QRS-100 Digital Manufacturing (DMFG)

LEONARDO
HELICOPTERS

QRS-100

Digital Manufacturing (DMFG)

Issue Date: June 2019 Issue: 05

CHANGES LOG

Issue	Approval Date	Main changes	Interested Paragraphs
01	November 2009	Initial Release	All
02	May 2010	Content and minor changes throughout	All
03	April 2015	New format	All
04	June 2018	Significantly reformatted Data output media added External Appendices incorporated in the body	All 5.2.3 6
05	June 2019	Identification of non-released design data	5.6

APPLICABLE DOCUMENTS

This document *shall* be applied together with the main document (QRS-01 Quality Requirements for Suppliers) and with the other applicable modules

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1 Purpose

Purpose of this document is to set requirements to exchange digital data for the programs developed in 3D data.

2 Applicability

All subcontractors involved into digital products.

3 Effective date

Issue date

4 Acronyms, definitions and abbreviations

4.1 Acronyms and abbreviations

CAD	Computer Aided Design
CAM	Computer Aided Manufacture
CDR	Critical Design Review
CMM	Co-ordinate Measuring Machine
DDS	Design Data Set
DIP	Dimensional Inspection Plan
DMFG	Digital Manufacturing
FAIR	First Article Inspection Report
LH	Leonardo Helicopter Division
FT&A	Functional Tolerancing and Annotation
ICT	**LH** Information Communication & Technology Department
LEV	Lower End Viewer
NDA	Non-Disclosure Agreement
PDR	Preliminary Design Review
SDP	Sealed Data Plan
SQA	**LH** Supplier Quality Assurance Department
SWIP	Secure Web Information Portal
TBA	To Be Advised
VPM	Virtual Product Modeller

4.2 Definitions

Article: raw material, process, tool, gauge, equipment, detail part, sub-assembly, assembly, avionics equipment, software, CAD/CAM/CATIA media (including Digital Data Definition), documentation, aircraft, airborne/non-airborne equipment and service that *may* be provided.

Authoritative Data: Undisputed source of **LH** approved Design and associated data used for Product manufacture and Quality Assurance acceptance without any form of change, subject to access control and configuration management by the Supplier.

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CATIA V5: Computer Aided Three-Dimensional Interactive Application, Product of Dassault Systems, V5: CATIA Version #5

Critical Part: an article which failure *could* have a catastrophic effect upon the product and for which the identified critical characteristics *shall* be controlled to ensure the required level of integrity (see table 2 of QRS-01 for critical part classification).

Defined Tolerance: A Design tolerance defined by **LH**, see Explicit Dimension.

Design Data Set: Set of digital data which completely defines a part or assembly and is used to transfer this information to other users (Manufacturing, Quality, Suppliers, Maintainers, Customers). A DDS includes, but is not limited to, Part lists, Bill of Material, Design notes, exact 3D geometry and a minimum number of 2D drawings, documents, data files, etc. 3D models and 2D drawings are in CATIA V5 format.

Dimensional Inspection Plan: A plan describing inspection requirements extracted from the DDS.

Explicit Dimension: A dimension and tolerance embedded in the Design Data Set in the form of a 3D annotation or 2D dimension and explicitly displayed on the 3D model or 2D view.

Feature: A Design attribute or characteristic that includes physical hardware such as a surface, face, edge, radius, hole, tab, slot, pin etc and requirements such as Non-Destructive Inspection and Interchangeability. All features require validation to certify the Product to the Design Authority. All features have associated notes and / or Geometric Dimensioning / Tolerancing**.**

LH Native CATIA: LH DDS transferred to a Supplier without being subject to amendment, corruption or interpretation.

Implicit Dimension

The dimensional value of a geometrical feature on the Design Data Set, DDS, that is not displayed on the 3D model or 2D view. The dimension is defined by extracting the digital CAD geometry using the CATIA toolset. The applicable tolerance is called-up in the associated Design notes.

Lower End Viewer: An entry level, visualization system (e.g. Enovia 3D com) used to view DDS with associated data as defined by **LH**.

Non-Disclosure Agreement: LH Agreement formally in place with a Supplier applicable to all types of **LH** proprietary information, e.g. designs, documentation, procedures, specifications, methodologies and data.

Pre-Release: Available for use under controlled conditions prior to being formally released (Pre-Released).

Non Released Data: Available for use under controlled conditions prior to being Pre-Release status.

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Sealed Data Plan: Sealed Data Plan produced by the Supplier to demonstrate compliance to QRS100.

Sealed Data Transfer: A term used to describe the movement, transfer, validation and storage of data transferred to a **LH** Supplier for which the integrity of the data is sealed and therefore no change or conversion is permitted.

5 Requirements

5.1 Introduction

QRS-100 defines the minimum requirements for a Supplier to receive, manufacture and certify compliance to, a DDS as opposed to traditional 2D drawings. For an overview of the process refer to Appendix 1.

The requirements and processes contained within this document are aligned to DMFG principles and methodologies, focussed upon operating high efficiency levels achieved from:

- Design for manufacture: Creating the opportunity for the Supplier to contribute to the Design content in order to introduce manufacturability prior to Design release.
- One-part-one-model: Single source control simplifying electronic distribution, tracking and configuration management of DDSs.
- Prioritising upon minimal 2D content within the DDS
- 3D models defined with Implicit Tolerances, Geometrical Dimensioning & Tolerancing principles and Design Notes.
- Operating from **LH** DMFG Methodologies: **LH** have released DMFG methodologies applicable to both General and specific Technology /Commodity Type rules.
- Sealed Data Transfer: Technically retaining the content and Design intent of the **LH** Design.
- Dimensional Inspection Planning, DIP: The creation of a DIP by securely extracting geometry for manufacturing and inspection purposes including Explicit dimensions, Implicit dimensions and Design Notes.
- Version Control and Setup of CATIA V5: There is a need for the Supplier to operate the version of CATIA V5 specified by **LH** and configure the corresponding setup.

5.2 Supplier Selection and Capability Classification

5.2.1 Supplier Selection

Suppliers *may* be selected on the basis of the applicable DMFG capability, related to :

- Data Input from **LH**
- Data Output to **LH**
- Tools Used
- Methodologies

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- Integration of **LH** DMFG Environment

The three levels of capability progressively leading to High are:

#	DMFG CAPABILITY	SCOPE OF APPROVAL
1	High	DMF-000
2	Medium	DMF-001
3	Low	DMF-002

5.2.2 Supplier's DMFG Capability Classification

As defined by the Supplier's SDP:

High: The Supplier complies with QRS-100 with respect to:

- Full integration with the DMFG environment exchanging **LH** DMFG native DDS.
- Operating CATIA V5 configured in accordance with the specified DMFG hardware and software requirements.
- Operating applicable DMFG methodologies in full 3D.
- Producing FAI Plans and Dimensional Inspection Plans from the **LH** native DDS.

In this case the Supplier operates as a client within both the **LH** system and **LH** DMFG environment.

Medium: The Supplier complies with QRS-100 with respect to:

- Exchanging **LH** DMFG native DDS. (Through SWIP Supplier portal or FTP Sites)
- Operating CATIA V5 configured in accordance with the specified DMFG hardware and software requirements.
- Operating applicable DMFG methodologies in 3D and 2D.
- Producing FAI plans and Dimensional Inspection Plans from the **LH** native DDS.

As an example in this case, the Supplier would have the minimum number of workstations to generate Process Plans, Work instructions and Tool Designs in 3D CATIA V5 and transfer models to **LH** e.g. of tooling designed by the Supplier in support of **LH** manufacture.

Low: The Supplier complies with QRS-100 with respect to:

- Only receiving **LH** native DDS. (Through SWIP Supplier portal or FTP Sites)
- Unable to resend DMFG data to **LH** in 3D Format when applicable.
- Operating applicable DMFG methodologies in 3D and 2D.

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- Producing FAI plans and Dimensional Inspection Plans from the **LH** native DDS.

As an example in this case, the Supplier has a limited number of CATIA V5 workstations restricted to reading the **LH** DDS and preparing Dimensional Inspection Plans. For all remaining purposes and applications, the Supplier operates an alternative CAD/CAM system(s).

Note: For suppliers authorized to the SWIP Supplier portal, its use is mandatory. The FTP site is still allowed as interim solution for supplier still not authorized to the SWIP Supplier portal.

Refer to Appendix 2 for the schematic representing Sealed Data Transfer.

5.2.3 Data Output to LH

When a Supplier is invited by **LH** to contribute to an evolving Design, one or a combination of methods *may* be used by the Supplier to remotely view the current **LH** design to provide feedback, using for example:

- WebEx
- ReplyWeb
- Low End Viewer at the Supplier
- Direct access to the **LH** concurrent environment
- Data exchange via FTP sites/SWIP Supplier portal

In some cases, the Supplier *may* be invited to route 3D data to **LH**. For example, the routing of tool designs generated by the Supplier in support of **LH** manufacture, DIP to be validated, etc.

In these cases the data *must* be exchange only through FTP sites/SWIP Supplier Portal.

5.2.4 Requirements for the Supplier's Information System Tools

- DMFG Environment Configuration for External Suppliers, AWDMFG021.

The Supplier *shall* operate and maintain the version of CATIA stipulated in AWDMFG021, aligned with last revision published by LH, to achieve technical compatibility with **LH** with minimum effort and maximum confidence.

In addition, the Supplier *shall* configure their CATIAV5 default settings using software provided by **LH** as called-up by AWDMFG021.

- For any changes to AWDMFG021 and/or the Supplier's CAD system, the Supplier *shall* revise and submit their SDP to **LH** for re-approval quoting changes to their hardware and software configuration.
- For the requirements appertaining to Suppliers transferring DDS to their lower tier Suppliers, refer to paragraph 6.4.

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- For data exchange through SWIP portal there are no additional requirements regarding the operating system. To access the portal the requirements are an internet connection with the Internet Explorer 7 browser or better, alternatively Firefox 5 or better.

Note: The SWIP portal using the following technologies:

- *Microsoft .NET Framework 4.0 Client Profile*
- *Windows Presentation Foundation (WPF)*
- *Windows Communication Foundation (WCF)*

These module are normally included in the basically installation of the operating system

5.3 Supplier Methodologies

If not already done-so, the Supplier is required to generate processes and procedures demonstrating compliance to QRS-100. These procedures *shall* be referenced in a dedicated DMFG Sealed Data Plan and **LH** SQA *shall* approve this document ideally prior to the commencement of manufacture.

Manufacture *may* commence in advance of approval with the written authority of **LH** i.e. in accordance with a documented and time-bound closure plan leading to the minimum approval Classification.

5.4 Content of the Supplier's DMFG Sealed Data Plan, SDP

Refer to Appendix 3 for a summary of the SDP contents.

- For the management of **LH** DDSs the Supplier *shall* map their Processes for DDS receipt, storage, and validation with a representation of associated Manufacturing Engineering, Production and Inspection DDS processes.
- The Supplier *shall* document within their SDP their hardware and software, with each revision status as applicable, required to maintain synchronisation with **LH** Sealed Data Transfer in accordance with AWDMFG021.

  This *shall* include:

  - CAD packages and any additional computing equipment receiving Authoritative Data.
  - The method of accessing and processing DDSs by each function of the Organisation.
  - The revision numbers of AWDMFG021 and the associated setup software provided by **LH**.
- The Supplier's SDP *shall* reference any existing DMFG / DDS procedures compliant to QRS100 or alternatively directly call-up new QRS100 procedures for e.g.:
  - Manufacturing Engineering
  - Configuration Management, see para 8
  - Inspection Planning
  - The use of **LH** native CATIA for Inspection purposes.

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- First Article Inspection
- Steady state batch Inspection
- DMFG Training.

- The SDP *shall* identify compliance with DMFG methodologies applicable to the Supplier's technology type. Refer to Appendix 3.

Applicable methodologies *shall* either be provided directly to the Supplier by Procurement, or the Supplier *shall* have access via the Portal to the **LH** Methodology Applicability Matrix in addition to the applicable methodologies.

To control this requirement, the Supplier *shall* create their own Application Matrix defining the methodologies applicable to their business and identify their method of receiving or accessing the methodologies subject to the **LH** Non Disclosure Agreement, NDA.

For initial and any change of technology type, the Supplier *shall* maintain continuous access to updates and ensure the methodologies are understood and flowed-out to all affected functions for compliance purposes.

- When there is an intention for a 1st tier Supplier to **LH** to second stage sub contract the **LH** DDS to a lower-tier Supplier in furtherance of a **LH** DMFG Purchase Order, the 1st tier Supplier *shall* be responsible for :
  - Ensuring all lower-tier Suppliers are approved by **LH** to QRS01, with DMFG scope of approval, prior to any order being placed.
  - Informing **LH** of the Informing **LH** of the intent to use a new lower tier Supplier for DMFG purposes and listing the lower tier Supplier in their DMFG SDP recording the version of CATIA to be used.
  - Ensuring DDS transfer to the lower tier Supplier does not take place in circumstances stipulated by **LH** when applicable.
  - Ensuring all low-tier Suppliers, not with low level of 1st tier DMFG approval supplier, are approved by **LH** for DMFG Purposes
- The Supplier *shall* provide prior notification to **LH** of any change that directly affects the approved content of the SDP. Similarly, the Supplier *shall* update their SDP against any up-issues of QRS-100, or on the specific request of **LH** and resubmit their SDP to **LH** for approval.
- The Supplier *shall* conduct an Internal Audit of the DMFG SDP at the commencement of manufacture, followed by periodic audits at maximum intervals of 6 months to ensure continued compliance and effectiveness.
- Results of all Internal Audits *shall* be documented and maintained for review by **LH**. The Supplier *shall* increase the frequency of audits following the discovery of any adverse findings or at the request of **LH**.

5.5 Configuration Management and Data Security

Throughout the manufacturing process the Supplier *shall* maintain the correct configuration of the Product Baseline and maintain traceability of each Product back to the **LH** Sealed Data Transfer and all associated DDS elements.

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The following controls within the Supplier's SDP *shall* apply:

- The Supplier *shall* configure and trace the physical Product, In Process Models, Manufacturing Engineering and Inspection Planning back to the original **LH** DDS and associated specifications, data, procedures and DMFG methodologies as listed in the SDP DMFG applicability matrix.
- Ensure any use of non-released DDSs are correctly authorised by **LH** and identified/controlled in accordance with para 5.6
- Record the version number of the **LH** CATIA DDS.
- Any DDS transferred from **LH** identified as "REFERENCE ONLY" *shall* not be used for Production purposes.
- Product compliance to the **LH** Sealed Data Transfer *shall* be underwritten by, and traceable to, the FAIR in accordance with QRS-01.
- Ensure a record of all data and DDS transmittals, to and from **LH**, is traceable to the Supplier's CAD software and authorised Users.
- Document in the Supplier's SDP specific validation processes for any exchange, translation or conversion of the original **LH** DDS, i.e. solely for manufacturing purposes, to ensure the original Design intent is retained with no risk of change or data corruption. Refer to Appendix 3.
- Maintain secure storage of **LH** Sealed Data Transfer, **LH** methodologies and the Supplier's own CAD/CAM models. Access *shall* be controlled and restricted to authorised personnel taking into account the Non Disclosure Agreement imposed by **LH**.
- Establish and maintain a secure data backup system and Disaster Recovery Process.

5.6 LH Design Maturity

The Supplier is authorised to manufacture and dispatch Products traceable to fully released **LH** DDS provided by **LH**, i.e. at the '100%' maturity status of RELEASED 'R'.

Tha maturity status of DDS is available in the Part List document.

Controlled exceptions *may* take place only when **LH** explicitly authorise the manufacture from a Design prior to release for a specified purpose. **LH** controls *shall* take into account any restrictions imposed by the current Maturity status.

When applicable, prior to **LH** Design release the following *shall* apply to the receipt and control of a DDS at the Supplier:

- Products *shall* be securely and temporarily identified as 'non-conforming' and segregated accordingly.
- The Supplier's Configuration Management system *shall* provide traceability to the **LH** Purchase Order with any corresponding **LH** manufacturing instructions and restrictions.
- All manufacturing instructions and restrictions imposed by **LH** *shall* be invoked.
- Parts manufactured from 'pre-release' or 'non-released' DDS can only be dispatched to **LH** under the authorisation and controls imposed by LH through Purchase Order.

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The Certificate of Conformity shall clearly report the statement “Part manufactured under non-released design data”

5.7 -Dimensional Inspection Plan

With respect to annotations or ‘dimensioning’ of Explicit dimensions created by the **LH** Designer:

- By definition, features subject to a Defined Tolerance *shall* have the dimension and tolerance annotated by **LH** Design on the specific feature of the DDS. i.e. ‘Explicit’ Dimensions.
- A dimension and tolerance not explicitly annotated on a feature by **LH** Design is termed an ‘Implicit Dimension’.
- Refer to methodology AWDMFG002 Dimensioning and Tolerancing Principle Rules and Guidelines for information relating to General Tolerancing as applied to profiles. This methodology is in addition to the Engineering Standard called-up by the Design, e.g. ASME Y14.5M, ASME Y14-41.

Hence the Supplier is required to produce a Dimensional Inspection Plan, DIP, to enable the Product definition in it’s entirety to be inspected and certified. The DIP *shall* consist of all Explicit dimensions annotated on the **LH** Design plus any additional Implicit dimensions required by the Supplier for Manufacturing and Inspection purposes.

The Explicit and Implicit dimensions and Design Notes *shall* be extracted from the **LH** DDS for Manufacturing and Inspection purposes using the standard CATIA toolset. In all cases there *shall* be no form of interpretation or change of definition.

Any emerging anomalies *shall* be formally raised with **LH** with a record of close-out including traceability to the **LH** response.

The retention of 3D definitions via electronic work instructions is encouraged by **LH** for DIPs.

- The DIP *shall* identify all of the features, dimensions/tolerances annotated by **LH** Design on the DDS plus any additional features not annotated, e.g. Implicit dimensions, required to retain and verify the Design intent for Manufacturing and Inspection purposes. For completeness, the DIP *shall* include all Design notes.
- The DIP *shall* be directly traceable to the original **LH** native CATIA DDS.
- The dimensional inspection requirements and Design Notes *shall* be extracted from the original **LH** DDS by competent personal trained in CATIA V5 using the standard CATIA toolset without interpretation or change.

  Any resulting queries *shall* be formally recorded and resolved directly with **LH**.
- FAIR and batch inspection results *shall* be traceable to the requirements of the DIP. For example, CMM programming, CMM reports and Bench Inspection requirements *shall* originate from the DIP.
- The DIP *shall* be subject to independent approval by the Supplier’s Quality Organisation. This role *may* be delegated by Quality, in accordance with the

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Supplier's governing Procedures, to a competently trained position within the Organisation, e.g. within Manufacturing Engineering.

- It is essential to use **LH** native CATIA throughout, in particular for CMM inspection purposes.
- FAIR requirements in QRS-01 *shall* apply. The DIP *shall* be quoted in the FAIR as the document required for subsequent steady state batch inspection clearance.

The actual dimensions of the Product *shall* be recorded in the usual manner in the FAIR, but need not be recorded in the DIP for batch Production unless required by another process.

5.8 Technical Problem Reporting and Corrective Action

- The Supplier *shall* ensure any irregular or non-conforming Sealed Data Transfers are formally identified to **LH** as being discrepant, quarantined from use and reviewed for disposition.
- The Supplier *shall* develop and maintain procedures for recording, reporting, tracking and resolving any data transfer, hardware, software and DDS issues.

5.9 Ongoing LH Approval of Suppliers

Following approval to QRS-100, **LH** reserves the right to periodically audit the Supplier's ongoing compliance.

5.10 Training Requirements

Regular training 'needs and analysis' *shall* be conducted for all functions to achieve and maintain minimum competency levels against QRS-100 requirements. Associated training records *shall* be updated and maintained for this topic.

Refer to Appendix 4 for training guidelines.

6 Annexes, Appendices and Forms

- Appendix 1 – Process Overview
- Appendix 2 – Sealed Data Transfer
- Appendix 3 – Example Sealed Data Plan Scope and Content
- Appendix 4 – Guidelines for Minimum Training Requirements for CATIA & DMFG Methodologies

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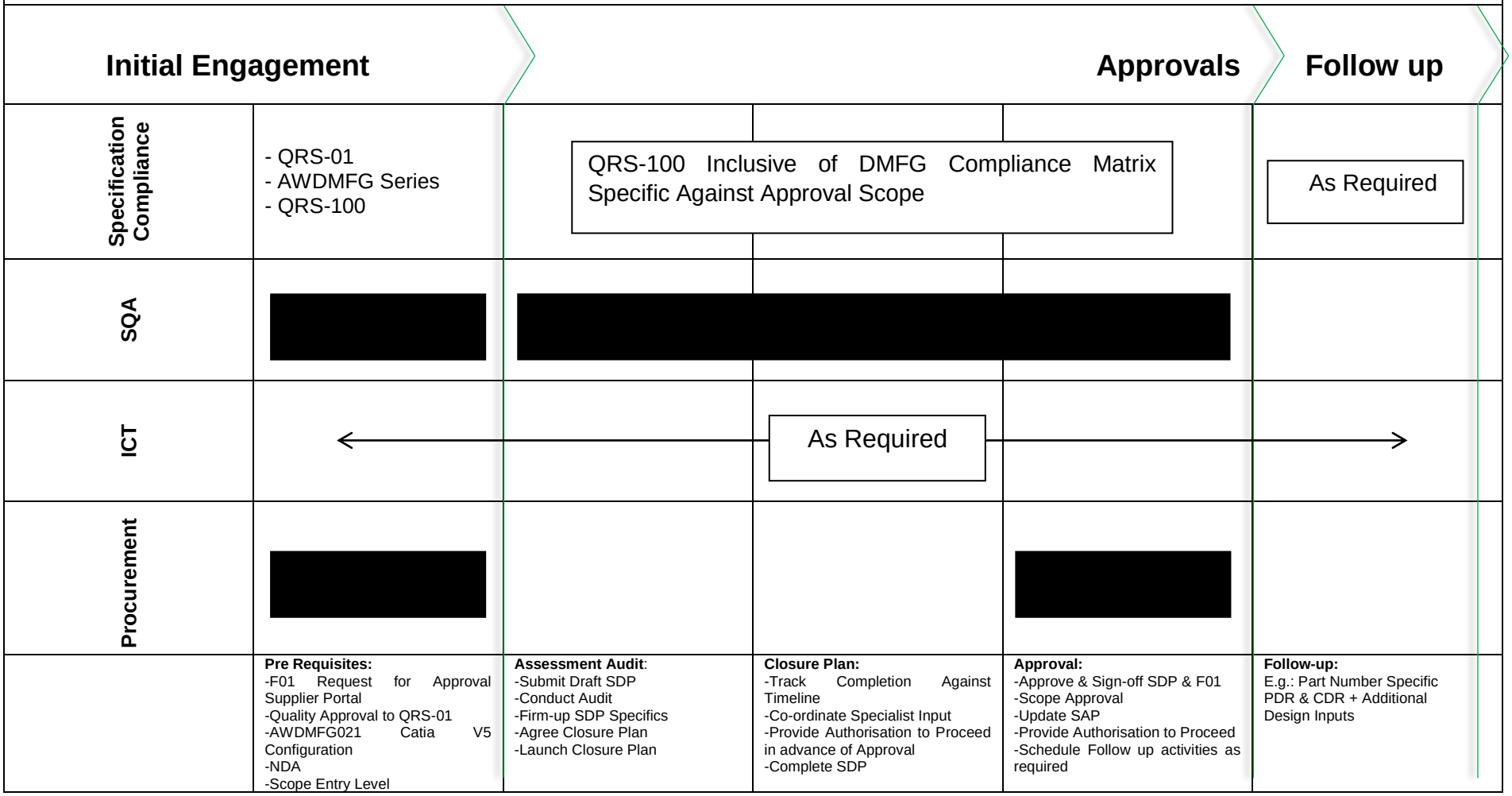
Appendix 1 – Process Overview

Quality Approval of LH DMFG Subcontractors against QRS-100 Requirements



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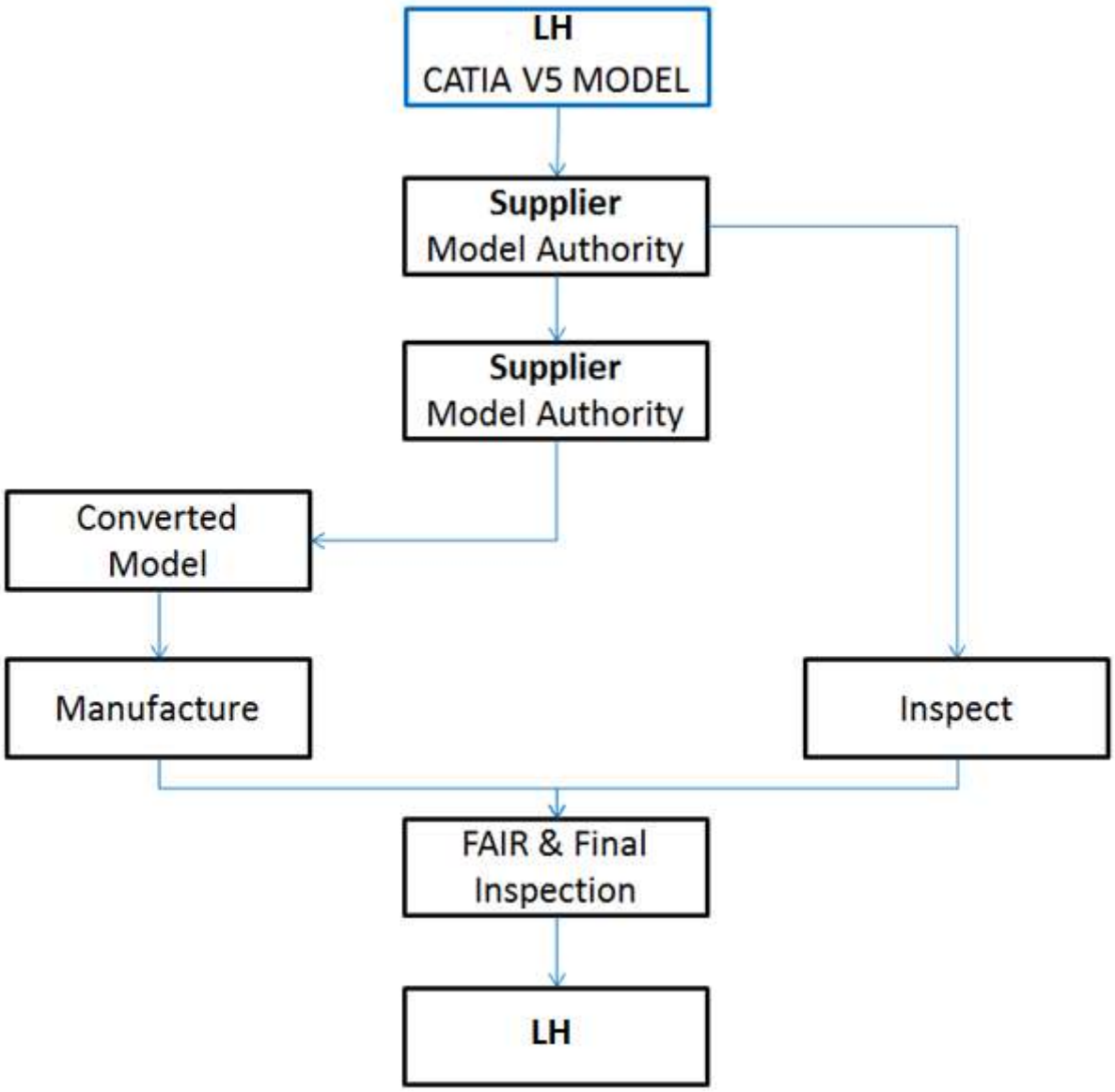
Appendix 2 – Sealed Data Transfer



Notes:

1. LH native CATIA *shall* be used for Inspection purposes, any conversion or change of LH native CATIA is not permitted
2. The Supplier *must* operate the release of CATIA specified in AWDMFG021

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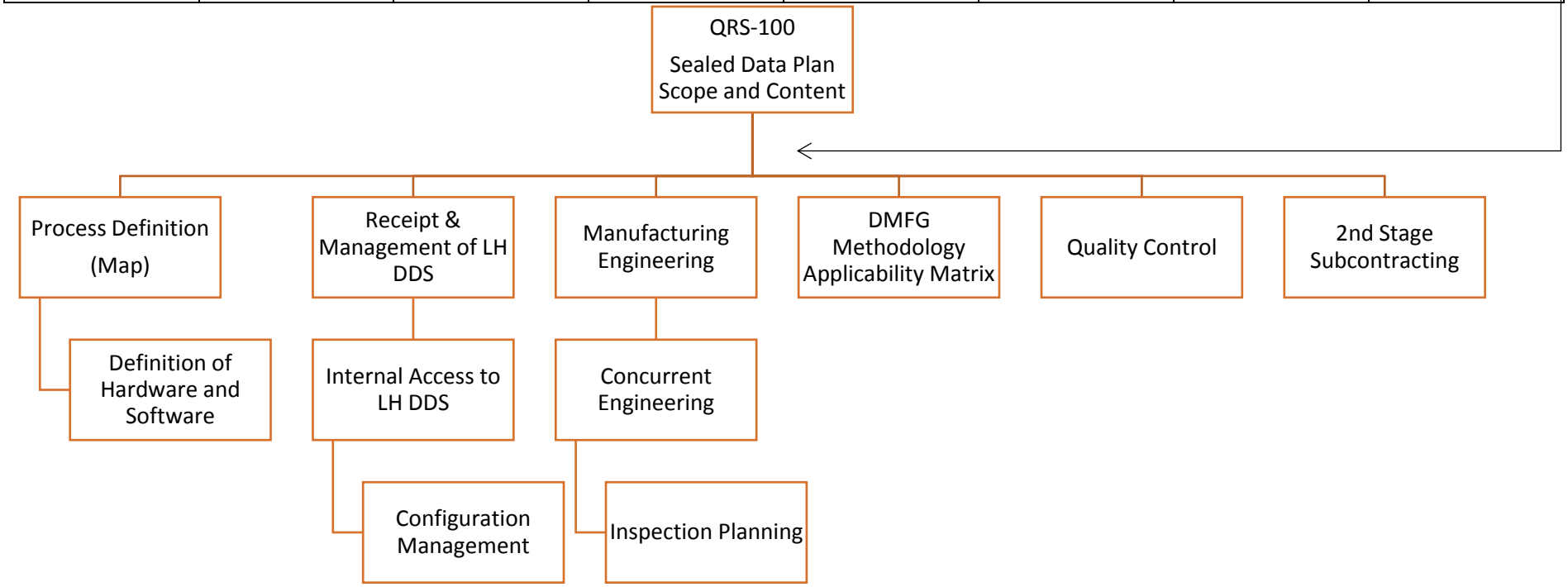
Appendix 3 - Example Sealed Data Plan Scope and Content

V5 Technical Toolsets				Methodologies	Processes		
DDS & DMU Management							
Collaboration	**Casting & Forgings**	**Machining**	**Sheet Metal**	**Composites**	**Electrical**	**Final Assembly**	**Tubing**



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Appendix 4 - Guidelines for Minimum Training Requirements for CATIA & DMFG Methodologies

#	Function and Department	Topic and Training Requirement	Training Source
1	**Inspection Planning** Manufacturing Engineering & Quality Control	**CATIA V5 & Related Modules** Extracting the Design Definition from the LH DDS including Implicit Dimension for Manufacturing & Inspection Purposes. Includes Inspection Planning for CMM programming (where applicable).	Dassault Systems or a formal DS Service Provider
2	**Remaining Support Functions** e.g. QA, QC, SQA	**CATIA Low End Viewer, LEV** Viewing the AW DDS	The LEV Provider or a formal Service Provider.
3	**As Appropriate**	**Applicable DMFG Methodologies and Engineering Standards*** Responsibility for: - A direct operation - A support role *e.g. ASME Y14.5M	Supplier with LH input as required.
4	**CMM Operation**	**Operating with LH Native CATIA**	CMM Supplier or Formal Service Provider

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