QRS-101 First Article Inspection

LEONARDO
HELICOPTERS

QRS-101

First Article Inspection

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CHANGES LOG

Issue	Approval Date	Main changes	Interested Paragraphs
00	April 2015	First Issue – Supersedes IQ S001	All
01	February 2017	- Company Name Change from AgustaWestland (AW) into Leonardo Helicopters (LH) - Articles not under FAI applicability - Definitions - Management of FAI Plan - FAI Declaration	- All - 2 - 5 - 8 - 10.2
02	June 2018	Document significantly rewritten and reformatted	All

APPLICABLE DOCUMENTS

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

CONTENTS

1 Purpose

The primary purpose of first article inspection is to validate that product realization processes are capable to produce articles and assemblies that meet engineering and design requirements. A well planned and executed first article inspection *will* provide objective evidence that manufacturer's processes can produce compliant articles and that Supplier has understood and incorporated associated requirements. First article inspection *will*:

- provide confidence that the article realization processes are capable to produce conforming product,
- demonstrate that the Supplier of the product has understood the associated requirements,
- provide objective evidence of process capability,
- reduce potential risks associated with production start-up and/or process changes,
- provide assurance of product conformance at the start of production and after changes.

A first article inspection is intended to

- reduce future escapes, risks, and total costs,
- help ensure safety of flight,
- improve quality, delivery, and customer satisfaction,
- reduce costs and production delays associated with product non-conformances,
- identify product realization processes that are not capable of producing conforming product and initiate and/or validate corrective actions.

The purpose of this procedure is to define the requirements and relevant responsibilities concerning the process of First Article Inspection (FAI) for articles and assemblies supplied to Leonardo Helicopters related to the validation and revalidation of the production process.

The reference used is EN/AS9102 standard in order to standardize FAI process requirements to the possible greatest extent and to provide a consistent process and documentation requirements for verification of articles and assemblies. All the forms *must* be filled in English, unless otherwise agreed.

2 Applicability

This procedure is applicable to all Leonardo Helicopters (LH) Suppliers according to Table 1 of QRS-01. The supplier *shall* flow down the requirements of this procedure to its suppliers or processor involved in the manufacturing process.

This procedure applies to installations, assemblies, sub-assemblies, and detail articles including castings, forgings, and modifications both to standard catalogue and to Commercial Off the Shelf (COTS) items.

Unless contractually required, this procedure does not apply to:

- development and prototype parts that are not considered as part of the first production run,
- procured standard catalogue items (COTS) or deliverable software,
- E/TSO Certified Articles,
- engine/APU articles if not included in Leonardo Helicopters Type Design,
- international Standards,
- STC articles, also if included in a configuration applicable to a LH delivered product if not included in Leonardo Helicopters Type Design,
- LH standard parts,
- Suppliers of raw material,

In case of experimental or not yet approved or not serial production items, including:

- Unique single run production orders, not intended for ongoing production (e.g., out-of-production spares).
- instrumented P/N (drawing type indicator "U"),
- experimental coded P/Ns (drawing type indicator "E" or "T"),

the activity shall be identified as "Test Article Conformity" selecting the appropriate box in the FAI form (see QRS-115 for process description and authorization).

3 Effective date

Issue date

4 Acronyms, definitions and abbreviations

4.1 Acronyms and abbreviations

CDR	Critical Design Review
CoC	Certificate of Conformance
COTS	Commercial Off The Shelf
DDS	Design Data Set
DPD	Digital Product Definition
DWG	Drawing
FAI	First Article Inspection
FAIR	First Article Inspection Report
KC	Key Characteristic
LH	Leonardo Helicopters
P/N	Part Number
PS	Procurement Specification
S/N	Serial Number
SCD	Source Control Drawing
STCH	Supplemental Type Certificate Holder
TCH	Type Certificate Holder
(E)TSO	(European) Technical Standard Order

4.2 Definitions

Attribute Data: A result from a characteristic or property that is appraised only as to whether it does or does not conform to a given requirement (e.g. go/no-go, accept/reject, pass/fail),

Baseline Part Number: This refers to previous FAI part number or approved configuration, including revision level, to which a partial FAI is performed.

Critical Characteristic: A significant characteristic on a critical part that in addition to the above definition, if not complied to, could generate a catastrophic failure. A critical part *shall* have, at least, one critical characteristic, but could also have significant characteristics. A non-critical part could only have significant characteristic.

Commercial Off The Shelf Items: Commercially available items intended by design to be procured and utilized without modification (e.g., common electronic components)

Deliverable Software: Embedded or loadable airborne, space borne, or ground support software components which are part of an aircraft type design, weapon system, missile, or spacecraft.

Digital Product Definition (DPD) Requirements: Requirements of any digital data files that disclose, directly or by reference, the physical or functional requirements, including data files that disclose the design or acceptance criteria of an article.

Examples of DPD include the following:

- The digital definition and fully dimensioned two-dimensional (2D) drawing sheets.
- Three-dimensional (3D) data model and simplified or reduced content 2D drawing sheets.
- The 3D model with design characteristics displayed as text.
- Any other data files that define a product in its entirety.

Design Characteristics: Those dimensional, visual, functional, mechanical, and material features or properties, which describe and constitute the design of the article, as specified by drawing or DPD requirements.

These characteristics can be measured, inspected, tested, or verified to determine conformance to the design requirements. Dimensional features include in-process locating features (e.g., target-machined or forged/cast dimensions on forgings and castings, weld/braze joint preparation necessary for acceptance of finished joint). Material features or properties *may* include processing variables and sequences, which are specified by the drawing or DPD (e.g., heat treat temperature, fluorescent penetrant class, ultrasonic scans, and sequence of welding and heat treat). These provide assurance of intended characteristics that could not be otherwise defined.

First Article Inspection: A planned, complete, independent, and documented inspection and verification process to ensure that prescribed production processes have produced an item conforming to engineering drawings, DPD, planning, purchase order, engineering specifications, and/or other applicable design documents.

First Article Inspection Report: The forms and package of documentation for a part number, sub-assembly, assembly, or installation including first article inspection results, as defined by this procedure, after the qualification of the part.

First Production Run Articles: First group of one or more articles that are the result of a planned process designed to be used for future production of these same articles (after DDS Approval by LH).

Manufacturer (or Vendor): See QRS-01 main document

Significant Characteristic: A characteristic of the part, referenced on the related drawing that if not complied to, could provide malfunction and/or behaviours different from the ones the part has been designed to.

Standard Catalogue Items: A part or material that conforms to an established industry or national authority published specification, having all characteristics identified by text description or industry/national/military standard drawing.

Subcontractor: See QRS-01 main document

Unique Single Run: The initial group of one or more articles that are the result of a planned process designed not to be used for future production.

For general definitions, refer to EN ISO 9000, EN 9100 and IAQG Dictionary.

5 Suppliers Involved

Every supplier that manufactures articles as described in paragraph 2 of this procedure *shall* perform a first article inspection on the First Production Run.

The first article inspection *shall* be completed before the delivery to LH of the first Serial Number (S/N) or Batch Number of the Part Number (P/N) involved and provided to LH (if requested) in advance to the shipment of the parts.

6 First Article Inspection Plan

The Supplier *shall* have a process to plan for completion of FAI activities prior to the first production run. FAI Planning *shall* address the activities to be performed throughout the FAI process and identify the responsible organizations for those activities.

6.1 FAI Plan for Manufacturers

If the Supplier **is not a POA Holder, or POA privileges cannot be applied**, the supplier *shall* prepare a FAI Plan and send it to LH for approval in accordance with paragraph 6.4, including any activities performed by sub-tiers. The Supplier can use its own forms or the ones attached to this procedure, prepared in compliance toEN/AS9102. FAI Plan *shall* list at least the 100% of the characteristics mentioned on LH and Supplier drawings/specifications (KC, dimensions, technical, drawing notes, functional and quality requirements).

If the Supplier **is a POA Holder, and it has applied to include the PN into its own capability list**, the FAI requirements applies as a quality requirement according to this procedure, and the supplier *shall* always perform a FAI plan and a FAIR, which are not subject to LH approval, but the Supplier *shall* communicate the positive closure of FAI to LH by submitting a copy of the FAIR to the relevant Quality Control. After successful completion of FAI, the P/N *shall* be included into the supplier capability list.

Note: upon request, access to sub-tier FAI documentation shall be granted to LH.

6.2 FAI Plan for Subcontractors

Every Supplier involved into FAI activities, *shall* have an internal procedure describing how FAI activities *will* be deployed, including any activities performed by sub-tiers.

Where requested by LH, LH Manufacturing Engineering can either issue a FAI plan to be carried out, partially or completely, by the Subcontractor or to evaluate FAI plan prepared by the Supplier itself (with a LH number) in advance to the performance of FAI activities.

6.3 FAI Planning

If the approval by LH of the FAI plan is requested, the FAI Plan *shall* be produced using the forms “Part Number Accountability”, “Product Accountability – Materials, special processes, and functional testing” and “Characteristic Accountability, Verification, and Compatibility Evaluation” in accordance with QRS.101.F01, QRS.101.F02 and QRS.101.F03 forms or EN/AS9102. In addition, the preparation of a process control document as per EN/AS9103 standard is encouraged to identify and control the key characteristics variation through the manufacturing process across the service life.

The supplier *should* consider the following activities for the first production run:

- determination of design characteristic inspection and sequencing for inspection of characteristics not measurable in the final product,
- extraction of DPD design characteristics required for product realisation that are not fully defined on 2D drawings, including tolerances for nominal dimensions,
- determination of objective evidence to be included in the FAIR for each design characteristic,
- determination that approved special process, laboratory, material, and customer required sources are identified, as applicable, and that the manufacturing planning, routing, and purchase document calls out the correct specification and relevant sources,
- determination that key characteristic and critical item requirements are identified, as applicable. The application of the EN/AS9103 standard is encouraged.
- determination when part specific gages and tooling are required. These gages and tooling are identified, approved, and traceable, as appropriate,
- provide for LH FAI review, if required,
- identification of events requiring an updated FAI (paragraph 7.5),
- defined Corrective Actions

6.4 FAI Plan Approval

6.4.1 FAI Plan Approval for Manufacturers

Note: This paragraph applies only to Suppliers that are not POA Holder or POA privileges cannot be applied.

FAI Plan approval *shall* be part of the CDR that can be jointly performed by LH and Supplier.

During the CDR, the FAI Plan prepared by the supplier *shall* be available for approval by the LH Chief Project and Manufacturing Engineering.

In case CDR is not applicable, the supplier *shall* send FAI Plan to LH Manufacturing Engineering that, after approval, involve the Chief Project. In order to be considered approved, a FAI Plan *shall* be approved by both Manufacturing Engineering and Chief Project, with double signature in "Customer Approval" field.

In the event a delta-FAI is needed (see paragraph 7.5), a delta-FAI plan *shall* be raised in advance the performance of delta-FAI activities and *shall* be sent to LH involved department for approval with the same rules followed for the FAI plan or upon request.

After LH approval, a copy of approved FAI Plan *will* be provided to the Manufacturer by LH Manufacturing Engineering.

Note: upon request, access to sub-tier FAI documentation shall be granted to LH.

6.4.2 FAI Plan Approval for Subcontractors

In case the LH Manufacturing Engineering decides to approve a FAI Plan prepared by a Subcontractor, the Supplier *shall* send the FAI Plan to the relevant Manufacturing Engineering.

LH Manufacturing Engineering evaluates the FAI Plan received prior to the start of manufacturing activities, notifying the approval/comments to the Supplier.

6.5 Modification Management for Manufacturers

When the supplier communicates a change to the technical data (even if minor), a copy of the new FAI Plan *shall* be provided to LH Chief Project. The Chief Project is requested to evaluate if a "Delta FAI" is applicable or not.

In case of manufacturing process modification, a copy of the new FAI Plan *shall* be provided to LH Manufacturing Engineering that is requested to evaluate if a "Delta FAI" is applicable or not.

In both cases, if a critical characteristic of a critical part is affected, a delta FAI is always required/applicable.

Signed FAI Plan *will* be returned to the Supplier by the first function that evaluates the change.

7 First Article Inspection Accomplishment

7.1 Requirements

First article inspection *shall* be performed on new articles representative of the first production run. The supplier *shall* use a representative item from the first production run of a new article to verify that the production processes, production documentation and tooling have the capability to produce articles that meet the established requirements. The Supplier *shall* also ensure that the processes are consistent and controlled to achieve repeatable characteristics on the article, by identifying the relevant key characteristics and planning appropriate article/process controls (FAI repetitions, Statistical Process Controls, monitoring of the key characteristics etc.).

In case of subassemblies manufactured by other suppliers, the main supplier *shall* indicate how the subcontracting supplies have been qualified.

In case of finished articles coming from castings or forgings, the supplier *shall* also accomplish FAI and submit it to LH for semi-finished parts.

For assemblies, first article inspection *shall* be performed on all the subcomponents of the main assembly and on the main assembly itself and provided to LH.

This process *shall* be repeated when changes occur that invalidate the original results (e.g. engineering changes, manufacturing process changes, tooling changes, plant).

7.2 Digital Product Definition Requirements

When design requirements are in digital format and no traditional 2D drawing information is available, DPD design characteristic required for product realization *shall* be extracted, verified and included in the FAIR.

The supplier *shall* extract the DPD design characteristics required for product realisation and ensure the production, inspection and operations requiring verification have been completed as planned to achieve DPD design characteristics.

7.3 Non-conformances handling

The first article inspection with non-conformances on design characteristics (that can invalidate FAI results), non-conforming articles or scrapped parts, is “not complete”. In case of first article inspection with non-conforming design characteristics, the form QRS.101.F01 (or EN/AS9102 equivalent) “Part Number Accountability” *shall* be filled, signed and noted as “FAI Not Complete”.

When processing a FAIR with documented non-conformances:

- Record the nonconforming design characteristics on Form QRS.101.F03 (or EN/AS9102 equivalent) "Characteristic Accountability, Verification, and Compatibility Evaluation".
- Record the non-conformance document reference number on Form QRS.101.F03 (or EN/AS9102 equivalent) "Characteristic Accountability, Verification, and Compatibility Evaluation" (see Field 11)
- Select the box "FAI Not Complete" on Form QRS.101.F01 (or EN/AS9102 equivalent) "Part Number Accountability".
- Sign Form QRS.101.F01 (or EN/AS9102 equivalent) "Part Number Accountability" per supporting form instructions.

The supplier *shall* implement corrective action(s) and perform a delta first article inspection or re-issue full first article inspection if requested for all affected characteristics on the next production run, after implementation of the associated corrective action(s). If the partial FAI does not clear all identified non-conformances, the first article inspection is still "not complete" and the requirement to complete the first article inspection is still in effect.

Such articles *shall* be sent to LH under Concession.

7.4 Evaluation Activities

The supplier *shall* conduct the following activities during product realization, when applicable, in support of FAI to ensure conformance with design characteristics:

- Review documentation for the manufacturing process (e.g., routing sheets, manufacturing or quality plans, manufacturing work instructions) to ensure all operations are complete as planned and call out the correct specification, material types, conditions, and approvals.
- Review supporting documentation in the FAI (e.g., inspection data, test data, Acceptance Test Procedures, special process approvals and certifications) for completeness.
- Verify that the raw material and special process certifications call out the correct specification, material types, conditions, and approvals.
- Verify that required customer approved sources are utilized.
- Review non-conformance documentation included in the FAIR for completeness.
- Verify that required designed tooling (e.g., part specific gages) are used and appropriately documented on QRS.101.F03 (or EN/AS9102 equivalent) "Characteristic Accountability, Verification, and Compatibility Evaluation".
- Verify that every design characteristic requirement is accounted for, uniquely identified, and has inspection results traceable to each unique identifier.
- Verify the design characteristics that are the output of the manufacturing process are measured, inspected, tested, or verified to determine conformance, including DPD characteristics.
- Verify part marking is legible, correct in content and size, and properly located per applicable specifications.
- Verify that personnel performing Special Processes is properly qualified.

7.5 Delta (Partial) or Re-accomplishment of First Article Inspection

- The FAI requirement, once invoked, *shall* continue to apply even after initial compliance.
- The FAI *may* be satisfied by a delta first article inspection that addresses only the changes from a baseline part number provided all other characteristics were conforming on the previous first article inspection and are produced by the original production processes.
- When a delta first article inspection is performed, the supplier *shall*, as a minimum, complete the affected fields in the first article inspection forms.
- When the supplier performs a delta first article inspection, the supplier *shall* record the "Baseline Part Number" or "Baseline FAI Number", including the revision level and reason for the partial first article inspection on Form "Part Number Accountability".
- In case of repetitive non-conformances related to the manufacturing process, even if the process has already been frozen through a positive FAI, a re-accomplishment of a First Article Inspection can be requested by LH after a detailed analysis performed by the Supplier and sent to LH for acknowledgement or performed by LH itself.
- First article inspection requirements *may* be satisfied by a previously approved FAI performed on identical characteristics of similar articles produced by identical means. When first article inspection requirements (delta or full) are satisfied in this manner, identify the "Baseline Part Number" on Form QRS.101.F01 (or EN/AS9102 equivalent) "Part Number Accountability"
- The Supplier *shall* also take into consideration "qualification requirements" (if any) indicated in LH drawing/SCD/PS.
- The supplier *shall* perform a full first article inspection or a delta first article inspection for affected characteristics, when any of the following occurs:
  - a change in the design characteristics affecting airworthiness and safety aspects, fit, form, or function of the part, environmental aspects, mass property aspects, reliability aspects, drawing aspects, traceability aspects, in-service effects, manufacturability aspects, test aspects or cost/delivery aspects,
  - a change in manufacturing source(s), process(es), inspection method(s), location of manufacture, tooling, or materials that can potentially affect airworthiness and safety aspects, fit, form, or function of the part, environmental aspects, mass property aspects, reliability aspects, drawing aspects, traceability aspects, in-service effects, manufacturability aspects, test aspects or cost/delivery aspects,
  - a change in numerical control program or translation to another media that can potentially affect airworthiness and safety aspects, fit, form, or function of the part, environmental aspects, mass property aspects, reliability aspects, drawing aspects, traceability aspects, in-service effects, manufacturability aspects, test aspects or cost/delivery aspects,
  - a natural or man-made event, which *may* adversely affect the manufacturing process,
  - an implementation of corrective action required to complete a previous first article inspection, as described in section 7.3,
  - a lapse in production for two years *shall* require an update for any characteristics that *may* be impacted by the inactivity. This lapse is from the completion of last production operation to the actual restart of production,

8 First Article Inspection Report

An article inspection has to be considered "not complete" if only a specific number of tests have been performed. These minimum tests *shall* be agreed with LH and can refer but not limited to dimensional checks, weight check, and functional tests.

An article inspection has to be considered "complete" if all the tests related to the manufacturing process have been performed and all the required documents (related to conformance of the articles) requested in the FAI Plan are available and conform.

Note: upon request, access to sub-tier FAIR documentation shall be granted to LH.

8.1 FAIR contents

The list of the required documentation is indicated in the Form QRS.101.F02 (orEN/AS9102 equivalent) "Product Accountability – Materials, special processes, and functional testing".

The Report *shall* contain, at least, the following documentation:

- certificate of conformity of assy parts,
- drawing (LH DWG and SUPPLIER DWG approved from LH),
- picture of parts marking and packing,
- raw material certificate,
- copy of work order or shop traveller frozen,

and, if applicable:

- copy of Concession,
- included FAI Reports of sub components,
- surface and Heat treatment evidence,
- metallurgical report,
- special Processes certificate result evidence,
- approved ATP and relative ATR,
- a specific test report for articles including Complex Hardware (see QRS-117)

NOTE:
All the characteristics defined in the FAI Plan *must* be fulfilled and evidences of conformity shall be provided.

8.2 FAIR Evaluation

When the FAI is considered "complete" by the Supplier, it *shall* be sent to LH Quality Control of the relevant plant for evaluation.

A complete FAIR document collection with traceable index of content shall be submitted, in electronic format.

Evidence of a positive evaluation *will* be given through the issue of a FAI Declaration by LH.

In case of negative evaluation, corrective actions shall be put in place and a new FAIR *shall* be submitted to LH.

LH can accept some Serial Numbers delivered with a "FAI not complete". In this case, the Supplier *will* receive a FAI Declaration with a limitation to those delivered serial numbers. The supplier *shall* have a system in place to monitor this status (to be considered as "FAI to be repeated"), in order to ensure the performance of a delta-FAI to cover the non-conformances *will* be put in place from the following batch.

8.2.1 FAI Declaration for Manufacturers

If FAI is considered positive, a FAI Declaration is raised by the relevant Quality Control and sent to the Manufacturer.

The Subcontractor *shall* record and maintain all the FAI Declarations received.

8.2.2 FAI Declaration for Subcontractors

If FAI is considered positive, a FAI Declaration is raised by Manufacturer Engineering, the FAI Declaration *will* be sent to the Subcontractor by the relevant Quality Control.

The Subcontractor *shall* record and maintain all the FAI Declarations received.

9 Documentation

9.1 Forms

Each field in the forms is designated with a unique reference number and is identified as follow:

(R) – Required: Mandatory requirement

(CR) – Conditionally required: *shall* be completed if applicable to the product (e.g. serial number *shall* be entered when there is a serial number) or upon LH request.

(O) – Optional: this field is provided for convenience.

The forms *should* be used to document the results of first article inspection. All the forms can be completed either electronically or in permanent ink and *shall* be completed in English.

9.2 Characteristic Accountability

The supplier *shall* verify every design characteristic during the first article inspection and record the results. Every design characteristic *shall* have its own unique characteristic number.

Characteristics not measurable in the final product *shall* be verified during the manufacturing process, as long as they are not affected by subsequent operations or by destructive means.

9.3 Record results

The supplier *shall* record the requirement and result in the units specified on the drawing, DPD or specification, unless otherwise approved by LH.

Results from inspection of design characteristics *shall* be expressed in quantitative terms (i.e., variable data), when a design characteristic is expressed by numerical limits. Except that attribute data (e.g., pass/fail) *may* be used in lieu of variable data when:

- No inspection technique resulting in variable data is feasible; or
- Designed tooling or approved tooling is consistently used as a check feature and a go/no-go feature has been established for the specific characteristic. When approved tooling (e.g., radius gauges) are used as a go/no-go gauge, record the numerical minimum and maximum limits of the tooling.
- Attribute data *shall* be used, when the design characteristic does not specify numerical limits (e.g., break all sharp edges).

9.4 Control of records

FAI documentation required by this procedure *shall* be considered a quality record. The supplier *shall* retain the appropriate FAI documentation while the product is being produced and, at a minimum, retain them according to the relevant QRS-112 procedure.

9.5 Delivery Documentation

Each Certificate of Conformity *shall* report FAI status of accomplishment (if “open”) and related FAI number.

In case of change of the status from “open” to “closed”, this information *shall* be reported at least for the first shipment of the articles with a “closed” FAI.

In case of change of status from “closed” to “open” (if a re-accomplishment or delta FAI is requested), the first CoC of delivery *shall* clearly states the status of FAI (“open” or “closed”).

9.6 Right of Access

The supplier *shall* grant LH access to all documents related to FAI in case of LH Design Authority, upon request.

10 Appendices, Annexes and Forms

- QRS-101_F01: Part Number Accountability form
- QRS-101_F02: Article Accountability – Materials, special processes, and functional testing form
- QRS-101_F03: Characteristic Accountability, Verification, and Compatibility Evaluation form