SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Technical Guidance Material

PART 21 SUBPART 2: TYPE CERTIFICATION

Subject: GUIDANCE MATERIAL FOR PART 21 SUBPART 2 TYPE CERTIFICATION (TC) PROCEDURES

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

The purpose of this technical guidance material (TGM) is to provide procedural guidelines concerning the planning and conduct of a Type Certification activity for a domestic aeronautical product. The TGM elaborates on the procedural requirements of the steps presented in CE 001.

1.2 Applicability

This TGM is applicable to domestic Type Certification projects of Class 1 Aeronautical Products. i.e. Aircraft, Engines and Propellers.

2. REFERENCES AND REQUIREMENTS

2.1 Reference Documents

It is intended that the following reference materials be used in conjunction with this document:

(a) Part 21 Subpart 1 of the South African Civil Aviation Regulations (CAR's), *General;*

(b) Part 21 Subpart 2 of the CAR's, *Type Certificates;*

(c) Part 21 Subpart 3 of the CAR's, *Changes to Type Certificates;*

(d) SA-CATS 21, South African Civil Aviation Technical Standards, *Airworthiness Requirements;*

(e) Part 147 of the CAR's, *Design Organisations for Products, Parts and Appliances;*

(f) SA-CATS 147, South African Civil Aviation Technical Standards, *Design Organisations*

(g) TGM on Part 147 approval, *Design Organisation;*

(h) TGM on Part 148 approval, *Manufacturing Organisation;*

(i) Part 187 of the CAR's, *Fees;*

(j) EASA CS-22 (previously JAR-22), *Certification Specifications for Sailplanes and Powered Sailplanes;*

(k) Part 23 of the Federal Aviation Regulations (FAR), *Normal, Utility, Acrobatic and Commuter category Aeroplanes*;

(l) Part 25 of the FAR, *Transport Category Aeroplanes*;

(m) Part 27 of the FAR, *Normal category Rotorcraft;*

(n) Part 29 of the FAR, *Transport Category Rotorcraft*;

(o) Part 31 of the FAR, *Manned Free Balloons*;

(p) Part 33 of the FAR, *Aircraft Engines;*

(q) Part 34 of the FAR, *Fuel Venting and Exhaust Emission Requirements for Turbine Engine Powered Aeroplanes;*

(r) Part 35 of the FAR, *Propellers;*

(s) Part 36 of the FAR, *Noise Standards*

2.2 Definitions and Abbreviations

The following definitions and terms will be used in this document:

(a) **Accept** -- means the acknowledgement by SACAA that an item or plan should lead to compliance. Applicants' engineering reports are accepted;

(b) **Approve** -- means to make formal acknowledgement that a product or document meets the regulations. Within this instruction the word approve is limited to the Type Certificate, Type Certificate Data Sheet (TCDS), Airworthiness Limitations section of the Instructions for Continuing Airworthiness (ICA), Maintenance Review Board (MRB) Report and the Flight Manual and refers to approvals made by the Director for Civil Aviation;

(c) **Applicant** -- means the applicant who is the legal entity on whose behalf the application was made. This will normally be the entity to whom the Type Certificate is issued when the certification activity is completed;

(e) **Certification Team** -- means those individuals who have been assigned to a particular type certification project, including the applicant, SACAA personnel and personnel delegated/authorized by the SACAA;

(f) **Engineering Inspection** -- Engineering inspections are physical inspections performed by a SACAA Certification Engineer or a delegate, when authorized. This inspection provides an opportunity to review an installation and its relationship to other installations on a product to determine compliance with airworthiness requirements that cannot be determined adequately from an evaluation of the technical data;

(g) **Finding of Compliance** -- means a determination that an element of the design satisfies the applicable standard of airworthiness;

(h) **Means of Compliance** -- means the principle means by which compliance is demonstrated. Examples are: analysis, test, similarity, flight test, compliance inspection, drawing review, process specification, and other actions and documents;

(i) **Project Manager** -- means the assigned individual from within the SACAA Certification Engineering Section, who manages the certification project. The applicant may also have a project manager, who will be referred to as the "applicant project manager" in this document;

(j) **Level of Involvement (LOI)** -- means the summation of SACAA activities undertaken during a certification program, as the SACAA share of the overall certification activity, to be satisfied that aeronautical products are compliant with accepted standards using accepted interpretations and that they have no unsafe feature.

(k) **General Compliance Program (GCP)** -- means a complete listing of the basis of certification; and

(l) **Certification Plans** -- Used to define the comprehensive planning details on how compliance will be shown. Certification plans are written for specific systems or technology areas.

3. BACKGROUND

(1) Type certification of a Class 1 Aeronautical Product (Aircraft, Engine, Propeller) involves a comprehensive type design examination to verify that the product complies with the applicable standards of airworthiness and environmental regulations pursuant to Part 21 of the CAR's. The scope of certification activities will depend on the category of product involved, the certification basis applied and the complexity of the product's design. Upon assurance that the design of the product complies with prescribed standards, the SACAA will issue a Type Certificate in the name of the individual or organization responsible for the type design. The Type Certificate includes the type design, the operating limitations, the TCDS, the applicable certification basis with which the SACAA recorded compliance and any other conditions or limitations specified by the SACAA.

(2) All locally-designed Class I products (Part 21) such as aircraft, engines & propellers, as categorised, prescribed and established under the SA CATS 21, must be Type Certificated under Part 21. This includes:

(a) Gliders, power-assisted gliders and touring gliders;

(b) Very Light Aircraft (VLA)

(c) Aeroplanes: Normal, Utility, Acrobatic and Commuter category

(d) Aeroplanes: Transport category

(e) Rotorcraft: Normal category (maximum certificated mass 2,700 kg or less)

(f) Rotorcraft: Transport category

(g) Manned free balloons

(h) Non-rigid airships

(i) Engines

(j) Propellers

(3) The appropriate airworthiness design standards for each category above are prescribed in SA CATS 21.

(4) This document is meant to provide a consistent process to clarify what is expected at each phase in the Type certification process. Details of each phase are covered in later sections of this document.

(5) The phases are:

(a) Phase One: Application and Establish Certification basis

(b) Phase Two: Establish Means of Compliance and SACAA LOI

(c) Phase Three: Demonstrate and Record Compliance

(d) Phase Four: Type Design Approval

4. PHASE ONE – APPLICATION AND ESTABLISH BASIS OF CERTIFICATION

Phase One covers activities up to and including the initial Type Board Meeting. The applicant will have already conducted a considerable amount of design work, so the conceptual design and general arrangement of the product or change thereof will be known. The certification approach and strategy will be determined during this phase.

-The primary output is an agreed basis of certification.

4.1 Pre-Application Inquiries / Meetings

Upon receipt of a certification inquiry, a representative from the Certification Engineering Section, may communicate with the potential applicant to obtain a preliminary assessment of the general features and degree of complexity of the given product. The holding of exploratory discussions is useful in assessing the need for and setting the parameters of a concept briefing.

4.2 Concept Briefing

(1) A concept briefing is suggested for complex projects. During a Concept Briefing the applicant should be prepared to provide a detailed description of the product. The applicant is also expected to advise SACAA how they intend to show compliance for novel or unusual features although at this time the applicant need do so only in a top-level fashion. The Concept Briefing is the first formal discussion of certification basis and means of compliance. Attendees at the briefing should include both SACAA specialists and managers.

(2) The agenda may include the following general topics:

(a) Aircraft, Engine or Propeller overview;

(b) Any applicable lessons learned from previous programs;

(c) Novel and unusual features;

(d) Multi-disciplinary requirements;

(e) Schedule for follow-on specialist meetings; and

(f) Objectives prior to initial Type Board meeting.

4.3 Application

(1) The applicant must submit an application for the issuance of a South African Type Certificate in accordance with the requirements of Subpart 2 of Part 21 of the CAR's and the associated technical standards SA-CATS-AR. The application needs to be accompanied by the appropriate fee as stipulated in Subpart 187.00.2 of Part 187 of the CAR's.

(2) The date of the application letter will be important for determining the certification basis of the product.

4.4 Fees

(1) Subpart 187.00.2 of Part 187 of the CAR's defines the relevant fees for the type certification of aeronautical products. Fees other than the application fee are charged to the applicant based on the hourly rate for the time spent on the project by SACAA personnel.

4.5 Estimate Project Schedule

(1) Although the applicant is required to include a proposed project schedule, this is typically a top-level schedule that only identifies major milestones. The Project Manager is expected to work with the applicant towards the development of a more detailed project schedule. Ideally, the applicant, who has the most control over the timing of events, writes this schedule and disseminates it to the certification team. Typical events to schedule in addition to the major milestones are design review meetings, major ground or flight tests, and submission and acceptance of major certification reports. The Project Manager will endeavour to assure that any SACAA resource constraints are accommodated in the schedule. The schedule should cover milestones, accomplishments and the expected levels of involvement of both the applicant and the SACAA project team.

4.6 Identify SACAA Team Members

The Project Manager shall request that team members be identified from the Certification Engineering, Manufacturing, Operations, Airworthiness and other relevant departments as required.

4.7 Create Action Item Database

(1) Action items may result from meeting minutes, flight test debrief notes, review of reports or a multitude of other sources. The Project Manager will work with the applicant project manager to create an action item database. Primary responsibility for maintaining the action item database is the applicant project manager and the SACAA project manager verifies it is accurate. The database is a shared database with input from all members of the certification team, applicant and SACAA alike. It is the responsibility of whoever raises a new action item to advise the SACAA and applicant project managers of the item. Ideally, the applicant, who has the most control over the timing of events, controls the Action Item Database.

(2) The database will remain active to the end of the certification process in order to ensure that no action items are overlooked and that all items are dealt with before the project is completed. A LOI matrix, described in Phase Two, will complement the action item database.

4.8 Reports / Meeting Minutes

(1) Reports are generated as an output from formal meetings, *ad hoc* meetings, test witnessing and some telephone calls or e-mails. A report might be generated anytime throughout the certification process. The rule of thumb should be that if a decision was made or an action item agreed, some form of report should be made. The essentials of the meeting should be captured, including: identification of personnel involved, date, place, topic, decisions made and action items generated. In addition, the report should indicate the agreement of the participants to the accuracy of the decisions or action items identified in it. All team members shall ensure that the Project Manager and the applicant project manager are aware of new action items and decisions made. The Project Managers will ensure that the action item database is populated with the new items.

(2) Either the applicant or a SACAA team member may write a report. In either case, copies must be forwarded to both the Project Manager and the applicant project manager. Ideally, both sides of the team will have reviewed it for accuracy. Signatures may be used to record agreement to the accuracy of the report.

(3) Larger, pre-planned meetings should have a secretary named ahead of time who will be responsible for generating minutes / reports.

4.9 Establish the Certification Basis

(1) In accordance with Subpart 2 of Part 21 of the CAR's, the applicable standards of airworthiness for aeronautical products are those standards in SA-CATS-AR that were in force on the date of application specified for the type certificate.

(2) The effective period of a Type Certificate application varies from 3 to 5 years, depending on the type of aeronautical product.

4.10 Identify Special Conditions (SC)

Special conditions are those conditions identified during certification planning which contain new or novel design features not sufficiently addressed by the applicable airworthiness standards.

4.11 Identify Required Exemptions

(1) An applicant may apply to the Director for Civil Aviation (CCA) for an Exemption from a particular requirement.

(2) An Exemption may be issued where it is the opinion of the CCA to be in the public interest and not likely to affect aviation safety. Part 11 of the CAR's is the applicable regulation governing exemption applications.

(3) Exemptions granted to design standards are permanent and are recorded in the basis of certification.

4.12 Identify Findings of Equivalent Safety

(1) A finding of equivalent safety may be needed where the usually accepted or industry standard means of compliance for a particular airworthiness requirement is not the one proposed by the applicant. As such, the applicant is not requesting an exemption from the requirement, since compliance by another means is proposed and the intent of the requirement is still being met. Neither is the particular design novel or unusual to the extent that a special condition would be considered appropriate. However, some aspect of the design requires further documentation, as part of the basis of certification, in order to fully explain and rationalize how the finding of equivalent safety was determined.

(2) A finding of equivalent safety typically results from a technical issue paper. When the need for a finding of equivalent safety becomes apparent, the Project Manager shall ensure that discussions documenting the logic of the finding of equivalent safety are captured in a technical issue paper.

4.13 Elect to Comply with Later Standards

(1) Applicants may elect to voluntarily apply standards later than those required by the CAR's. It must be understood that any additional standards with which the applicant elects to comply will form an integral part of the certification basis for the given product and are not optional for subsequent changes to the type design.

4.14 Establish the General Compliance Program (GCP)

(1) The GCP details the certification basis and the means of compliance by which the applicant is **proposing** to demonstrate compliance with the standards. The applicant is requested to produce a GCP for review and acceptance by SACAA.

(2) The GCP should have a checklist section broken down section by section, and in some cases by subsection. The checklist should ideally be in a matrix form. A list of the reports that are to be generated to document compliance should also be included. Spaces for sign-off by authorized persons and SACAA specialists should be available. A proposed schedule should also be included in the GCP. The SACAA LOI would be identified at the beginning of the program, although it may be changed depending on SACAA concerns as the program develops.

(3) Points to be noted in managing the GCP are that:

(a) The Project Manager will circulate the GCP to team members and solicit comments;

(b) Team members are responsible to comment on / agree with the proposed program;

(c) The means of compliance will be agreed and recorded against each certification basis requirement in the GCP;

(d) Team members will indicate those items for which they intend to have some LOI;

(e) The Project Manager will ensure that the indicated LOI is clearly documented; and

(f) Issue Papers, Special Conditions, Exemptions and Findings of Equivalent Safety can be appended to the GCP as they arise.

4.15 Establish Certification Plans

(1) The Certification Plan ensures that early agreement is reached between the applicant and SACAA on the detailed plan of compliance applicable to the type certification requirement for each specific system or technology area. The certification requirements include compliance with both Standards and Regulations.

(2) A Certification Plan is developed by the applicant and exists as a sub-set within the GCP. Each Certification Plan should be written to address a specific system or technology area, some examples of which are landing gear system, landing gear loads, pitch trim system, flight loads, etc.

(3) Preparation of Certification Plans is linked closely with the preparation of the GCP. The means of compliance to be indicated in the GCP is often fairly general in nature. The Certification Plan provides a formal vehicle to present and agree upon specific methods of compliance. For example, if 'test' is the means of compliance indicated in the GCP, the Certification Plan will indicate whether the test is a flight test, ground test, rig test, or component test, etc. Other information included, such as a proposal of the LOI by SACAA in terms of delegation and test witnessing, as well as the deliverables to SACAA, are identified in detail.

(5) The need to develop a Certification Plan should be discussed with SACAA to ensure that there is value in the exercise for each specific case.

(6) The applicant is expected to have at least drafted Certification Plans in Phase One of a Type Certification Program.

4.16 Function and Reliability Test Flight Requirements

(1) If function and reliability test flying is required it should be identified in the GCP and tabled at the initial Type Board meeting. At the beginning of the certification project the applicant should present a function and reliability test flight specific Certification Plan or test plan. An issue paper or certification memo may also be raised on the topic in Phase Two detailing the extent of the function and reliability test flights to be done and how credit toward the requirement could be given using pre-production flight test vehicles.

(2) The Project Manager must ensure that an agreement is reached between the team and the applicant on:

(a) The function and reliability test plan;

(b) The representative type design configuration to be subject to function and reliability test flying;

(c) Where applicable, the breakdown of dedicated and non-dedicated function and reliability test flight hours; and

(d) The extent of SACAA involvement.

(3) The applicant should submit for acceptance a separate schedule of test activities, including systems to be exercised, the frequency of exercising each system, test flight witnessing, etc.

(4) In Phase Four the last function and reliability flight tests are completed. Frequently this is done in conjunction with operational evaluation flights.

4.17 Initial Type Board Meeting (ITBM)

(1) The goal of the initial type board meeting is to bring together the applicant with the specialists and management from SACAA in order to exchange information about the technical aspects of the aeronautical product, its proposed certification basis and the proposed schedule. Attendance should be the SACAA Certification Engineering team, their Managers, Aircraft Maintenance, Manufacturing, Flight Operations and the applicant counterparts at the engineering and management levels.

(2) Applicants are urged to discuss their expectations for the certification process with their SACAA counterparts prior to the initial type board meeting. At the initial type board meeting, the applicant should be fully prepared, present information clearly, agree on milestones and identify any possible areas of contention.

(3) A suggested agenda for an initial type board meeting is:

(a) Detailed Design Description. This will include the anticipated role of the aircraft, weights, performance, passenger capacity, etc. and include any novel or unusual features to be incorporated into the design;

(b) Proposed Basis of certification. The ITBM meeting will formally agree to the certification basis while acknowledging that there may still arise unknown SC, findings of equivalent safety, Exemptions and Election to Comply items that it will be necessary to include in the basis of certification;

(c) Proposed Certification Schedule. This will identify the top-level. At this time any SACAA resource constraints will be discussed. In addition, any lower level schedules that are already completed at this time may be discussed. These might include Rig Testing, Flight Testing, Function and Reliability Test Flying;

(d) Means of Compliance. These are discussed in a general way at this meeting. Itemized means of compliance are documented in the GCP and Certification Plans, which is covered in depth in Phase Two;

(e) Flight Test Program overview;

(f) Maintenance Schedule proposed;

(g) Function and Reliability Test Flights program;

(h) SACAA LOI Overview;

(i) Operational Evaluation plans;

(j) Plan for development of Instructions for Continued Airworthiness (ICAs) and Maintenance Review Board (MRB);

(m) Involvement of suppliers and partners; and

(n) Engine and Propeller Certification status.

(4) The **primary outputs** of the initial type board meeting are an **agreed Certification Basis** and a commitment to respect the schedule. These outputs are documented in the minutes of the meeting. The minutes of the meeting should be made available to attendees shortly after the meeting.

5. PHASE TWO – ESTABLISH MEANS OF COMPLIANCE AND SACAA LOI

By the end of this phase a thoroughly planned certification approach with considerable detail should be available that has been negotiated and agreed with SACAA. Although testing and demonstrating compliance is part of Phase Three, Phase Two may include cockpit mock-ups and other tools to agree on the certification nuances of proposed configurations.

5.1 Provide Fundamental Certification Documents

Certain compliance documents are required very early in the certification program as aids to discussion and to improve the certification teams' understanding of the applicant's product. These early deliverables

are called the Fundamental Certification Documents (FCD). The FCDs should be drafted by the applicant during Phase One and submitted for discussion and acceptance by SACAA early in Phase Two. The list may include, and is not limited to:

(a) Aircraft Level Functional Hazard Assessment;

(b) High Intensity Radiated Fields (HIRF) System Criticality;

(c) Durability and Damage Tolerance Methodology; and

(d) Software System Criticality Assessments.

5.2 Establish Maintenance Review Board (MRB)

(1) For large transport category airplanes, maintenance programs and supporting instructions are typically developed using a MRB. The Aircraft Maintenance and Manufacturing Departments certification team member, in cooperation with his applicant counterpart, will initiate and follow through with this activity.

(2) For rotorcraft, small airplanes and engines, the MRB process has seldom been applied, but a plan to address the requirements for Instructions for Continued Airworthiness (ICAs) is needed within Phase Two.

5.3 Review Certification Plans

Certification Plans are developed by the applicant in Phase One. In Phase Two, SACAA and the applicant should discuss, negotiate and modify these certification plans as necessary prior to acceptance of them by SACAA. Acceptance of the Certification Plans accomplishes the core goal of Phase Two, which is to agree on the means and methods of compliance and LOI. The witnessing requirements and compliance inspection requirements should be identified in the discussions and should be documented in the plans as appropriate.

5.4 Define Conformity Inspection Requirements

At this phase SACAA should identify all the conformity inspections required. The list should consider the rigor of conformity used by the applicant, the adequacy of the applicant's configuration control system, as well as the criticality of the configuration for the relevant tests. The Project Manager should extract all conformity requirements from certification plans. A certification team meeting might be needed to accomplish this planning. Details of the conformity requests will follow in Phase Three.

5.5 Create LOI Matrix

(1) The LOI should be depicted in a "matrix format" created by either the applicant or the SACAA Project Manager. Each activity, such as conducting a test, completing a report or assembling data is listed. The levels of involvement for SACAA for each document, data element or test can then be shown next to the activity. The matrix should include references to the certification schedule and to any known SACAA resource constraints that could affect the schedule. It should be possible to identify the responsibilities in

the matrix at the level of the individual responsible for the activity. The level of detail that can be presented for each requirement using a LOI matrix ensures that SACAA and the applicant understand their respective expectations and obligations. The specialists and managers, both at SACAA and with the applicant, must agree to the LOI.

(2) The SACAA LOI can be considered as the total of all:

(a) Reports to be reviewed and accepted;

(b) Flight Manual and Airworthiness Limitation approvals;

(c) Reports received for information;

(d) Test witnessing;

(e) Conformity inspections conducted by SACAA;

(f) Engineering inspections conducted by SACAA;

(g) Flight testing activities conducted by SACAA;

(h) Activities associated with issue papers;

(i) Software process reviews on site, including those for programmable logic devices;

(j) Meetings including design review and type boards; and

(k) SACAA findings of compliance.

5.6 Refine Project Schedule

In Phase Two, the overall development schedule produced by the applicant for the initial type board meeting should be expanded into a detailed schedule. The exact testing requirements should be developed either from certification plans or other planning. The detailed schedule should be compared to the LOI matrix to provide early identification of busy periods and timing conflicts for SACAA. This schedule should be regularly updated and shared with SACAA.

5.7 Issue Certification Memorandums

(1) A Certification Memorandum is raised when a point of clarification is required with respect to a requirement or group of requirements within the certification basis.

(2) During type board meetings, the Project Manager shall provide a status report of the outstanding Certification Memorandums.

5.8 Technical Issue Papers

(1) An issue paper documents a technical issue on a certification project, which indicates the possible existence of non-compliance to one or more related elements of the certification basis for that product.

(2) An issue paper may be used when the specialists from the applicant and SACAA cannot reach agreement on a subject. The Project Manager should attempt to resolve disagreements between the applicant and the team before issuing a Technical Issue paper.

(3) An issue paper may be raised when design or means of compliance is not traditional, or is of a novel or unusual approach. In this context, the issue paper serves as a recording medium to give special visibility to that aspect of the design even though there is no disagreement between the applicant and the SACAA.

(4) The Project Manager is responsible for raising the issue paper and coordinating the sign-off of the issue paper by the appropriate technical specialists and managers prior to submitting it to the applicant. Sign-off of the issue papers is used as a control mechanism within SACAA to ensure that the position stated in the paper is accurately and clearly reflected and acceptable to all disciplines. Typically, all affected specialists, including project managers, and their managers will initial each outgoing revision of the technical or administrative issue papers. The format and writing of the issue papers is the Project Manager's responsibility, while technical specialists are responsible for ensuring that the technical details of the issue are correctly represented.

(5) The Project Manager must ensure that agreement is reached on actions required to close the issue paper prior to certification. There may be cases where the technical solution to a problem will not be available until after certification. In these cases the agreement on the proposed solution should be sufficient to close the issue paper.

(6) The Project Manager will ensure that the alternating positions of the applicant and SACAA clearly summarize the ongoing discussions and correspondence. Once the applicant's position is acceptable to SACAA, a clear statement that the issue paper is closed should be added. The issue paper will become a part of the compliance record. Some applicants append the issue papers to the GCP once completed.

(7) Should an issue be resurrected due to a design change or a change in the position of the applicant or SACAA, the existing issue paper should be re-opened rather than creating a new issue paper.

5.9 Establish Configuration Control System

(1) The applicant is expected to have an effective configuration tracking system in place at all times.

(2) Before each certification test such as, for example, flight, ground, fault board analyses, etc., the applicant must document the configuration of the product and must ensure that the product is representative of the type design in those areas that will be the subject of the test.

(3) If the type design is changed subsequent to a certification test, the applicant may have to either repeat the test or substantiate that the design change does not affect compliance with the relevant design standard requirements.

(4) SACAA may conduct conformity inspections as necessary. At the end of the certification project, the configuration control system must result in a definition of the type certified product.

5.10 Cockpit Review Meetings

The design of the cockpit involves many subjective assessments of ergonomics and is typically of interest to all certifying authorities. Frequently it is useful to define the cockpit layout well in advance of other aspects of the design. Meetings are usually held to discuss these matters, often with the aid of a cockpit mock-up.

5.11 Review and Accept Documents

(1) During Phase Two the first of the compliance documentation may be generated and submitted to SACAA, although the bulk of the documentation is generated in Phase Three. The reports submitted during Phase Two will usually be test plans, certification plans or fundamental certification documents.

(2) Reports submitted for review as part of SACAA LOI, are sent to the Project Manager, logged in and forwarded to applicable team specialists. Comments from the specialists are received by the Project Manager, consolidated into an official correspondence and forwarded to the applicant. Once the applicant has shown compliance to appropriate requirements, the SACAA specialists may sign-off the GCP.

(3) The applicant and SACAA responsibilities are as follows:

(a) The applicant is encouraged to discuss report content with the SACAA specialist prior to submitting the report to SACAA;

(b) The applicant is responsible for submitting to SACAA the certification deliverables identified in the Certification Plans and the GCP;

(c) The Project Manager shall monitor the submission schedules. Should serious delays occur, he will advise the certification team and management;

(d) The Project Manager shall also ensure that copies of all other documents referred to in the compliance plan are available to the team;

(e) The certification team shall review the submissions in a timely manner and provide concise technical comments or acceptance of the documents; and

(f) The Project Manager shall facilitate discussions between specialists as needed and collate all technical comments in a letter to the applicant. Once acceptance on a report is reached, the applicant or Project Manager should note acceptance on the LOI matrix.

6. PHASE THREE – DEMONSTRATE AND RECORD COMPLIANCE

Phase Three comprises the bulk of the certification work by the applicant. In this phase the aeronautical product is built and tested, reports are written, compliance documentation is reviewed for acceptability as

documenting compliance, the flight-testing begins and the supporting approval documents such as the flight manual and airworthiness limitations section are drafted.

-Phase Three will culminate in a declaration by the applicant that the design is compliant.

6.1 Design Review Meetings

(1) Design review meetings are generally intended to allow SACAA specialists to perform detailed reviews of specific areas of the product design with their counterparts. Design Review meetings should be scheduled well in advance but they may be arranged as required. The objectives of the meetings are to gain detailed knowledge of the product design in specific areas and enable SACAA to accept the company proposals on finding compliance. The applicant is responsible and expected to prepare meeting minutes and have SACAA sign-off on such minutes.

(2) The Specialist attending a design review meeting must ensure that:

(a) A detailed report is prepared outlining the specific topics discussed and the aspects of the product reviewed;

(b) The report identifies agreements reached and records any outstanding action items; and

(c) A copy of the report is given to the Project Manager for updating of the overall project status, the action item database, the LOI Matrix and the compliance plan, and to aid in preparation of type board and management meetings.

6.2 Update Project Schedule

(1) The applicant is responsible for updating the overall project schedule. Updates to the project schedule are likely to affect the LOI matrix and the LOI schedule. Regular communications between the applicant and the Project Manager is needed to avoid conflict with other SACAA commitments and constraints.

(2) The Project Manager may have team meetings or another method to ensure that specialists are aware of significant changes in schedule.

6.3 Prepare Test Plans

(1) At the beginning of a project, or soon after the start, an agreement must be reached between the team and the applicant on the required tests and the responsibility for test witnessing. The details must be written into the GCP and Certification Plans and LOI Matrix. Test Plans will be written by the applicant and **accepted** by SACAA. They identify the test apparatus, test vehicle and configuration, test details including conditions and pass/fail criteria, data requirements, and hazard level with risk mitigation actions. Test Plans should be written and accepted as early as possible and prior to the test.

(2) Time for SACAA review must be provided. Applicants should be cautioned that if the test plan is not accepted or if SACAA's test witnessing requirements are not satisfied before a test is conducted, there is a risk that SACAA will not accept the test results.

(3) Test articles will be built to an agreed build standard and shown by the applicant to conform to that standard. In many cases the SACAA specialist will request that an additional conformity inspection be performed before the test is conducted. The Manufacturing inspectors will conduct this conformance inspection.

6.4 Witness Tests

(1) Specialists witness tests in order to be able to assess the design and to make a finding of compliance.

(2) SACAA specialists witnessing tests do not participate in the tests. This ensures that the individual remains impartial and can concentrate on the overall activity rather than being tasked with performing a specific function while the test is going on.

6.5 Engineering Inspections

(1) An engineering inspection is a specific task carried out to review the finished product against the design requirements. **An engineering inspection is not a conformity inspection.**

(2) Reasons for an engineering inspection include:

(a) To give perspective to the drawings and determine their adequacy;

(b) To provide familiarization with the aircraft: its layout, systems operations and structural load paths;

(c) To show possible interactions and interference between systems or components;

(d) To examine HIRF or lightning related features such as bonding or gaps in metallic enclosures;

(e) To conduct zonal inspections for the purposes of compliance to standards for flammable fluids, fire zones or interior installations; and

(f) To verify compliance with the requirements of an airworthiness standard.

(3) SACAA specialists conducting an engineering inspection should document the results and note any discrepancies resulting from design or conformity issues as action items for the applicant. The applicant must be debriefed on the inspection and the action items recorded.

6.6 Issue Flight Permits

An Experimental C of A is required for all developmental and certification flight-testing issued in accordance with Subpart 21.08.4 and 21.08.5 of Part 21 of the CAR's. It should be understood that this flight authority is not an airworthiness declaration but simply permission to fly an aircraft deemed safe for flight. Such a flight permit will have conditions and restrictions attached which will change throughout the certification program.

6.7 Perform Company First Flight

(1) The application for first flight requires meeting pre-requisites: for example, the existence of a maintenance program, achievement of an appropriate level of maturity of the design, establishment of a conformity control system and completed pilot egress training. The Project Manager shall coordinate the engineering, maintenance and flight test acceptance of the conditions and limitations for the flight authority.

(2) A draft Aircraft Flight Manual is required as early as possible, typically two months before the company first flight. This draft will mature and grow during the certification project.

6.8 Intermediate Type Board Meetings

The Intermediate Type Board is normally held prior to first flight with SACAA personnel. This meeting is optional but encouraged. More than one intermediate type board meeting could be convened. The meeting serves as a useful management update between senior management representatives from SACAA and the applicant's organization. The meeting should be used to:

(a) Review the design description;

(b) Review the basis of certification;

(c) Review the status of the certification tests;

(d) Review the status of the compliance plan;

(e) Review the status of issue papers and Certification Memos;

(f) Review / sign-off Conditions for SACAA First Flight personnel;

(g) Provide an overview of the project status and schedules;

(h) Provide the status of reports submission and acceptance/approval;

(i) Identify significant issues and problems; and

(j) Establish a mutually agreed direction and action to resolve areas of concern.

6.9 SACAA First Flight

In essence, the requirements outlined here are an extension of the company's first flight activities but with more stringent assurance that the aircraft is "safe for flight". The Project Manager will coordinate this approval.

6.10 Flight Test Debrief Notes

Flight Test De-brief Notes are written by the SACAA Flight Test Team after each certification flight. They document the flight results with comments and identify certification issues and/or ask questions which the applicant must action. The applicant must track the flight test debrief notes and keep SACAA management informed of the status of the action items. The SACAA project manager shall always be kept informed as to flight test debrief notes related to the project.

6.11 Create Action Item

(1) Towards the end of Phase Three the need to track work remaining becomes increasingly important. Accordingly, some form of "to-do" list is often created. A previously created action item tracking system can serve this function.

(2) Such a list is simply a list of outstanding action items that need to be accomplished in order to reach the certification target. This could include signatures required on the GCP, open action items, open issue papers, remaining tests, reports to be submitted and accepted, or any element of SACAA's LOI or the applicant's compliance demonstration and recording. The list diminishes over time as actions are completed.

(3) The Project Manager and the applicant should work together on this list that provides management with the required summary of future activities while also providing the certification team with the required task details and proposed schedules to meet the goals. It is expected that if a complete and current LOI Matrix, LOI schedule and Action Item tracking system have been created and updated; the creation of an accurate "to-do" list should not involve significant effort.

6.12 Finalize Definition of Type Design

SACAA specialists require a thorough understanding of the configuration for which they are expected to find compliance. The Project Manager needs this information for dissemination to the certification team. The information forms an integral part of the TCDS. It is the applicant's responsibility to clearly define the product or type design being certified. Reference to a model number or name is not sufficient. Typically, reference to a definition drawing, a top drawing or a detailed configuration description is used to define the product being approved. Some applicants will further define the product as a basic aircraft with a list of optional equipment.

6.13 Applicant/SACAA Certification Readiness Review Meeting

(1) Near the end of Phase Three it is useful to hold one or more certification readiness review meetings. In such a meeting, specialists discuss the entire design with the goal of determining how close the project is to the goal of certification. Topics will include open action items, unfinished tests, determination of the flight envelope to be approved, closure of issue papers, approval of airworthiness limitations and of the flight manual, and any other items from the "to-do" list.

(2) There might be three certification readiness review meetings: one held by the applicant alone, one held by the SACAA team alone and a combined certification team meeting. The purpose of the separate meetings is to prepare for the combined meeting.

(3) The end of Phase Three will be **a declaration by the applicant that the design is compliant with its certification basis and that no unsafe feature is known to exist.** Both are equally important. It is the goal of the certification readiness review to discuss and agree on actions needed to make this declaration by the applicant.

6.14 Sign-Off GCP/Make a Finding Of Compliance

(1) Sign-off on the GCP by the applicant and by SACAA is done in both Phase Three and Phase Four. The GCP sign-off process is a systematic means to record compliance with all the applicable airworthiness requirements. It provides confidence that the approval of the Type Certificate is warranted.

(2) The typical sign-off includes each applicable paragraph of the certification basis signed by each applicable specialty area within the applicant's design approval organization. It is countersigned by SACAA specialists.

(3) The original paper copy of the GCP is signed by the applicant near the end of Phase Three. Ideally, signatures should be applied at the earliest opportunity once compliance has been shown for an item. Specialists should keep in mind that they are finding compliance for a particular design operated within a particular envelope. If the envelope is still in flux and if growth of the envelope would invalidate the compliance finding, the finding should be delayed until the envelope is firmly defined.

(4) There are essentially four situations that may exist at the end of Phase Three with respect to findings of compliance:

(a) **Applicant and SACAA agree compliance has been demonstrated**. The applicant indicates their finding or recommendation of compliance by signing the GCP against the specific requirement. The SACAA specialist indicates his concurrence that compliance has been shown by also signing the GCP against the requirement.

(b) **Compliance with limitations and/or mandated inspections**: In some instances, compliance can only be found by the imposition of a limitation and/or inspection. If a limitation/inspection can enable compliance to be found, the applicant and the SACAA specialist shall sign the GCP. SACAA must provide explicit agreement on the acceptability of the limitations before the applicant can sign. The GCP should be annotated to include the nature and location of the limitation/inspection that enabled the finding to be made. Such limitations/inspections must also be included as part of the appropriate approved publication: Flight Manual or Supplement, Airworthiness Limitations Section of the ICA, etc. Compliance items falling into this category are fully compliant, and as such could remain as permanent situations.

(c) **A non-compliance exists**: Sometimes the applicant cannot make a finding of compliance because compliance has either not been fully established or the aircraft has been found not to be compliant with the type basis of certification. The applicant is therefore not able to sign the GCP. The SACAA specialist would therefore also be unable to sign. Requirements that cannot be signed shall be listed as such and clear and agreed reasons shall be defined for each.

Compliance finding items falling into this category may require interim limitations or mandatory inspections to be imposed to assure that these are satisfied.

(d) **Applicant and the specialists are known to be in disagreement:** In cases where disagreement exists between the applicant and the specialist concerning compliance or means and methods of compliance, neither should sign the GCP. Such a disagreement would normally result in the creation of an issue paper as a vehicle to resolve the problem.

6.15 Review and Approve Flight Manual

(1) An approved Flight Manual is a requirement for the issuance of a Type Certificate in order to comply with the requirements of the basis of certification.

(2) SACAA Flight Test and Engineering specialists review the AFM and provide their comments to the Project Manager for formal transmission to the applicant, until there is an agreed version ready for approval.

(3) It should be noted that only sections that are required to be approved by the airworthiness design standard, are to be approved by the SACAA Certification Engineering section. These sections are usually the "Limitations", "Procedures" and "Performance" sections of the AFM, and the requirements are found in the xx.1580 chapter series of the design standard. General information, and information not specifically required to be furnished as per the design standard requirements, are not SACAA-approved. The Project Manager must establish the requirements from the design standard and approve those sections required to be furnished.

(4) The final AFM must clearly identify and distinguish which sections are SACAA-approved.

6.16 Review and Accept MMEL

(1) An approved Master Minimum Equipment List (MMEL) is not a requirement for the issuance of a Type Certificate. However, in the event that an applicant wishes to have a MMEL, it will normally be developed during Phase Three of the type certification project. The applicant will forward a draft MMEL to the responsible person in the SACAA. A formal review meeting of applicant and SACAA specialists will be convened and may include operators, Commercial and Business Aviation and foreign authorities. .

6.17 Review and Approve ICA

(1) At the start of the project, all parties will discuss and agree on the extent of the Instructions for Continued Airworthiness (ICA) that will be needed to ensure proper operation and maintenance of the product in the field. The title, format and content of these instructions should be defined as early as possible. The detailed content may be revised during the certification project as the need arises and as agreed to by the team and the applicant.

(2) ICA are required to show compliance with a particular paragraph of the airworthiness standard applicable to the product. For example, for a Transport Category Rotorcraft, the appropriate section is FAR 29.1529.

(3) The airworthiness limitations section must contain any mandatory replacement times and mandatory structural inspection intervals and procedures required for compliance with *Damage-tolerance and Fatigue Evaluation of Structure* of the airworthiness standard applicable to the product. These are called Certification Maintenance Requirements (CMR).

(4) The applicant may use an MRB process, a Maintenance Type Board (MTB) process or a Manufacture's Recommendation process to develop its maintenance program.

(5) The Project Manager will:

(a) ensure the early involvement of the Aircraft Maintenance and Manufacturing sections in the discussions with the applicant;

(b) ensure that the GCP identifies items that are to be submitted by the applicant to address the instructions for continued airworthiness;

(c) coordinate the review of the Airworthiness Limitations with the team and their subsequent approval.

(6) The final ICA must clearly identify and distinguish which sections are SACAA-approved.

6.18 Type Certificate Data Sheet

(1) Work on this activity spans Phases Three and Four. The TCDS forms part of the Type Certificate.

(2) The TCDS:

(a) defines the type design, often by reference to a top level drawing;

(b) identifies the applicable regulations that form the certification basis; and

(c) identifies the limitations and conditions under which the type certificate was issued, which might include description of the approved flight envelope, engine limits, approved fuels and lubricants, maximum weights, number of passengers, the Airworthiness Limitations, the approved MRB report (if applicable) and the applicable ICA by reference to the maintenance manual or section where this is recorded

(3) The Applicant and Project Manager Responsibilities:

(a) The applicant is to provide the necessary content for the draft TCDS. Often the applicant will provide a completed draft TCDS;

(b) The Project Manager will create the SACAA draft TCDS. The TCDS must be compiled with care, as it becomes a public document used widely by the aviation community worldwide for subsequent approvals. The Project Manager will forward the draft TCDS for comment to the applicant and all certification team members;

(c) The applicant and the team member specialists ensure that the information is accurate and complete prior to certification; and

(d) The Project Manager will arrange for the final release of the TCDS concurrent with the Type Certificate

7. PHASE FOUR –TYPE DESIGN APPROVAL

The bulk of the compliance demonstration and the entire compliance findings were made in Phase Three. Phase Four concerns primarily the approval of the design, its airworthiness limitations and its operating envelope.

7.1 Close Issue Papers

(1) Issue papers should be closed as soon as practical. Often they will be closed in Phase Three. Closure should be based on an agreed position and not necessarily on the demonstration of compliance. For example, should the issue concern a means of compliance, it should be closed as soon as SACAA and the applicant have agreed on the appropriate means of compliance.

(2) It is expected that all issue papers would be closed before certification.

7.2 Sign-off GCP/Make a Finding of Compliance

Sign-off on the GCP by the applicant and by SACAA is done in both Phase Three and Phase Four. At the end of Phase Three the original GCP will be sent to SACAA for completion. At this point the applicant will have signed the GCP completely, indicating either a finding of compliance or recommendation of such a finding. The Project Manager will have custody of the original GCP. The Project Manager ensures that all specialists have access to provide compliance finding signatures.

7.3 Approve MRB Report

The MRB Chairman approves the MRB report. Continuing Airworthiness may provide advisory assistance on the MRB as required.

7.4 Approve Airworthiness Limitations Section

The Airworthiness Limitations Section of the ICA must be approved by the Certification Engineering Section. The applicant will have provided a suggested Airworthiness Limitation section at the end of Phase Three. The Project Manager will distribute this for acceptance by the affected engineering specialists. Once all affected specialists have accepted the contents, the Airworthiness Limitations are approved in accordance with XX.1529. The original is forwarded to the applicant for publishing and safekeeping.

7.5 Approve Flight Manual

The applicant will have provided a proposed Flight Manual at the end of Phase Three. The Project Manager will distribute this for comment by the affected engineering and flight test specialists. The Project Manager will coordinate the discussions and criticisms to establish a basis for consensus. Once all affected specialists have accepted the contents, the appropriate sections of the Aircraft Flight Manual are approved in accordance with the design standard. The original is forwarded to the applicant for publishing and safekeeping.

7.6 Final Type Board Meeting

(1) When the applicant has met nearly all certification requirements, a final type board meeting is held. The board reviews any outstanding items and decides on the recommendation to issue the Type Certificate.

(2) The objectives of the meeting are to review and evaluate the following:

(a) Definition of type design configuration;

(b) Status of the certification testing, including flight testing and function and reliability test flying;

(c) Status of the compliance schedule;

(d) Status of the AFM;

(e) Status of the Maintenance Manual and other Instructions for Continued Airworthiness;

(f) Status of the TCDS;

(3) The outcome of the Final Type Board Meeting is:

(a) a list and schedule for all actions required to be completed prior to certification;

(b) a list and schedule to resolve all issues required for foreign approvals.

7.7 Issue Type Certificate

(1) Once all the Type Certification requirements have been satisfied and the draft TCDS has been reviewed by the specialists, all assigned specialists make a recommendation for issuance of a Type Certificate to the Project manager. This recommendation should affirm that the design is compliant, that it has no unsafe features, and that the SACAA LOI is complete.

7.8 Produce, Sign and Distribute

(1) The applicant and/or the Project Manager will have provided a draft TCDS at the end of Phase Three. SACAA must create the official TCDS to be awarded to the applicant along with the Type Certificate. It is

the responsibility of the SACAA Project Manager to create these documents and have them signed at the appropriate time.

(2) Once signed, the original certificate and TCDS is forwarded to the Type Certificate Holder for safekeeping.

7.9 Requirements for First Certificate of Airworthiness (C of A)

Instructions for Continued Airworthiness containing the minimum information as required by the applicable Airworthiness Standard should be written and accepted by the date of issuance of the first standard Certificate of Airworthiness, or entry into service, whichever occurs later.

7.10 Provide Documents Required for Entry into Service

(1) For many products the entry into service and the issuance of the first C of A occur for practical purposes on the same date. However, for some large transport airplanes, a distinction between these dates is useful. For example, when the first aircraft are delivered to a completion centre, they will be given a C of A although possibly lacking a completed interior or a complete suite of avionics. While the aircraft would have a C of A, the entry into service date would come later when the completion centre delivers the aircraft to the operator.

(2) In some cases compliance to some items, for example, to a few occupant safety requirements, might not be determined until close to the entry into service date. In this example, the GCP might remain unsigned for those affected paragraphs and the TCDS and/or Flight Manual would be annotated that no passengers are permitted. Accordingly, the entry into service date can become an important milestone in the approval process.

(3) A Master Minimum Equipment List (MMEL) is not required by the certification requirements. Operational rules for some operators require the use of a MEL, which will drive the need to produce a MMEL. Thus, the entry into service date is often a useful deadline for the publishing of a MMEL if one is needed.

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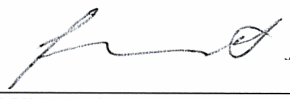	**JASON ASHWORTH**	**04 NOVEMBER 2013**
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