4.1.1 Introduction to Conformity Inspections

This Chapter provides procedures and methods to be followed by the inspector when conducting inspections to determine that parts, appliances and products (aircraft, aircraft engines, propellers or parts) conform to the approved design drawings and specifications.

Conformity inspections are carried out during the certification phase in obtaining a Type Certificate (TC) or during initial production to verify that parts and products conform to design data.

4.1.2 Conformity Inspections

The depth of conformity inspections may vary depending on the particular manufacturer. In the case of a manufacturer with well-established policies, quality system procedures, experience, inspection personnel, equipment and facilities and who has previously demonstrated first article acceptability, the inspector may choose to reduce the depth of conformity inspection by a form of sampling inspection of the manufacturer's product and procedures. In the case of a manufacturer whose ability is unknown—e.g., during the initial production period by a manufacturer producing under a TC only—it will be necessary to conduct in-depth conformity inspections until the inspector is confident that reducing the degree of assessment will not compromise safety.

The Project Officer is recommended to use CASA Form 1248 *Request for Conformity Inspection* as a positive means of documenting those particular inspections required.

Inspector

1. Regardless of the manufacturer's ability, the initial parts or products inspected for conformity for issue of a production approval need to be inspected to a level which conforms all detail parts and processes specified by the design data.

2. When the degree of conformity inspection required has been determined, develop an appropriate conformity verification plan. The plan should focus on:
   - Verifying the conformity of the critical and major characteristics of materials, parts and assemblies
   - Evaluating process controls to assure production of consistent and uniform products. For other than initial conformity, statistical quality control methods may be utilised for process evaluation. Complete descriptions of such statistical methods should be documented.
   - Observing tests of important functional parameters of systems, modules, components and completed products.

3. Regardless of the manufacturer's experience, CASA is responsible for determining that the manufacturer has carried out a complete article conformity inspection and that the results of that inspection are properly recorded, before carrying out the conformity inspection (Refer to 4.1.3).

   In the case of a manufacturer producing under a TC only prior to the issue of an APIS, CASA holds full responsibility for the conformity inspection.

4. Record all conformity inspections conducted or tests witnessed on *Form 882 CASA Conformity Inspection Record* and include all discrepancies, non-conformities and corrective actions.

5. Retain these records on the applicable CASA file.

6. Where design non-conformities or discrepancies are found, forward a copy of the applicable documents to the Manager, Initial Airworthiness.

7. Address the following issues when undertaking a conformity inspection as described in sections 4.1.4 through 4.1.16 as follows:
   - 4.1.4 Materials
   - 4.1.5 Processes and Processing
   - 4.1.6 Automatic Production Processes
   - 4.1.7 Non-destructive Inspection (NDI) Method Evaluation
   - 4.1.8 Critical and Major Characteristics
   - 4.1.9 Workmanship
   - 4.1.10 Adequacy of Drawings and Related Change Records
   - 4.1.11 Adequacy of Inspection Records
   - 4.1.12 Material Review Action
   - 4.1.13 Software
   - 4.1.14 Conformity Inspections of Test Articles
   - 4.1.15 Structural Test Articles—Aircraft
   - 4.1.16 Flight Test Articles—Aircraft
   - 4.1.17 Endurance Test Articles—Engines and Propellers.

   Should discrepancies be found, you may require the manufacturer to carry out a re-qualification of the part/product.

8. Following any re-qualification of the manufacturer, carry out a further conformity inspection, considering the previous results as appropriate.

4.1.3 First Article Inspection

(Reference Standard SAE AS 9102.)

The purpose of First Article Inspection (FAI) is a physical and functional inspection process commonly used to provide objective evidence that all engineering design and specification requirements are properly understood, accounted for, verified and documented. The first conforming article is intended to be a 'standard' that verifies conformance and one that provides a yardstick for corrective actions and problem resolution.

FAI shall be performed for a new part representative of the first production run including all detail parts and sub assemblies that constitute the end item ordered. The FAI record is not complete until all non-conformities are resolved.

> **Note:** Prototype parts or parts made using different methods or processes cannot be considered part of the first production run.

The FAI requirement applies even after initial production compliance and CASA approval. Depending on the degree to which characteristics are affected partial or complete accomplishment of the FAI is required for the following events:

1. A change of design affecting form, fit or function of the part.
2. A change in manufacturing source(s), processes, inspection method(s), location, tooling or materials with the potential of affecting the form, fit or function of the part.
3. When required as part of a corrective action for a part with repetitive rejection history. (Typically with three repeat rejections).
4. A change in the numerical control program or translation to another media.
5. A natural or man-made occurrence that may adversely affect the process.
6. A lapse in production of two years.

All documented FAI reports are considered a quality record under the CASR record keeping requirements.

Inaccessible characteristics shall be evaluated as early in the process as possible provided they are not affected by subsequent operations. Naturally, tooling used to verify a design characteristic must be qualified by FAI verification back to national standards. Where feasible, FAI measurement equipment and/or personnel shall be independent of the equipment or personnel utilized for the final product acceptance inspection. It should be noted that where FAI results are near limits of tolerances, additional parts should be inspected to verify hardware conformance.

The FAI process for a given part initially includes identification of the original source documents and their respective revision status. Purchase orders or equivalent documents must be examined to determine the basic requirements and the validity of the data called up by the customer. Relevant drawings and specifications must be subject to source substantiation to ensure that the current complete data is available for the inspection.

4.1.4 Materials

- Were raw materials used in the fabrication process in conformity with the design data?
- Is evidence available to assure that chemical and/or physical properties were identified and checked as appropriate?
- Is there documented evidence to show traceability from the raw material to the completed part?
- Are there any parts or process deviations recorded against the submitted design data (including material review dispositions)?

4.1.5 Processes and Processing

Production approval regulations require fabrication methods that consistently produce conforming parts and all methods requiring close control to attain this objective must be covered by approved process specifications. In evaluating processes, the MI is primarily concerned with performance and conformity. Process performance should be capable of consistently producing articles that meet the specified requirements.

Process conformity is determined by checking the articles being processed to determine that they are being processed in accordance with the process specification and that the materials, tools, and equipment called for are being utilised. Since the end results depend on strict adherence to the process instructions, any deviation or discrepancy should be corrected on the initial runs.

Product conformity is determined by inspecting the processed articles. The manufacturer should make a determination that the process operations are capable of consistently producing articles in conformity with the design requirements. The method used in determining this fact should be measurable, as required by the process specification, and recorded.

4.1.6 Automatic Production Processes

Background

Modern production methods involve many automatic machines such as:

- Milling machines
- Lathes
- Work Centres
- Riveters
- Routers
- Fabric cutters
- Lay-up placers
- Electronic component placers, etc.

Traditionally, conformity inspection has been against clearly defined Type Design (TD) data, in the form of drawings and specifications.

With numeric- or computer numeric-controlled (NC or CNC) machines, traditional conformity inspections may be difficult due to the non-existence of traditional TD data. Nevertheless, conformity must be achieved. TD data that may now be in the form of Computer Aided Design (CAD) models or other computer instructions must achieve and demonstrate conformity. That is the regulatory requirement and nothing less is acceptable. Conformity is evidence that the automatic machine software is performing correctly.

Conformity Inspection Requirements

The CASA inspector must be satisfied that the applicant has the systems and ability to produce conforming parts.

The CASA inspector should ensure that the applicant has a system in place that ensures that:

- The approved TD data is permanently stored and available for conformity inspections. The TD may be in the form of drawings and specifications or computer generated models or instructions
- Any software used is identifiable as to the package and the version
- Computer programs such as CAD programs used are of proven validity

- Operators of CAD programs have demonstrated competencies in the use of the particular CAD package
- Computer Aided Manufacturing (CAM) programs used are of proven validity
- Operators of CAM programs have demonstrated competencies in the use of the particular CAM program
- Operators of NC or CNC machines have demonstrated competencies in the use of the machine(s)
- Manually-inserted CNC machine instructions are related to approved drawings
- Conformity is performed against the approved TD data, which may be held electronically. The conformity inspection may be in any form acceptable to CASA that achieves the result, eg;
  a. Comparison against drawings printed out from the relevant CAD package, or from other approved drawings or sketches.
  b. Use of calibrated “go” and “no go” gauges developed from the TD data, for specified dimensions.
  c. Use of a Computer Coordinate Measuring Machine (CCMM) for comparison with the computer-held model.

4.1.7 Non-destructive Inspection (NDI) Method Evaluation

The procedure for evaluating an NDI method must provide for the manufacturer to demonstrate to the MI’s satisfaction that the NDI method used has the capability to detect the allowable defect size and location specified by the engineering data, that the inspection results are repeatable, and that instruments required to perform the inspection meet the procedural acceptability requirements.

4.1.8 Critical and Major Characteristics

- Has the manufacturer identified and inspected all the critical and major characteristics?
- Does the manufacturer have a record of these inspections?
- Does witnessing the re-inspection and surveillance indicate that the above inspections were accurate and adequate?
- Are there any deviations recorded against the approved design data (including material review disposition)?

4.1.9 Workmanship

- Does workmanship contribute to the safety of the product?
- Have criteria been established to identify acceptable production techniques and practices?

4.1.10 Adequacy of Drawings and Related Change Records

- Can the part be produced and inspected using the information on the drawing?
- Are drawing tolerances practicable and attainable under production conditions? What evidence supports this?
- Have all of the changes been correctly made to drawings submitted for CASA approval or MRB approval in the case of minor changes?
- What procedure is used to ensure the incorporation of an engineering change in the production part, on the relevant drawing/s and on completed parts in store?
- Does the drawing include all the characteristics necessary to inspect the part, the material to be used, the treatment of the material such as hardness, finish and special process specifications?
- Does the drawing (or associated engineering data) include applicable test specifications?

4.1.11 Adequacy of Inspection Records

- Do the inspection records show all inspections that are conducted?
- Do they show who conducted the inspection?
- Do they indicate the results of the inspection and disposition of unsatisfactory conditions?
- Are procedures adequate to ensure re-inspection of any parts that are reworked?

4.1.12 Material Review Action

- Is the material review procedure documented and adequate to ensure disposition of non-conformities?
- Is there adequate corrective action for observed non-conformities to prevent recurrence?

4.1.13 Software

- Are all software products (version description document, source code, object code, documentation, test procedures, loaded hardware/firmware etc) properly identified, including revision levels, when compared to the hardware and software engineering drawings?
- Have all software problem reports been properly actioned?
- Do the records indicate that all software products, including support software and procedures, have been placed under configuration control?
- Have the verification and acceptance tests been successfully executed to approved test procedures and results recorded?
- Are there records that indicate that the object code was compiled from released source code by approved procedures?
- Do records indicate technical acceptance of the software prior to loading into the system or product?
- Are there any indications of non-compliance with the software manufacturer's procedures?

4.1.14 Conformity Inspections of Test Articles

- Prior to initiating conformity inspection activity for test articles, it is essential that the manufacturer and the MI establish and document the parameters of the test article configuration and test equipment configuration.
- The conformity of the test article and test set-up such as for static, endurance, operational, pressure, environmental etc. tests, should be established by an MI or AWE as appropriate to determine conformity.
- In all cases, the approved engineering data should include:
  - Appropriate instructions
  - Reference to the manufacturer's agreed test plan.

  When witnessing tests, the MI should determine that the instructions and test schedule described in the agreed test plan are followed.

4.1.15 Structural Test Articles – Aircraft

CASR 21.033

CASR 21.033 requires the manufacturer to allow CASA to perform or witness conformity inspections. This includes structural tests during fabrication and assembly.

The final design submitted for CASA inspection must reflect all changes that have been found necessary as a result of previous tests. CASA must ensure that such changes are incorporated into the production drawings. Only then can CASA be certain that subsequent production articles conform to the tested articles.

It is strongly recommended, due to the different effects of non-conformities on structural test articles versus flight articles, that parts and assemblies destined for structural testing should be clearly identified. This should be necessary only in those cases where structural test articles are being fabricated concurrently with prototype flight articles. Once parts and assemblies have been subjected to structural testing beyond limit load they must be clearly and permanently identified to prevent their use in production.

4.1.16 Flight Test Articles—Aircraft

Determining conformity of flight test articles, including system checks, should begin during fabrication. It is important that flight test articles conform to the data specified in the design data on which the manufacturer's statement of conformity is based.

4.1.17 Endurance Test Articles—Engines and Propellers

In addition to conformity of production, endurance test conformity will also be required. These tests will be part of the CASA approved specifications, and the inspector should coordinate with the CASA engineers before undertaking conformity of endurance tests.

CASR Part 33 Part 35

CASR 201.001

At the conclusion of the endurance test, during the teardown inspection, the MI should spot-check conformity of major and critical parts by witnessing the manufacturer's inspections, paying particular attention to critical characteristics. Teardown inspection of test articles after endurance testing is a specific requirement of CASR Part 33 and Part 35. These activities should be witnessed by the MI, a CASA engineer or a CASR 201.001 appropriately authorised person. The manufacturer should not clean or disassemble the test article until the independent inspector is present, at which time the manufacturer's inspection should be conducted as follows.

Inspector

1. Verify that the manufacturer carefully notes the appearance of subassemblies during the teardown and before complete disassembly. The manufacturer should specifically note any abnormal leakage in valves, seals, fittings, etc.; indication of excessive or lack of lubrication; excessive coking; metal or foreign particles in the oil screens or passages; sticking or breakage of parts; lack of freedom of moving parts; breakaway torques; and any other condition which may not be noticeable after complete disassembly and cleaning.

2. Verify that all parts are thoroughly cleaned and visually inspected for indications of galling, metal pickup, corrosion, distortion, interference between moving parts, and cracks. Highly finished surfaces should be checked for condition and any discolouration due to excessive heat and lack of lubrication. Special attention should be given to bearings, gears, and seals. Engine pistons, cylinder heads, and turbine assemblies should be carefully inspected for indications of cracking, burning or local collapse.

3. Verify that both ferrous and nonferrous stressed parts are inspected for incipient failures by suitable non-destructive testing methods such as magnetic particle inspection, x-ray, penetrant, ultrasonics, etc., in accordance with the test plan.

4. Verify that all parts subject to wear of distortion are dimensionally inspected to determine the extent of change during the test. This may be done by pre-test and post-test dimensional comparisons. The manufacturer should record the results in a suitable manner.

5. On completion of the above steps for certification of an engine or propeller, the manufacturer's inspection report, verified by the independent inspector, is submitted to the Team Leader, Manufacturing. This report should contain the results of the inspection, giving a comprehensive description of all defects, failures, wear or other unsatisfactory conditions including photographs as required. Since the report is used for evaluation, its importance cannot be overemphasised.

6. Ensure that non-conforming parts are identified and retained by the manufacturer in safe storage for review by CASA.

4.2.1 Applicability — Final Inspection and Production Flight Test

The basic purpose of the ground inspection is to physically determine that the aircraft readied for flight test:

- Conforms with the technical data
- Is safe for the flight tests intended.

The results should be recorded for the project file, together with any other data requested by CASA engineering and flight test personnel.

The ground inspection is normally a progressive inspection of parts and assemblies culminating in the aircraft being finally readied for its initial test flight.

4.2.2 Preliminary Ground Inspection

Preliminary ground inspection includes all inspections of the first production unit that can be performed satisfactorily in the course of construction.

Manufacturing Inspector

1. Require the manufacturer to notify the MI whenever changes are made to components, systems, or installations previously cleared.

2. Witness such re-inspection as necessary.

4.2.3 Final Ground Inspection

The final ground inspection is the final inspection of the complete aircraft and should be performed just prior to first production flight test. Detailed procedures for conducting inspections and test for the assembled product should be included in the approved production procedures. They should also be coordinated by the manufacturer to preclude unnecessary delays and duplication of effort and to assure that all required inspections and tests are properly accomplished before flight.

Inspector

Notify CASA flight test personnel when the initial flight test phase is to commence. Make sure that flight test personnel have sufficient time to prepare for the flight test programme.

The manufacturer should provide all necessary assistance, equipment, and data essential for the flight test.

Flight Test and Manufacturing Inspector

1. Carry out the inspection:
   - Witness the operation of all ground operable systems by the manufacturer's personnel.
   - Witness the weighing of the aircraft and verify scale accuracy.
   - Verify equipment installed, including test equipment, during each flight test to determine flight loadings.
   - Verify the weight and balance report, showing the actual empty weight centre of gravity together with the list of equipment installed. Retain a copy of these records and make sure flight test personnel have a copy.
   - If necessary during this phase, verify weights and moment arms of equipment items.
2. Determine what other inspections remain, such as instrument markings, placards, unusable fuel, etc. These inspections must be completed prior to issue of the Statement of Conformity by the manufacturer.

4.2.4 Flight Inspection

Manufacturing Inspector

1. Establish with the Flight Test Pilot a mutually agreeable system for informing the Team Leader, Manufacturing of changes to the aircraft and any problems encountered during flight test.

   Cooperation with the Flight Test Pilot is crucial to the safe and professional completion of the flight-testing.

2. Prior to the flight test, determine that the manufacturer carries out the various loading conditions specified by the flight test specialist. This includes a determination that the ballast used is accurately weighed, located, and safely secured.

3. Throughout the flight test program, determine that the manufacturer has a plan to ensure that the aircraft is adequately inspected to reveal any unsafe conditions that may develop and to require their correction prior to further flight tests. The frequency and extent of such checks should be coordinated with CASA. Participate in the checks whenever practicable to determine compliance. The MI and the flight test specialist should have a system of informing each other of changes made to the aircraft and problems encountered during any flight test.

Flight Test Pilot

The Flight Test Pilot is not to fly a test aircraft without coordinating with the Project Officer or Manager, Initial Airworthiness Section to be assured that the aircraft is released for flight.

The final acceptance of the test aircraft as it relates to the operation of the aircraft and the integrity of the test is the responsibility of the CASA Flight Test Pilot. Instruments, gauges, recording devices, etc., which are used in the official flight test for flight, should be in current calibration by a qualified agency and calibration reports furnished. The Flight Test Pilot is to be given copies of the reports prior to flight.

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