual, partnership, company, corporation, association, or other service having an agreement (contract) with an acquirer for the design, development, manufacture, maintenance, modification, or supply of items under the terms of an agreement (contract).
5. Digital Product Definition Quality Assurance Procedures and Documented Processes

5.1. Documented Processes - The Supplier, supplier sub division and supplier sub-tiers shall develop and maintain comprehensive documented DPD / MBD processes and/or procedures that assure integrity of product and/or tooling configuration is maintained throughout the supplier’s QMS from receipt of GKN-SC (or customer) data through creation of derivatives to product acceptance and process improvement.

5.1.1. The supplier’s documented process shall specifically address the processes and techniques unique to all DPD / MBD processes beginning with the receipt of DPD / MBD data from GKN-SC (or customer) through the product lifecycle.

5.1.2. The supplier’s documented process shall specify all departmental organizations responsible for performance of CAD/CAM/CAI operations including organizations responsible for the delivery of GKN-SC (or customer) data or supplier derived data to sub-tier suppliers.

5.1.3. It is recommended that supplier documented DPD / MBD processes describe a single, consistent configuration management and QA process to meet all customer DPD / MBD requirements (GKN-SC or customer, other companies, regulatory agencies, etc.) This documented process shall remain in effect throughout the life of the contract.

5.1.4. GKN-SC reserves the right to survey and/or review the supplier’s QMS to verify effectiveness of the supplier’s documented DPD / MBD processes and procedures.

5.1.5. Elements of the documented DPD / MBD processes shall address, but not be limited to the elements in sections 5.0 thru 14.0. The sections in P-PLN Digital Product Definition for Suppliers may be addressed in other supplier documents. If so, reference to the document and sections shall be made in the documented process.

5.1.6. Supplier’s documentation shall be available in English in addition to supplier’s native language.

5.1.7. Additionally, program specific requirements not provided in this document shall be implemented.

5.2. Flow Diagram - The supplier shall include a flow diagram or equivalent in their documented process including process ownership that graphically depicts the flow of data through the DPD / MBD system from receipt of GKN-SC (or customer) DPD / MBD data through the product life cycle.

5.2.1. The flow diagram shall identify the documented DPD / MBD processes, and or work instructions associated with control of the datasets and derivatives.
5.2.2. In lieu of flow diagram, supplier may provide a complete relational diagram of their internal procedures to the requirements of this document.

5.3. **Responsibilities** - The quality organization shall be responsible for the documented DPD / MBD processes with procedures for change control and notification to affected organizations. The authority and responsibility for each element of the documented DPD / MBD processes shall be defined and documented to assure consistent implementation.

5.3.1. The supplier shall notify their GKN-SC Procurement Rep and GKN-SC Supplier Quality Rep within 30 calendar days of implementing any changes to:
   a) The Documented DPD / MBD Processes
   b) CATIA synchronization
   c) CAD, CAM (when used for product acceptance), CAI software additions, updates or changes
   d) Addition of new coordinate measurement system (CMS) and CNC On-machine probing equipment
   e) Quality manager or key personnel.

6. **Configuration Management and Media Security**

6.1. **Media Security** - The Supplier shall develop and maintain documented processes used to ensure the integrity and security of GKN-SC (or customer) provided datasets or Specification Control Drawing (SCD) data. This may include the use of envelope datasets, supplier created CAD/CAM/CAI datasets, type design and tool designs. Integrity and security of datasets shall include requirements for:

   6.1.1. Secure storage and retention of GKN-SC (or customer) provided DPD / MBD, supplier created DPD / MBD derivatives, and digital inspection media used for product acceptance.

   6.1.2. The supplier shall assure that datasets found discrepant are suspended from use and originator is contacted for disposition.

   6.1.3. Archiving procedures with read/write protection which ensure access control per the time specified per program or contract requirements. This includes authority datasets, derivatives and digital inspection media used for product acceptance.

   6.1.4. Encryption protection for sending/receiving of electronically transmitted data.

   6.1.5. Establishing and maintaining a secure data backup and storage system whether local or remote, a disaster recovery process for authority datasets, derivatives and digital inspection media used for product acceptance.

   6.1.6. Access control with permission and/or password protection shall be established in order to ensure that GKN-SC (or customer) provided datasets shall not be inadvertently modified. This process shall include derivative datasets released for manufacturing and inspection.

   6.1.7. Supplier will have a process to manage and maintain (addition/removal of) supplier employee access to GKN-SC (or customer) technical data systems.

6.2. **Configuration Management and Traceability** - The supplier shall develop and maintain documented processes to ensure configuration control of all GKN-SC (or customer) provided datasets, supplier created CAD/CAM/CAI datasets, Special Tooling, type design, tool designs and datasets sent to sub-tier suppliers used in the production or inspection of GKN-SC (or customer) products. These procedures shall include the following:

   6.2.1. Formal release process of DPD / MBD data which ensures that only current authorized DPD / MBD datasets and derivatives are available for use in production and inspection.

   6.2.2. The supplier shall ensure the GKN-SC (or customer) authority dataset(s), planning and all derivative DPD / MBD data used to manufacture and inspect product is traceable to the authority.
6.2.3. Supplier shall be able to demonstrate traceability of all product planning and DPD / MBD derivatives to the current authority dataset including filename, revision and extension. Additionally derivatives shall have their own revision control system in addition to the product/tool revision.

6.2.4. A documented process for change control and retention for all authority datasets and dataset derivatives including engineering, manufacturing engineering, Bill of Material, and CAE datasets, Etc.

6.2.5. A documented process that includes segregation, storage and retention of non-current (obsolete) authority datasets and dataset derivatives.

6.2.6. Supplier shall have a documented process to generate digitized manufacturing/inspection data from GKN-SC (or customer) provided full scale engineering Mylar plots or from any authority physical representation. This process shall ensure integrity of derived dimensions and include review, release and configuration control.

6.3. **Engineering Type Design** - A supplier who performs Type Design or Tool Design for GKN-SC (or customer) using GKN-SC (or customer) provided SCD, MDD, MDI, MDS, TDI or other digital definition, shall develop a documented process per section 5.0 of this document.

6.3.1. The supplier shall describe documented processes for design and development to ensure:
   a) Customer acceptance of design and changes to design
   b) Configuration Management and Identification
   c) Media Security, including local or remote storage and transmittal using encryption protection between supplier sub divisions or sub-tier suppliers.
   d) Access and change control of engineering and tool design
   e) DPD / MBD control when providing datasets or derivatives to supplier sub divisions or sub-tier suppliers
   f) Designs shall have traceability to GKN-SC (or customer) provided authority definition.
   g) Type Design or Tool Design must meet data exchange requirements for GKN-SC (or customer).

6.3.2. Design and development outputs shall meet the program requirements for design and shall identify any critical items, including any key characteristics, and specific actions to be taken for these items.

6.3.3. The design shall provide the data required to allow the product to be identified, manufactured, and inspected. This includes the specifications necessary to define and maintain the configuration and the design features of the product. (E.g. material, process, features, annotation, specification, notes, and manufacturing and assembly data needed to ensure conformity of the product).

6.3.4. When required by contract, the supplier shall have a process to perform predetermined periodic design reviews to GKN-SC (or customer) requirements to ensure that all requirements have been met.

6.3.5. A Non-Manufacturing GKN-SC (or customer) Supplier performs only Product Design or Tool Design creation and Design maintenance tasks, and uses their own design(s) and OMS exclusively to manufacture and inspect the product or tool purchased by GKN-SC (or customer). The scope of DPD / MBD at Non-Manufacturing suppliers shall be limited to a documented process per section 5.0 of this document. In addition, elements of the documented DPD / MBD processes shall address, but not be limited to those operations in P-PLN Digital Product Definition for Suppliers sections 6.0, 8.0, 9.0, 12.0, and 14.0 regarding a secure and configuration managed environment to communicate, create, and maintain the designs and/or intellectual property they own for the purpose of delivering their designed and maintained product(s) or tool(s) to GKN-SC (or customer).
7. **Product Acceptance Software (PAS)**

7.1. **Commercial Off The Shelf Software** - The supplier shall document and maintain documented processes for the control of Product Acceptance Software (PAS). PAS includes software used in the acceptance of special tooling and products.

7.1.1. Supplier must document and maintain PAS procedures and reference applicable documents in their documented DPD / MBD processes. Documented results shall provide for identification of software name, software version and validation results when used for QA applications.

7.1.2. Procedures or processes will be maintained to prevent unauthorized changes, to limit personnel access to software files, and to archive masters and duplicates.

7.1.3. Supplier should request objective evidence or certification/accreditation (independent) of the PAS from the software manufacture per ASME B89.4.10 or equivalent. The supplier shall maintain documentation for certification/accreditation as a means of identifying approved PAS, version control and QA management approval. Sample testing of existing product and tool programs following new or revised PAS installation to verify compatibility is considered a best practice.

7.1.4. In the event supplier is unable to obtain objective evidence or certification of the PAS from the software manufacturer, supplier is responsible for verifying PAS prior to product acceptance use. Examples of PAS functionality verification include using calibrated standards, known physical artifacts or embedded software to test feature construction and output accuracy. Examples also should include GD&T functions, temperature compensation, CAD translations and software that controls hardware.

7.1.5. **Computer Aided Manufacturing Software** - When used for inspection (i.e. CNC On- machine probing, etc.) the supplier shall develop and maintain documented processes for configuration identification and control of CAM software and must meet the requirements of sections 7.1.1 through 7.1.4. Supplier must verify numerically controlled software prior to product acceptance and maintain records.

7.2. **Supplier Developed Software** - Software developed by suppliers requires plans and instructions for building, configuration management, loading and testing of code. Supplier developed software, and subsequent revisions, will require independent testing and meet the requirement in sections 7.1.1 through 7.1.4 to insure the software accomplishes its intended function.

8. **Internal Quality Audits**

8.1. **Internal Audits** - Internal Audit procedures shall include provisions for auditing all operations annually affecting DPD / MBD data and related documentation to assure compliance with contractual requirements, software and production part quality standards, and the observance of security restrictions.

8.1.1. The audit plan shall include provisions for auditing sub-tier suppliers that use DPD / MBD data to manufacture or inspect GKN-SC (or customer) product or tooling.

8.1.2. The audit plan shall address all requirements of the latest revision of this standard including notification from sub tier to supplier of items listed in section 5.3.1.

8.1.3. Results of all audits shall be documented and maintained for review per contract requirements.
9. Procurement Control

9.1. Sub-tier Supplier Activity - The supplier shall flow down the requirements of this document to sub-tier suppliers and document sub-tier supplier compliance when GKN-SC (or customer) authority datasets or dataset derivatives are used for manufacturing or product acceptance. This would include design collaboration when design responsibility is shared with sub-tier suppliers.

9.1.1. The supplier shall be responsible to GKN-SC (or customer) for the maintenance, change incorporation, use of DPD / MBD and observance of security restrictions by sub-tiers for design, manufacturing and inspection.

9.1.2. The supplier shall establish procedural controls to assure GKN-SC (or customer) DPD / MBD transferred (authority or derivative) between their company divisions and all levels of sub-tier suppliers shall be in compliance with this document.

9.1.3. The supplier shall determine scope of DPD / MBD sub-tier supplier approvals based on their ability to interpret and maintain control, configuration of DPD / MBD data and CMS for acceptance of products and/or tools. Criteria for selection, evaluation and re-evaluation shall be established. Records of the results of evaluations and any necessary actions arising from the evaluation shall be maintained.

9.1.4. The supplier shall continue to approve sub-tier suppliers and measurement service providers. It is recommended that suppliers recognize the Nadcap M&I accreditation of sub-tier suppliers. Nadcap accreditation does not relieve suppliers of the responsibility to monitor and measure sub-tier performance.

9.2. Export Control - Flow down to sub-tier suppliers shall include ITAR, MLA, MA, TAA, and EAR requirements.

9.3. GKN-SC Right of Entry - GKN-SC reserves the right to survey and/or review the DPD / MBD quality assurance and configuration management systems of sub-tiers.

10. Control of Measurement Equipment

10.1. Calibration - The supplier shall implement and maintain a documented process for the calibration and recall of monitoring and measuring equipment. Calibration shall be traceable to NIST or equivalent international standards. These controls shall provide records of date of acceptance/rejection and next maintenance due date. Measurement equipment shall be physically identified in accordance with certification records. This includes all CMS equipment including CMS sub-components, N/C (CAM) equipment used for inspection, Optical Lay-up Template (OLT’s), ply cutters, and plotters used to produce mylars or other inspection or tooling media.

10.2. CMS Procedures - Suppliers using CMS and OLT’s for fabrication and/or inspection of GKN-SC (or customer) products (parts and tools) must document and control their processes.

10.2.1. Additional CMS requirements are stated below and require capability approval by GKN-SC.

10.2.2. The supplier and its sub-tier suppliers utilizing CMS and OLT must have documented user level processes or documented procedures that provide adequate asset care, equipment setup, operation, training, and QA procedural methods to perform acceptance of measurements.
Supplier shall determine the applicability and document the criteria to perform the following: (any exclusion shall be approved by the GKN-SC Supplier Quality representative)

a) Purpose / Scope – Overview or statement of specific equipment and its intended use.

b) Calibration – Supplier shall define calibration intervals and maintain a system for periodic maintenance of measurement equipment. The supplier must document inventory of all specific components used for CMS and OLT measurement that could affect the integrity of data collection. This inventory shall include but not be limited to CMM reference sphere and Laser Tracker target accessories (e.g. bushings, adapters, sphere mounts, bar/rod, probing, drift nest, supports, all reflector types, etc.) and weather station equipment. Calibration and measurement processes shall be traceable to the National Institute of Standards and Technology (NIST) standard, or equivalent, and meet original equipment manufacturing requirements.

c) Product Acceptance Software – Supplier shall perform Product Acceptance Software testing per section 7.0.

d) Field Checks / Probe Calibration / Set up – Establish criteria for field checks / probe calibrations / set up to ensure data and system accuracy prior to collecting measurement data.

e) Drift Points / Stability – For all non-fixed (CMM) CMS equipment drift point analysis is required to ensure stability between the equipment and object being measured. Drift points must be attached to the object being measured and a record of drift points measured and acceptance tolerance used, before and after measurements, is required as objective evidence. It is also recommended that Drift Points be measured periodically during the survey as an indication of ongoing stability, particularly for long surveys.

f) Temperature Compensation / Scale Factors – The product dimensional characteristics being verified must meet the engineering definition requirements at 68 degrees Fahrenheit as defined in ANSI/ASME Y14.5 and ANSI B89.6.2.

1) When product is measured in a controlled environment the allowable deviation from 68 degrees F shall be documented by the supplier based on product material, size and allowable tolerances. A process, often referred to as soak time, shall be defined, documented and followed to insure product is at the correct temperature at the time of measurement.

2) When products are measured in an uncontrolled environment, or the process often referred to as soak time has not been followed, a documented process to compensate for thermal effects of the objects being measured is required. Objective evidence is required for temperature compensation when using scale bars, artifacts or temperature calculation. Supplier shall document their temperature compensation process which includes planning for pre, post and during measurement survey analysis.

g) Establish Coordinate System – Establish criteria for changing the coordinate system from a CMS coordinate system to a part or tool coordinate system (e.g. tolerances, datum targets, datum features, tooling holes, tool enhanced reference system or best fit). Establishment of coordinate systems shall be in accordance with customer engineering definition and ANSI/ASME Y14.5 as applicable. Best Fit alignment shall not be used for production hardware acceptance unless contractually authorized by GKN-SC (or customer) engineering and evidence of authorization shall accompany final inspection reports.

h) Multiple Station Set-up Criteria – When moving CMS equipment or product is moved from one location to another, or combining CMS equipment during a survey, supplier shall document their process and acceptance tolerance. A minimum of seven adequately distributed Common Points used as reference for repositioning/adding the CMS equipment during a survey shall be verified.
i) Data Collection Parameters – Establish measurement guidelines and specific collection parameters for the CMS equipment prior to collecting measurement data. (E.g. point density, point labels, time/distance separation parameters, apex angles, distance limitations).

j) Data Analysis – Establish guidelines for the evaluation of 3D point data to tool engineering, engineering datasets, point maps or drawings.

k) Reports – Establish standard process for CMS reports shall include job information, coordinate system establishment (alignment verification), object temperature, data analysis, measured results and point maps. When measured in a controlled environment object temperature is only required when the documented process, often referred to as soak time, is not followed. When products are measured in an uncontrolled environment CMS reports shall also include scale bar and drift point measurements. Reports shall be in English and in inches unless directed otherwise by customer contract. Reports shall include feature identification, nominal, actual, tolerance and deviation.

l) Record Retention – Establish standard process for all inspection and test records to be archived and retained per customer contract requirements and provided to the customer upon request.

10.2.3. GKN-SC (or customer) will recognize a supplier’s option to become Nadcap Measurement and Inspection (M&I) approved in lieu of the applicable CMS portion of a GKN-SC (or customer) DPD / MBD audit for the measurement devices:

- Fixed CMM - AC7130, AC7130/1 – Nadcap accreditation for Coordinate Measurement Machines
- Laser Tracker - AC7130, AC7130/2 – Nadcap accreditation for Coordinate Laser Trackers
- Articulating Arm - AC7130, AC7130/3 – Nadcap accreditation for Articulating Arms

11. Inspection Media

11.1. Inspection Planning for Validation - When product or tool engineering definition 2D drawings include digitally defined surfaces/features (3D models), the supplier must ensure inspection of these surfaces/features. Supplier’s QA organizations are responsible, at a minimum, for inspection media, measurement instructions and analysis of data for product acceptance. Inspection planning shall include the following activities, as appropriate, in meeting the specified design requirements;

11.1.1. Description of the method and instructions for validation of each digitally defined product feature for first article inspection and production parts.

11.1.2. To validate digitally defined product features with methods other than CMS inspection the supplier must document the media and/or process used.

11.2. Inspection Media - The Supplier shall develop and maintain documented processes to create inspection media from DPD / MBD datasets. These shall assure:

a) Media is independently derived from and traceable to the authority dataset Media must be under configuration control

b) Media contains graphics, annotations, text, and GD&T to illustrate inspection operations
c) Coordinate system, alignment and datum features are defined Part/Tool set up instructions

d) Media is created by qualified personnel

e) A media review process exists (checker, checklist or peer/team review)

11.2.2. Document the establishment of the coordinate system, datum targets and datum features.

11.2.3. Digitized manufacturing/inspection data generated from GKN-SC (or customer) provided full scale engineering Mylar plots must have evidence of QA acceptance.

11.2.4. Data or datasets identified as "Pre-Release" or “REFERENCE ONLY” shall not be used for product acceptance purposes. Any use of this data for manufacturing or design is at the risk of the supplier.

11.2.5. Supplier may use definition of MDD, MDI, MDS, TDI, loft surfaces or other digital definition, including IGES or STEP format, as authority for product acceptance when supplied by GKN-SC (or customer) according to a Master Dimensions Request (MDR) process.

11.2.6. Reduced Content Drawings - Suppliers who receive reduced content drawings with an associated 3D model, must be able to extract information from the 3D model sufficient for manufacturing and inspection in addition to the 2D drawing. Suppliers must identify and document for manufacturing and inspection, the following requirements at a minimum:

   a) All features identified on the 2D drawing

   b) Features of the 3D model not defined by the 2D drawing

   c) Fabrication & manufacturing process specifications

   d) Flag notes, parts list and other specified requirements

   e) GKN-SC First Article Inspection (per GKN requirements)

11.3. Printed Wire Boards (PWB) - PWB suppliers that have been provided 100% GKN-SC (or customer) defined 2D drawings are exempt from the P-PLN Digital Product Definition for Suppliers approval.

11.4. Model Based Definition (MBD) - Suppliers who receive Engineering and/or Tooling MBD datasets must extract information from the dataset sufficient for manufacturing and inspection activity for the product. Additionally, utilizing MBD requires a capability assessment by a GKN-SC Supplier Quality Rep.

11.4.1. Supplier’s QA must verify that all design implicit and explicit requirements (e.g., all features defined by GD&T, annotations, specifications, notes and other specified requirements in the authority MBD dataset and associated parts list including dimensional and other properties) are identified and planned for inspection/validation.

Note: 2D drawings, 2D sketches/views or a Low End Viewer (LEV) may be used to convey manufacturing and inspection information as required to fit the supplier’s methods of operation.

11.5. First Article Inspection - All explicit and implicit design characteristics within the engineering shall be positively identified within the FAI plan. This shall include all engineering characteristics requiring traceability:

   a) All features annotated within the 3D model (explicit)

   b) Features of the 3D model not annotated (implicit)

   c) All characteristics applicable on the 2D drawings/reduced content drawings
11.6. GKN-SC (or customer) Provided Plots - GKN-SC (or customer) plotted media used for manufacturing and inspection shall be requested through procurement agent.

Boeing Supplier only - Product Definition Template (PDT) - Suppliers using GKN-SC (or customer) PDTs shall order, control and perform verification prior to use of GKN-SC (or customer) PDTs in accordance with D950-11288-1 Product Definition Template (PDT) Requirements, Validation and Verification Processes, and Handling Instructions for Plot Centers and Supplier Use.

11.7. Supplier Created Plotted Media - Suppliers creating plots for product acceptance must have a documented procedure. These procedures shall include the following, at a minimum, and require capability approval by GKN-SC Supplier Quality representative:

a) Plotter calibration – Follow OEM process for calibration and adjustment and independent validation to NIST or equivalent.

b) Plotting Environment – Equipment located in temperature and humidity controlled environment to meet product requirements. (Typically 68 degree Fahrenheit (with +/- 2 degree variance) and 50% Humidity (with +/- 5% variance))

c) Verification of engineering definition – Verification of developed flat pattern and plot verification features

d) Plotted media material - should be minimum .005 inches thick polyester film. Paper plots may be approved on a case by case basis for tolerances greater than +/- .10 inches.

e) Part number Identification & revision - Traceability to the GKN-SC (or customer) authority dataset

f) Validation of plotted media - Acceptance criteria of plot accuracy prior to stamping and releasing plot to manufacturing or inspection

g) Quality acceptance stamping – Date, Temperature, Humidity, Accuracy and evidence of inspection.

h) Accuracy of plots used for inspection – Plotted media will be verified prior to use in the environment where they are used. (Manufacturing or Inspection, etc.)

Note: The tightest product tolerance that can be reasonably inspected with a Mylar overlay is +/- 0.030 inch after grid check or defined verification features check has been performed.

11.7.1. Verification of plot accuracy - Check plots for accuracy prior to manufacture and inspection of parts. Measure to ensure the accuracy of the grid lines, or defined verification features vertically, horizontally and diagonally to verify plots. Grid lines are usually plotted in 10-inch increments. Check the grid lines from the first to the last grid line or defined verification features. Grid lines shall be within a tolerance of +/- .020 up to 100 inches and within +/- .030/- .010 over 100 inches.

Note: A calibrated steel scale (Starrett or equivalent) is recommended to check the grid lines for accuracy.

11.7.2. Environmental Controls - Plotting equipment shall be located in a temperature and humidity controlled environment. Development and validation of plots will be done in an environmentally controlled area using a real time monitoring system for temperature and relative humidity.

Note: The tolerance noted in the plot accuracy stamp is the accuracy of the plot at the time it was generated and does not relieve the user of the responsibility to verify the plot at the time of use.
11.7.3. Handling and Storage - To maintain media accuracy and stability, plots are recommended to be handled and stored as followed:

11.8.3.1. Plots should be handled according to the following recommendations. Failure to follow these recommendations may shorten the usable life:

a) Do not roll less than 3 inches inside diameter
b) Do not expose the media to heat generating sources. This may include laser printers, computer monitors, copy machines, air compressors, transformers, batteries, engines and sunlit enclosed places.
c) Do not fold, crease or damage in anyway, as this also effects the dimensional stability.

11.8.3.2. To maintain accuracy and stability, it is recommended that plots be stored in:

a) In a dust free, non-condensing moisture and chemical free area
b) Temperature from 65 to 80 degrees Fahrenheit and relative humidity from 45 to 55 percent.

11.7.4. Destruction of Obsolete/Unusable - All materials and computing media of any kind containing GKN-SC (or customer) PROPRIETARY information shall be disposed of by methods that ensure that all GKN-SC (or customer) proprietary information is destroyed so that none of it can be reconstructed from the residue or remains. Disposal methods may include recycling, shredding, burning, etc. and are dependent upon the resources at any given company/supplier facility. Recycling may be used only where procedures are in place to assure continuous security controls throughout the recycling process.

12. Data Exchange Methods

12.1. CAD Compatibility Requirements - The supplier shall maintain the current level of hardware configuration, software, software revisions and other digital system information required to maintain compatibility with GKN-SC (or customer) supplied datasets and/or data exchange formats per applicable GKN-SC (or customer) system(s) requirement documents.

12.1.1. For GKN-SC Supplier building Boeing product, see D6-56199 Hardware and software compatibility requirements for supplier’s use of CATIA native datasets as authority for design, manufacturing and inspection. This includes CAD, LEV, data exchange, and other computing equipment that receives authority data and/or is installed/tested by GKN-SC (or customer). Supplier shall comply with and reference applicable synchronization documents in their documented DPD / MBD processes.

12.1.2. Supplier must have a documented process that ensures they can translate, receive and validate all authority datasets without change to the data integrity.

12.1.3. The use of 3D-PDF is for viewing annotation, and shall require authority 3D surface geometry for manufacturing and inspection use.

12.2. Translations - When suppliers with native CAD Software receive their Authority dataset in the same CAD System (native to native) and manage their process which includes manufacturing and inspection software using the same Native system and version, translation verification is not mandatory due to lower risk but recommended as an industry best practice. When suppliers translate from Native CAD format to alternate formats including CATIA V4 to CATIA V5 or Native to STEP suppliers are responsible for all dataset translations and must have a clear documented process for each. The documented process must include a method to verify the accuracy of translations. Suppliers must be able to demonstrate the CAD translation process, including
verification/interrogation methods used, and the ability to identify known discrepancies.

12.2.1. Acceptance criteria for accuracy of translated surface profile/geometry, (tolerance) must be determined by the supplier, and must ensure the end product will be within engineering tolerance/specification. Objective evidence validating the suppliers’ documented translation process must be retained. (Typical allowable deviation is 1/10th of the tightest engineering tolerance)

12.2.2. The verification process for translation of datasets containing 3D annotation (i.e. feature control frames, dimensions, text, and/or surface geometry) must ensure that all intended entities are accounted for in the translated media.

12.2.3. Suppliers receiving GKN-SC (or customer) authority STEP format datasets supplemented with a 2D DWG, 3D-PDF or STEP formats throughout their product realization and inspection processes are not required to perform data translation validation. It is strongly recommended data translation validation remain a best practice to mitigate potential errors.

13. Special Tooling

13.1. **Tool Design** - The supplier shall describe documented processes to ensure release, acceptance, identification, security, access and change control of tool design and tool inspection datasets. Tooling datasets shall have traceability to current authority engineering and derivative tooling dataset sources. The engineering authority dataset(s) shall be identified on the tool design when applicable.

Note: Boeing suppliers will have to meet P-PLN Digital Product Definition for Suppliers requirements and Boeing’s D33200-1 tooling specification

13.1.1. Tool Designs shall be produced using authority data and when required by contract be approved by GKN-SC (or customer) authorized personnel.

13.1.2. The supplier shall ensure that when Tool Design responsibility is flowed down to sub tier suppliers, the sub-tier supplier will be approved by the supplier.

13.2. **Traceability** - All digitally defined special tooling and physical inspection media (check fixtures, templates, etc.) will be identified and traceable to the engineering authority dataset, tool design dataset and any tool inspection datasets.

13.3. **Inspection** - These tools and tooling media shall be dimensionally accepted and periodically validated to the authority design at a frequency determined to ensure accuracy and repeatability of the tool before use.

14. Training and Process Performer

14.1. **DPD / MBD Training** - Suppliers shall define training requirements to assure competence and shall maintain employee training records, including on-the-job-training, for all DPD / MBD system users (e.g. Quality, IT, planning, purchasing, tooling, contract review and Mfg).

14.1.1. The supplier shall ensure that all personnel having DPD / MBD system access have completed training adequate to perform digital product acceptance activities including digital inspection media generation, performance of inspections and 3D data collection.

14.1.2. Syllabus shall include training criteria necessary to ensure proficiency of process performers (e.g. planning, programmers, quality, tooling, CMS etc.) to interpret ASME
Y14.5 Dimensioning and Tolerancing (GD&T).

14.1.3. Training shall be updated due to changes driven by new equipment, software or GKN-SC (or customer) program requirements.

14.1.4. If Quality activities are performed by individuals other than the supplier’s quality assurance personnel, the supplier shall define the specific tasks and responsibilities that are authorized and the training necessary to perform those tasks.

15. Digital Data Transfer Process

15.1. The supplier shall receive digital data sets from GKN-SC using secure file transfer per section 12.0 Data Exchange Methods. Along with the data transfer GKN-SC shall provide a Data Transfer Request Form (F-CM Data Transfer Request form). Digital data shall only be transferred to suppliers that have previously been granted DPD approval by GKN-SC. On a case-by-case basis, limited approval may be granted to allow digital data to be transferred to suppliers. This data shall be considered Reference Only until DPD approval has been granted.

15.2. The purpose of this process is to ensure GKN-SC and its suppliers have a documented process to meet the requirements of P-PLN Digital Product Definition for Suppliers with respect to the transfer of digital data. The primary purpose of the Data request Form is to identify the type of digital data being sent, the file name, and revision. The data being transferred shall be identified using the following:

a) Authority Digital Data - Undisputed source of GKN approved dataset used for manufacturing purposes.

b) Reference Only – Provided to suppliers who are not DPD approved. These datasets may not be used for either manufacture or inspection of product or tooling.

15.3. The supplier shall receive a DTR anytime digital data is required. Examples of activities that would require a DTR can be but are not limited to, RFQ, RFI, and change to configuration. DTR's shall be sent to the Supplier's DPD administrator. Upon receipt of a DTR, the Supplier’s DPD administrator shall receive the digital data and process digital data per their documented DPD processes. The supplier shall acknowledge receipt of the DTR to the GKN-SC representative identified on the DTR form.

15.4. Only suppliers with DPD approval and a DTR containing data identified as the Authority Digital Data may use digital data for manufacture or product acceptance.

Control of these dataset is a requirement of P-PLN Digital Product Definition for Suppliers to ensure traceability for digital data.

DPD Approval Process is outlined in the GKN-SC Supplier Quality Manual.

16. Supplier Capability Review

16.1. The Supplier shall complete the F-PLN Supplier Capability Questionnaire to assist GKN-SC in determining Supplier capabilities for:

a) Data Transfer Requests (DTR)

b) Coordinate Measurement Systems (CMS)

c) Tooling

d) Special Processes
16.2. The Supplier’s status/approval of capabilities will be maintained in GKN-SC’s TipQA database.

17. Record of Revision

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<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>By</th>
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<tr>
<td>Original</td>
<td>08/11/2020</td>
<td>Jason Myers, SQE</td>
<td>New procedure</td>
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