



Advisory Circular

AC146-1

Aircraft Design Organisations - Certification

Initial Issue

01 July 2002

GENERAL

Civil Aviation Authority Advisory Circulars (AC) contain information about standards, practices and procedures that the Director has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

This Advisory Circular also includes Explanatory Material (EM) where it has been shown that further explanation is required. Explanatory Material must not be regarded as an acceptable means of compliance.

PURPOSE

This Advisory Circular provides methods, acceptable to the Director, for showing compliance with the design organisation certification requirements of Part 146 and explanatory material to assist in showing compliance.

RELATED CAR

This AC relates specifically to Civil Aviation Rule Part 146.

CHANGE NOTICE

There was no previous issue of this AC, consequently no change is in effect.

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Subpart A — General

EM 146.1 Purpose

The purpose of Part 146 is to prescribe the certification requirements for organisations wishing to conduct aircraft design activities in respect of aircraft registered, or to be registered, in PNG. Aircraft design activities in relation to this Part include designs and design changes for aircraft, engines, propellers, their components, and appliances.

Design organisations must have the capability to determine the compliance of designs with airworthiness requirements and design standards, e.g. FAR 23 and FAR 25, and employ, contract or engage professionally qualified engineers who can provide certifications for that compliance. To support its activities, a design organisation is required to have an exposition that includes a design assurance system, an internal quality assurance system, document and data control procedures and procedures for the exercise of any regulatory authorisations.

There is no such aeronautical design capability in PNG and therefore, organisations who undertake design work in respect of PNG registered aircraft are located offshore and undertake such work in accordance with approvals granted by other regulatory authorities.

Part 146 is therefore structured to accept or validate the design organisation approvals granted by Contracting States. Subpart B provides for the Director's acceptance of a design approval issued by a Contracting State on the basis of known equivalence. Subpart C provides for certification of a foreign design organisation where the standards for foreign certification are either unknown or are known to differ from PNG.

EM 146.3 Definitions

The definitions shown in this rule are specific to Part 146. Definitions associated with more than one Part are contained in Part 1.

EM 146.5 Requirement for certificate

This rule prohibits any design activity encompassed by the ratings detailed in 146.11 from being carried out unless that activity is conducted by an organisation certificated under Part 146.

EM 146.7 Application for certificate

The application form CAA 146/01 must be completed in full and must identify the full extent of the intended activity. This information will be used in determining the ratings to be issued under 146.11 and the assessment and preparation of any limitations associated with the certificate.

Form CAA 146/01 can be obtained from the CAA Airworthiness Authority.

The applicant should submit the application not less than 90 days before the date of intended commencement of activity. For applicants that apply without giving 90 days notice the CAA may not be able to offer any confirmation that the organisation will be certificated in time to meet the applicant's deadline.

Applicant's should plan their certification programme in advance and early consultation with the CAA will ensure all issues are dealt with well before the planned start-up date. Having said this, the time involved for certification is dependent on the quality and completeness of the application and exposition.

EM 146.9 Issue of certificate

There are several requirements to be met for the issue of the certificate. Primarily, the applicant must meet the requirements of Subpart B or Subpart C of the Part to be issued a certificate.

To be assessed as meeting the requirements of Subpart B, the applicant will need to provide a copy of the foreign design organisation's certificate and exposition, and details of the senior person's who will be

responsible for liaison with the PNG CAA on design matters. The documentation will be assessed for acceptance and the suitability of the persons nominated for liaison with PNG confirmed.

To be assessed as meeting the requirements of Subpart C the applicant's documentation will be checked for compliance with the rules and suitability for the type of design tasks the applicant is proposing to carry out. After the documentation is accepted as satisfactory, an entry inspection of the applicant's facilities and resources will be made and will normally include interviews with key staff members.

Once the CAA is satisfied with the organisation and the applicant's nominated senior persons have been assessed as fit and proper as required by the Act, the certificate is issued. A certificate will normally be issued for a limited period on completion of which, a full compliance audit will be conducted before full certification is given. The length of the initial induction period will depend on the type of design work proposed, the adequacy of resources, and the experience of the applicant and their staff.

The Director may prescribe limitations and conditions on a design organisation certificate. These additional limitations placed upon the certificate may include limitations based on the applicable requirements of Part 21, or general qualifications of the design activities considered appropriate. For example, a design organisation can be limited to modification and repair design work only, and not supplemental type certificates.

EM 146.11 Privileges of certificate holder

The holder of a design organisation certificate may—

- develop design changes for aeronautical products and their components (rating D1)
- develop designs and design changes for appliances (rating D2).

Whilst the ratings are general abilities, the detailed capability of an organisation should be stated in its exposition. This detailed capability will largely be dependent on the facilities the organisation has access to and the experience of the personnel the organisation employs. An applicant should not detail activities the organisation will not be able to provide.

Holder of an authorisation to approve design changes

If a design organisation wishes to approve design changes without reference to the CAA it must employ an Authorised Engineering Representative appointed under Part 183. This person must be employed as a senior person in the design organisation.

Additional limitations and qualifications on a certificate

The Director may prescribe limitations and conditions on a design organisation certificate. These additional limitations placed upon the certificate may include classes of design changes, limitations based on the applicable requirements of Part 21, or general qualifications of the design activities considered appropriate.

Classes of design changes are based on the approval abilities of the Authorised Engineering Representative. These abilities will be detailed on the authorisation itself but also can be used to define the organisation's abilities. For the purposes of defining the abilities of the design organisation, design changes are classed as follows—

- Class A are those design changes that require comprehensive engineering justification, assessment, and substantiation
- Class B are those design changes that do not require comprehensive engineering justification, assessment, and substantiation.

Additional qualification of the scope of design development a certificated organisation may perform may include, but is not limited to, the following—

- Structures, including load determination and stress analysis
- Systems, hydraulics, electrical, control, pneumatic, and fuel

- Flight test and performance determination
- Radio and navigation system installations

Part 21 defines the process for, and details of, design and design change approvals. The design organisation may be limited further to specific areas of design work identified in accordance with the subpart of Part 21. For example, a design organisation can be limited to modification and repair design work only, and not supplemental type certificates. This limitation would be reflected by reference to Subparts F and G of Part 21 on the certificate.

EM 146.13 Duration of certificate

The initial issue of a certificate will normally be for a period of six months to enable the organisation to demonstrate compliance with their exposition and Part 146. Prior to the expiry of the initial certificate the CAA will conduct a full compliance inspection of the organisation and, if satisfactory, a longer duration certificate, up to five years, will be issued.

The initial compliance audit should ensure that the organisation is complying with their exposition and that the exposition accurately reflects the organisation's activities. Future audits will examine similar compliance requirements and any other relevant matters.

Certificates which expire, or are revoked, must be returned immediately to the CAA Airworthiness Authority. Suspended certificates should also be forwarded immediately to the CAA for endorsement.

EM 146.15 Notification of ceasing manufacturing

If an organisation decides to cease design activity, this rule requires the certificate holder to notify the CAA. A letter should be sent to the CAA Airworthiness Authority, together with the certificate, within 30 days of ceasing activity.

As well as ensuring the CAA has an accurate picture of the aircraft design organisations supporting aircraft in Papua New Guinea, this rule ensures continuing airworthiness responsibilities are addressed when a design organisation ceases to operate.

EM 146.17 Renewal of certificate

The rule specifies a period of 30 days before the certificate expires for application for renewal. The certificate holder should make provision for this in the exposition. The renewal of a design organisation certificate may be delayed if the organisation's application is not forwarded with the required lead-time.

An organisation should allow sufficient time for the renewal process to be planned and carried out. The time involved will vary according to the type of design activity the organisation is certificated for and carrying out, as well as the period the certification has been in force.

Where a certificate has been in force for the full five years, a re-entry application and audit process will be required to be followed. This process will ensure that all facets of the organisation comply with Part 146 and the latest revision of its exposition. The extent of this re-entry process will depend on the organisation's conduct to date, any changed circumstances, and results of safety audit findings over the period of validity.

Subpart B — Acceptance of Foreign Design Organisations

EM 146.51 Purpose

This purpose of this Subpart is to provide a mechanism for the CAA to recognise acceptable foreign design organisation certificates as an alternative to organisations holding such certificates having to go through the full compliance process detailed in Subpart C.

EM 146.53 Acceptable foreign certifications

This rule lists those authorities which the CAA has determined issue design organisation certificates to the same standards as are prescribed in Subpart C. Where the certification processes for design organisations in other countries are either known to be different (e.g. in the USA) or are unknown, an applicant is not eligible for certification under this rule. Applications will be assessed on a case by case basis and if the foreign authority certification process is shown to be equivalent to this Part 146, that authority will be added to the list in 146.53.

An applicant seeking to have a certificate issued by one of these authorities accepted for the purpose of gaining PNG certification under Part 146 is only required to provide the CAA with a copy of the foreign design organisation certificate and the associated exposition, together with the names of the senior persons in that organisation who will liaise with the CAA on matters relating to PNG.

The rule does allow the CAA to verify the conditions of continuing validity of the foreign organisation certificate and to impose any conditions and limitations of the PNG certificate.

Subpart C — Certification Requirements

EM 146.101 Purpose

This Subpart details the certification requirements to be met by an organisation which is not eligible for certification under Subpart B. A foreign design organisation currently holding a certificate issued by an authority other than one of those listed in 146.53, or and a PNG organisation seeking approval as a design organisation, must meet the requirements of this Subpart.

EM 146.103 General

This rule recognises that an applicant may have an exposition which could either be shown to meet all the requirements of Subpart C or which otherwise could be supplemented to address the Subpart requirements not considered to be met. An applicant would only be required to produce a complete exposition specifically for PNG certification if neither of the previous conditions could be met.

EM 146.105 Personnel requirements

An applicant must identify their Chief Executive and other key personnel. The applicant's nominated senior persons must be employed, contracted or otherwise engaged to work sufficient hours such that the individual can fulfil the management functions associated with the size and scope of the applicant's business.

The rule identifies what are considered the critical members of an organisation who will exercise an appropriate level of control, direction, and responsibility, to ensure the continued effectiveness of the activity undertaken. Further, the applicant must have in their exposition an organisation chart showing the lines of responsibility extending from the CEO through to each location where design staff are located.

An applicant may utilise any organisational structure as part of their overall business structure provided the applicant can satisfy the Director as to the effectiveness of the reporting lines and control required to be exercised. Applicants should note that approval of alternative organisation structures is not automatic.

146.105(a)(1)

The intent of the rule regarding the responsibility and authority of the Chief Executive is to ensure that:-

- the design activities carried out by the organisation can be financed
- those activities are carried out in accordance with Part 146
- the organisation complies with the requirements of Part 146.

It is clear that this person needs to have the authority to ensure the activities of the organisation can be financed. A suggested method of demonstrating this could be by presenting an annual business forecast, or have as a part of compliance with rule 146.121(a)(3), the authority to finance the operation clearly defined as part of the Chief Executive responsibilities.

The Chief Executive must assure that the exposition complies with the rules. The exposition amendment procedures should cover this.

The Chief Executive must also be assured that design activity is conducted in compliance with the exposition. Ensuring compliance with the exposition is the responsibility of the senior persons under rule 146.105(a)(2) and the assurance that the Chief Executive requires could be shown through the medium of the internal audit reports or inspections.

This person will need to demonstrate during initial application and at any other time, that they have the knowledge to control the organisation.

If an organisation has several independent business units then it may be appropriate to apply for certification independently. If this is the case a Chief Executive will be required to be identified for the design unit specifically.

If, on the other hand, an organisation retains one identity the Chief Executive should be clearly shown to have an appropriate level of authority. This may occur where an organisation is certificated for other tasks such as maintenance or manufacturing and only one core exposition is used for all administrative functions.

146.105(a)(2)

Under this rule, the organisation must appoint senior persons responsible to the Chief Executive for —

- design control
- inspection and test
- internal quality assurance
- if design approval is required by the organisation, the functions of an AER appointed under Part 183.

Titles may vary between organisations but the requirements are for management representatives for design control, inspection and testing, and internal quality assurance. If a particular area is specifically excluded, or specifically included, in the exposition the responsibilities required to be addressed may vary.

In smaller organisations the Chief Executive and the senior persons may be the same individual but in all cases there should be clear definitions of the position's responsibilities. The individual undertaking one or more functions in the organisation should have a clear understanding of the division of the responsibilities and be able to show this to the CAA. Some functions should not be combined as they conflict with responsibilities assigned to the intended positions, for example, the functions of Chief Executive and Quality Assurance.

The person or persons nominated will represent the management structure of the organisation and are required to be acceptable to the Director.

The senior persons should be responsible for ensuring that—

Design control

- the design control system is implemented and running effectively
- designs are processed in accordance with the requirements of the Civil Aviation Rules
- concessions are processed in accordance with the exposition and any CAA requirement
- the drawing system is effective in providing for the design activities of the organisation
- the continued airworthiness facilities for any design produced are provided
- support systems are effective in providing for the activities of the design teams
- any corrective action relating to the design control system resulting from the internal quality assurance programme is quickly and effectively carried out

Inspection and testing

- any inspections and tests carried out are implemented and running effectively
- inspections and tests reflect the current state of the art of the aviation industry and provide the results necessary to show compliance with airworthiness requirements
- suitable arrangements with providers of testing equipment and facilities are established and reflected in the exposition
- support systems are effective in providing for the activities of the inspection personnel
- any corrective action relating to the inspection and testing resulting from the internal quality

assurance programme is quickly and effectively carried out

Internal quality assurance

- the organisation remains in compliance with Part 146
- the exposition and the associated procedures remain adequate for the scope of the organisations activities
- any exemptions required are processed in accordance with the organisation's procedures and Part 11
- personnel meet the initial and on-going training and qualification criteria defined in the exposition
- staff are authorised appropriately for performing certifications on behalf of the organisation
- support systems are effective in providing for the activities of any internal quality assurance personnel
- any corrective action relating to the exposition, procedures, qualifications, personnel, or support systems resulting from the internal quality assurance programme is quickly and effectively carried out

146.105(a)(3) Authorised Engineering Representative

Responsibility for the approval of designs and design changes resides with the Director. The Director may appoint a person meeting the requirements of Part 183 as an Authorised Engineering Representative (AER) to carry out specified design change approval functions.

The AER must be employed by a design organisation to ensure that sufficient support systems are in place to complete the design approval function.

Whilst the AER acts as the Director for the design change approval functions, he or she is required to be authorised by the organisation to exercise their privileges. This ensures that control remains with the organisation maintaining the design control system. The organisation cannot authorise the AER for functions beyond their Part 183 authorisation.

The requirements for the approval of design changes are explained in Appendix A and are further expanded in Part 21, Part 43, and their associated advisory circulars.

The AER will have their responsibilities explained in their authorisation, but as a senior person in a design organisation he or she should be responsible for ensuring—

- any inspections and tests fulfil the requirements they specify before approving a design change
- design change descriptive and supporting data is assembled and distributed as required by the exposition
- they can supervise the design work and be readily available, in person, for consultation with those performing the work
- each complete design complies with the applicable airworthiness requirements
- they only approve design changes in areas that they are competent
- where the proof of compliance depends on calculations alone, and these calculations are extensive or are based on other than fundamental technical procedures, checking is done by competent persons other than those originally performing the work
- they prescribe relevant limitations and conditions to design changes to ensure an adequate level of safety is maintained

- support systems are effective in providing for their authorised privileges
- any corrective action relating to the approval of design changes resulting from the internal quality assurance programme is quickly and effectively carried out.

146.105(a)(4)

Under this rule, the organisation's personnel levels should ensure that a sufficient number of suitably qualified people are available to carry out the design task.

146.105(b)

The competence of all staff should be determined on the basis of—

- academic qualifications
- certificates or approvals held
- employment records
- written, oral, or practical examination

The organisation should provide for the assessment and maintenance of the levels of competency of all personnel.

At the time of application the applicant must consider how they will deal with transfer of the senior person functions, to other suitable and qualified persons during periods of absence. Although the rule does not make provision for or have any requirement for the situation where a senior person may be absent for a prolonged period of time, or vacates the position it is advisable to provide for this in advance. Consideration should also be given to a situation where a senior person has been incapacitated. This would in effect cause the position to be vacant for the period of incapacitation and would require a substitute person to meet the requirements of this Part. In the event that the responsibilities and functions are transferred to another person they would also be required to be fit and proper, and meet the experience and qualifications set out in the exposition.

In the event an applicant chooses not to provide for the situation where a senior nominated person vacates a position, it should be remembered that the Director has to be notified of such a situation and the certificate holder will also be called to provide details of the contingency arrangements to be implemented pending a permanent solution being achieved.

It should be noted that where a change of senior person is proposed, rule 146.203(b)(2) requires the prior notification of the change and acceptance by the Director.

In accepting such contingency arrangements, the Director may impose limitations or conditions of a temporary nature for the period of the contingency. The conditions or limitations imposed by the Director in all cases will be clearly stated to the certificate holder in writing, and could be as simple as providing a time frame for events to take place or a total suspension of design activity.

EM 146.107 Facility requirements

Office accommodation should provide for management, planning, records, quality, design, and other staff. The offices should be sufficient to meet the requirements for the scope of design work to be undertaken.

As there is an ongoing requirement to retain design records the provision of storage and the methods of cataloguing and preventing deterioration of this material is required.

Testing facilities may include calibrated and critical equipment and this test and measurement equipment should have adequate protection and control.

EM 146.109 Equipment and tools

An applicant for Part 146 certification must show that all tools and equipment, necessary to accomplish the approved design activity will either be permanently on hand or available as required in accordance with documented arrangements in the exposition.

This rule requires the design organisation to not only have the necessary equipment but to also have the procedures to ensure control of the process.

The requirements extend to the provision of—

- design data from organisations such as libraries, standards organisations, the Civil Aviation Authority, the military, and other design organisations
- tools and testing facilities requiring workshop, or other specialised environments
- equipment including measurement, drawing, and computer support equipment.

In undertaking design work the organisation should ensure that it identifies, in its exposition, the testing locations it intends to use regularly. If testing equipment is located at these other premises then controls should be in place to ensure the equipment is controlled and calibrated as necessary.

Outside organisations, or organisations certificated under other Civil Aviation Rules, may be acceptable to provide testing facilities. In these instances a contractual arrangement would be expected and this agreement should be referenced in the exposition.

EM 146.111 Design control system

The design control system can be likened to the internal quality system but is more specific in its application. The design control system should ensure—

- design control procedures are published, maintained, and followed
- designs and design changes comply with the applicable airworthiness requirements and have no unsafe features
- subcontracted work is identified and the design organisation exercises control over the performance of subcontractors
- responsibilities for issuing documents are clearly identified and personnel are given clear descriptions of the scope of their authorisations.

To ensure that there are no unsafe features in a design or design change may practically be impossible to achieve. For example, changes incorporated subsequent to the design entering service may introduce problems with the original design unforeseen by the designer. A design organisation should include procedures that ensure designs have no unsafe features that could have reasonably been identified during the design process. The organisation should take all possible compromises to airworthiness into account and may subsequently use limitations, conditions, operating instructions, and incorporation procedures to limit the effect of any otherwise unsafe features.

The design control system does not specify a requirement for a totally separate checking system. This allows the small design organisations consisting of few individuals to be certificated. Since the certificate can be limited in its scope, the smaller organisations may be required to rely on a degree of CAA involvement for the tasks that require independent checking. Such certificate limitations will be dependent upon the competency of the applicant's staff.

EM 146.113 Design control procedures

The design control procedures form an integral part of the design control system. As part of the system there should be adequate copies of all technical data necessary to carry out the design activities for which the organisation is certificated.

In providing this information, the organisation should make the relevant data available to personnel requiring to use it. When computer systems are used, the number of terminals and the types of software should be adequate to provide for use by the relevant staff members. In providing electronic information the organisation should ensure that the necessary software and information updates are scheduled to enable the correct reference material to be accessed.

The drawings produced by a design organisation ultimately define a design and there is a requirement for drawing control procedures. Appendix B of this advisory circular details more considerations for the drawing production and control system.

As well as control of the drawings, a design organisation has a requirement to provide document control procedures. These procedures should ensure that the correct reference materials are current and authorised for use in the design activities. These requirements extend to computerised records and documents as well as software updates. The procedures should include an electronic information control section if this is utilised by the organisation.

The design control procedures include the requirement for methods for the inspection and testing of specimens of the design to demonstrate compliance with airworthiness requirements. The inspection and test procedures may not apply to all designs and design changes developed by the organisation and the design control procedures should include methods to determine when testing is required.

Documentation

The design control procedures should include systems to control the documentation used by the organisation.

The documentation required to be addressed in the procedures includes all company procedures, test procedures, technical data, and reports. The documents should be available to all employees requiring the information and should be reviewed prior to use.

The rule requires that each item of documentation is identifiable so that only that information relevant to the design is used. Documentation otherwise considered obsolete may therefore be required for a design task. If a design or design change is still in current use, then the documentation should not be considered obsolete. The rule however recognises that otherwise superseded data may be appropriate to a design activity.

When utilising documentation that is otherwise considered obsolete, the organisation should ensure procedures provide for confirmation of the relevance of that documentation. This confirmation would normally be made by the person approving the design or issuing the statement of compliance. In accepting that documentation the appropriate person should ensure—

- the design activity cannot be carried out with otherwise acceptable documentation
- the documents are directly relevant to the product to which the design activity relates
- the level of safety is equivalent to those standards considered acceptable for the type of operation the product is to be submitted to.

Proprietary information

In determining the procedures to be employed by the design organisation the issue of commercial-in-confidence and proprietary information is raised.

The actions up to and including the statement of compliance can be taken as being commercially sensitive and owned by the developing design organisation.

The approval however, even if completed by the design organisation's AER, is carried out by the Director and becomes publicly available information. This means that any pages containing the approving signature become public information. One particular example of this is any supplemental pages for flight manuals, where they do not form the design change approval itself, but are however approved as part of the authorisation holder's functions.

Figure 1 shows the relationship between design organisation commercial information and public information.



Figure 1. Proprietary Information

Any submission to the CAA for approval is treated in a similar manner and the approval itself is the only document generally available.

Design stages

There are three broad stages of design development and each has its final certification requirements. These stages are shown in Figure 2.

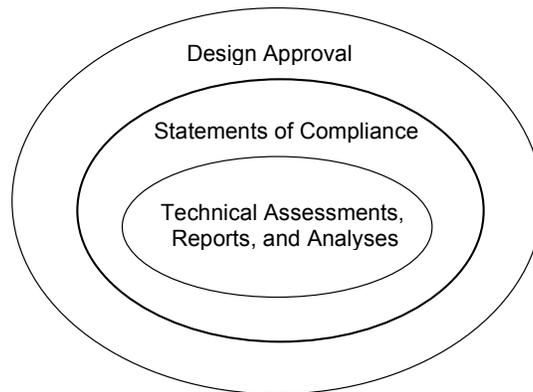


Figure 2. Design Stages

Technical assessments, reports, and analyses

This area forms the majority of the design organisation's tasks. The technical assessment should examine all facets of the design or design change and conclude with a statement that the design meets the intended requirements.

At this stage this is not a certification of anything other than the fact that the design has been developed, all reports supporting the design are available, and any stress analyses or other testing has been concluded.

The format of technical assessments and reports is up to the organisation but standard layout should be used and identified in the exposition or other design control manuals. The layout should include the following sections—

- the name of the organisation and a reference number for the assessment
- the description of the items affected

- a brief description of the design change
- technical data that includes—
 - descriptive data
 - substantiating data
 - amendment requirements
 - other supporting data such as weight and balance calculations

Statements of compliance

This is the confirmation by an authorised company person that the design has been checked, complies with the airworthiness requirements, and is acceptable for approval.

The terms compliance and conformance are often used interchangeably. This is not strictly correct.

Conformance generally refers to the conformity of a design to an applicable type design. It is correct, therefore, that a statement of conformity attests to the design showing conformity with the type design.

Compliance has a much broader meaning and better reflects the entire design concept. A design comprises several parts and conformance to the type design is only one aspect.

A design or design change must meet the relevant airworthiness requirements including the following—

- conformity to the type design
- applicable design standards
- special conditions prescribed by the CAA
- general safety aspects of the design
- the design's fitness for use.

The statement of compliance therefore refers to the wider considerations a design must take into account.

A design organisation may utilise the services of an outside agency to provide for some of the design activities. In these cases the details of the authorisations issued to other persons is a requirement of the exposition. It is appropriate that a design organisation use contractual arrangements to formalise these authorities.

Commonly used subcontractors should be listed in the exposition and be acceptable to the Director. The scope of the tasks assigned to these subcontractors should be dependent on their competency and the assessment of the organisation. Most examples of these arrangements will be for testing requirements that may be met by recognised laboratories and testing establishments.

In all cases a design organisation should require statements of compliance or written reports attesting to the satisfactory completion of the contracted tasks.

Design approval

Design approval considerations are detailed in Appendix A and are further expanded in Part 21, Part 43, and their associated advisory circulars.

The design approval is the final stage of the design process and may or may not be required by a design organisation. If a design organisation wishes to approve designs they must employ an AER as described earlier. This person should be authorised by the organisation so that positive control of the approval function is retained with the organisation.

After design change approvals have been issued, copies should be forwarded to the CAA for their records.

This is an important requirement for two reasons. Firstly the CAA retains a complete picture of the products, components, and appliances in use or available in the Papua New Guinea aviation environment. Secondly, in approving the design change, as the Director, the AER has carried out a CAA function.

The procedures for the issue of design change approvals should detail the requirements the organisation expects to be met to enable the AER to sign the approval. These requirements would likely take into account commercial-in-confidence issues, corporate image issues, and other considerations that may not directly relate to the development of the design.

EM 146.115 Continued airworthiness

The design organisation has a responsibility to ensure that the parts and appliances designed are monitored and supported. As with manufacturing organisations, part of this monitoring includes the investigation and analysis of defect incidents.

Defects that have no effect on safety, in any form, do not come under the definition of defect incidents and as such are not subject to this rule. These include defects which if corrected may aid production or make the item easier to use, resulting in an economic advantage to operating and maintenance organisations.

Defects that may result in injury, accidents, or hazards to other aviation activities are considered defect incidents. Under this rule, the design organisation has a responsibility to keep the users of products which they design and the manufacturer of those products informed of defect incidents.

The defect reporting responsibility of a design organisation will generally cover those product features that are causing a problem that are introduced by poorly controlled design processes rather than manufacturing faults or maintenance practices. Defect reporting to the CAA is covered in Part 12.

As part of the documentation of a design, particular a product design, there is a requirement for Instructions for Continued Airworthiness. These instructions should be developed by the design organisation but will involve collaboration with manufacturing and maintenance organisations.

Advisory circulars AC148-1 and AC145-1 contain additional information on the continued airworthiness responsibilities of manufacturing and maintenance organisations.

EM 146.117 Records

Design records

The holder of a design certificate should provide procedures that ensure—

- a record is kept of all designs and design changes produced by the organisation; and
- all drawings, analyses and reports for each design are recorded and retained
- all significant inspection and test records attesting to the conformity and compliance of each design are retained
- a record is kept of all calibrations on tools and equipment, including the standards used for calibration.

The procedures should also detail the method of identifying records that are no longer current, but are required to be held for research or other purposes.

Records should be legible and of a permanent nature.

Records can be kept electronically but systems should ensure the information security, integrity, and retrieval. A system of backing up electronic data would be considered appropriate. Procedures for electronic record and document keeping should consider—

- avoidance of data loss in the event of power interruptions

- software control, including amendments and prevention of corruption
- unauthorised access
- audit trail facilities
- archiving of data in a similar manner to hard copies, and for a similar period
- backup of critical information, preferably once a day, with storage for that backup information
- data verification, on entry and retrieval
- publication provision
- staff training
- amendment of stored data
- problem report register including the problem details and solutions

For ease of access records may also be microfilmed or magnetically stored but the original documents should be retained in a secure environment.

The rule requires the ideal retention of records to be 2 years from the date of the withdrawal of the last example of the product from service. This is a very onerous requirement but ensures that the information is available no matter how long the product remains in service. The rule recognises the need for varying this time limit in special cases. The cases that may support the reduction of this period will vary considerable but may include, but not be limited to, the following—

- the only examples of the design in use are installed on aircraft limited to experimental operations
- although products conforming to the design still exist, the likelihood of restoring an operating example of the product is considered extremely rare.

Personnel records

A certificated design organisation must establish procedures to ensure records are kept of all staff authorised to certify under its authority. The following minimum information should be kept in respect of each certifying person—

- name
- date of birth
- qualifications
- initial training
- continuation training
- experience
- qualifications relevant to the authorisation
- privileges of the authorisation
- date of first issue of the authorisation
- the expiry date of the authorisation
- identification number of the authorisation

The records may be kept in any format but must be controlled by the organisation's quality assurance senior person. Safeguards must be put in place to ensure that the records cannot be altered in an unauthorised way. Personal information must not be accessible to unauthorised persons. Organisations should take account of Privacy of Information legislation in the management of personal information.

The persons to whom the records relate should be given access, on request, to his or her own records. The CAA is an authorised person in respect of any aviation documents and records. When the CAA is assessing eligibility for initial or continued approval, or when it has cause to doubt the competence of a particular certifying person, it may access those records.

An organisation should keep the records for at least five years after the individual has ceased to be in its employment, or after withdrawal of the authorisation, whichever is sooner. In addition certifying persons, on leaving an organisation, must be provided with a complete record of company certification authorisations which they have held.

EM 146.119 Internal quality assurance

An applicant must establish an internal quality assurance system that meets the requirements of this rule.

The requirements of this rule are common to all certificated organisations which require an internal quality assurance system, for example all the organisations to which the 140 series and 170 series Parts apply.

Detailed information on what is required for an internal quality assurance system is contained in PNG AC 10-1.

EM 146.121 Design organisation exposition

This rule requires an applicant for a design organisation certificate to establish an exposition.

The purpose of an exposition is to express the Chief Executive's requirements for the conduct of the organisation, to set out the means by which an organisation defines its operation, and to show both its employees and the CAA how it will conduct its day-to-day business in compliance with Part 146.

An exposition must assure the CAA that the organisation is in documentary compliance with the rule. Hence before the CAA grants an organisation entry into the system, the exposition must be accepted by the Director.

Makeup of exposition

An exposition may be produced as a single volume or any number of separate manuals. Depending on an organisation's structure and size, separate manuals could cover—

- Management and Policy
- Personnel
- Design Procedures
- Document control
- Quality Assurance
- Contractual Arrangements with Test and Calibration Organisations.

If the exposition comprises more than one volume, the make up of the exposition and the content of individual manuals must be described in the management part of the exposition.

Procedures should be established to ensure Managers hold copies of those parts of an exposition which affect their areas of responsibility and staff are familiar with those parts of an exposition which affect their area of employment.

Content

The exposition should be constructed to address each element of 146.121. The structure should reflect the hierarchy of Part 146 such that the exposition progressively moves from higher level organisational material such as policy, scope of approval, and duties of senior persons to more detailed procedures.

Structuring the exposition according to the flow of the rules in Part 146 should be avoided, the result will not be a user friendly document.

The level of detail should be consistent with the size and complexity of the organisation and the design activity undertaken.

Exposition acceptance

The acceptance of an organisation's exposition by the Director will be one step in the process of Part 146 approval. Unless an exposition is accepted by the Director, a Design Organisation Certificate cannot be issued. Evidence of acceptance of the exposition is the issue of a certificate, however the CAA will normally stamp the log of pages to signify that they have found the exposition acceptable at a particular status.

Multiple certification

When an organisation seeks certification under more than one Civil Aviation Rule Part each of which requires an exposition, it may be possible for some parts of the exposition to be common to each certificate. For instance, if the same management set-up is used for each certificate, the management and policy part of the exposition could be common. Equally, all of the quality assurance procedures for one or more certificates could be placed in one manual.

Whatever format of exposition is chosen, it must be possible to clearly show how the requirements of each Part are satisfied. It is desirable that a compliance matrix is provided showing where compliance is shown in the exposition for each Part. This matrix should distinguish between those requirements which are common and those which are specific.

Any difficulty in establishing compliance will require more investigation time to be expended, and can only result in delays and additional cost to an applicant.

Subpart D — Operating Requirements

EM 146.201 Continued compliance

To ensure that all members of the organisation have access to the exposition, a certificated organisation is required to provide copies of its exposition at all places where work is normally carried out.

For continued compliance with the conditions of its Part 146 certificate, the organisation must comply with all the procedures detailed in the exposition and continue to meet the standards and conditions, which were required for initial certification.

In the case of organisations accepted under Subpart B for issue of a PNG design certificate, that organisation's foreign certificate must remain valid. If that foreign certificate is suspended, revoked or cancelled, the organisation's PNG certificate will be suspended, revoked or cancelled.

EM 146.203 Changes to certificate holder's organisation

An organisation should always ensure that its exposition remains an accurate description of the organisation and its activities. When there are changes to staff, structure, location, or documented procedures the organisation should ensure the exposition reflects these changes.

Prior acceptance by the Director is required for certain changes including—

- the Chief Executive

- the listed senior persons
- the design activities undertaken
- the locations at which design work is carried out, including testing and inspection locations.

Organisational changes

When the holder of a design certificate changes their organisation in such a way as to necessitate a revision of their manuals or exposition, the CAA is to be kept informed. An acceptable means of compliance with the notification requirements is to notify the CAA in writing of any changes. A facsimile message may be accepted as a notice in writing.

The CAA's agreement to the change may be more readily obtained if the proposed wording of the change is fully defined and any supplementary information is provided to assist the CAA in deciding whether the change is acceptable.

Design certificate amendments

An application to amend a design certificate is made in the same form and manner as the original issue. Where the changes include changes to the design organisation's exposition, only the changes need be submitted.

EM 146.205 Safety audit and inspections

The organisation must also comply with any reasonable requests from the Director to undergo audits and inspections. The Director is empowered by the Civil Aviation Act to make such requests.

The CAA operates a safety audit programme for all participants in the aviation system. For design organisations the safety audit will be part of the total industry safety monitoring schedule and visits will be notified in advance. These arrangements will allow for forward planning by both the CAA and the certificated organisations.

An organisation's policy and procedures will be accepted by the CAA during the entry process. These policies and procedures, documented in an organisation's exposition, will form the agreed performance standard for an organisation's safety audit programme. This safety audit programme will initially examine the certificate holder's internal quality assurance system. Any deficiency found at this level will result in a broader and deeper investigation until the causal factors of the deficiency are identified. The on-going frequency and depth of audit will depend directly on the performance of the organisation.

The CAA's level of confidence in an organisation will be raised when it is found to comply with its documented procedures. The CAA can then consider reducing the frequency and depth of the audit programme, with consequent financial savings for the organisation. Conversely where the level of confidence is low, due to non-compliance, the level of auditing and the consequent cost to an organisation may be expected to increase. Whenever it is discovered, through an audit or other reporting method, that an organisation is not conforming with its procedures, or complying with the Part 146 rules, the Director may suspend or revoke the certificate.

Appendix A – Design approvals

Design approval is an important stage of development as it finalises the product, component, or appliance for manufacture and modifications for incorporation. The approving person for a design is the Director although certain design changes may be approved under design delegations.

The design package

Designs generally consist of several distinct sections that together make up a package. The design package or modification package should consist of the following sections—

- descriptive data
- substantiating data
- other supporting data and consequential information

The package as a whole should be arranged inductively so that the purposes and summary of the design is provided in a covering document. Each subsequent section should be deductive permitting the person approving the work to follow the logical development of the design in each section.

Descriptive data

The completed design package requires descriptive data that fully describes all aspects of the design or design change for manufacturing purposes.

The descriptive data should include—

- use and application of the design
- purpose of the design
- maintenance, operating, and performance data including any limitations for the use of the design
- installation properties including any factors that affect the interaction of the design with other equipment
- references to standards and specifications used during the development of the design
- drawings, diagrams, and other physical descriptions of the design, including—
- special processes and their required outcomes, such as—
 - heat treatments
 - surface finishes
 - weld quality
- wiring diagrams
- an equipment list that details the items that make up the completed item
- a summary of particular manufacturing considerations, including—
 - pressures
 - temperatures
 - environments

- a list that details the substantiating data for ease of reference.

Limited descriptive data

In some cases the descriptive data may not be fully available, or considered required, by the design organisation. Limited descriptive data may be appropriate in the following cases—

- acceptance by the approving person
- the design change is a trial installation to be used for a limited time and under the direct control of the approving person
- the design change has been previously approved by acceptable military authorities
- where the design change is inadequately described for manufacture, the design can be fully checked by inspection during manufacture and installation.

Substantiating data

The substantiating data makes up the majority of the design package. It contains the supporting calculations and descriptions of special processes chosen to provide compliance with the airworthiness requirements.

Substantiating data should include—

- load analyses
- failure analyses
- the requirement and suitability of any special processes chosen
- installation considerations
- methodology and results of test as to the interaction and compatibility between existing units and the new items
- for an avionics design—
 - an electrical load analysis
 - a failure analysis ensuring that essential equipment are sufficiently independent to prevent complete system failure
 - the layout and ergonomics of applicable units, in particular instruments
- performance confirmation
- crashworthiness assessments.

Other supporting data

Other data that a design package should address includes weight and balance data, manufacturing data, manual amendment requirements, and installation or incorporation instructions.

Weight and balance

Unless the design change results in a negligible weight change then weights and moment arms should be calculated in the description of the change. Alternatively a complete reweigh could be requested of the aircraft after embodiment.

What is considered negligible varies dependent on the aircraft size and type. The following are considered acceptable guidelines for weight and balance—

- For aircraft less than or equal to 5700 kg MCTOW—
 - a cumulative weight change of up to 1% is considered negligible
 - a moment arm change of less than 1% is considered negligible
- For aircraft greater than 5700 kg MCTOW—
 - a cumulative weight change of up to ½% is considered negligible
 - a moment arm change of less than ½% is considered negligible

Manufacturing data

The manufacturing details should ensure that the equipment can be produced within the design limits. Considerations should include the application of special processes, particular pressures, temperatures, and environments, and the repeatability of production standards if appropriate.

Manufacturing data for designs that are subsequently sold for incorporation should consider the different environments that production may be conducted. In many cases the ideal production of a prototype will not be achievable subsequently, from either the airworthiness or economic standpoints.

Amendments

Amendments to manuals is an important aspect of a complete design package. Maintenance manuals, illustrated parts catalogues, and flight manuals are three documents that may require amendment when a design is incorporated.

In many cases the manuals will not be controlled by the design organisation and to amend the document would require approval of the issuing organisation. A design package may provide supplements to these types of manuals that would subsequently be provided to the purchaser of the design or equipment manufactured to that design. In many cases, if the design is significant enough to require substantial changes to manuals some liaison with the manual issuer would be expected.

Flight manual supplements may be approved when they form part of the design change. As guidance a flight manual supplement should include the following sections—

- **Cover Page**; including—
 - the aircraft type / applicability
 - a contents table
 - a list of effective pages
 - the date and revision status
 - the identification of the design organisation developing the supplement
 - a signature, designation, and delegation reference of the approving person
- **General**; including a description of the application of the supplement, particular special considerations for installation or operation, and a drawing if necessary
- **Limitations**
- **Emergency Procedures**

- **Normal Procedures**; including the installation and performance of pilot maintenance as well as the normal operating procedures
- **Performance**

Installation data

For designs that progress to installation there should be some installation data provided. In many cases this is provided in an instruction booklet to assist the person carrying out the work. Although a booklet is not required in all cases, design packages should include considerations for maintenance actions pre and post installation, performance testing when installed, and subsequent operation instructions.

Design checking

It is important that compliance with airworthiness requirements is adequately proven and checked. In some cases there is no need for the calculations to be checked by independent persons. For example, where structural testing confirms the results of structural calculations an independent calculation check would not normally be required.

Where the proof of compliance depends on calculations alone, and these calculations are extensive or are based on other than fundamental technical procedures, it is important that checking is done by suitably qualified persons other than those originally performing the work.

Design approval

It is the responsibility of an approving person to ensure the complete design complies with the applicable airworthiness requirements. In approving a design a person should ensure the following—

- only designs in areas that the person is competent in should be approved
- the design changes approved should be those that the person has—
 - personally performed; or
 - supervised and checked to the extent necessary to ensure that it complies with the applicable airworthiness requirements
- the applicable descriptive data is included in the design documentation
- ready availability in person for consultation with those performing the design, testing, or prototyping when supervising the design work
- a qualification such as OK by inspection or OK by comparison is provided to indicate how—
 - the final design has been assessed
 - the production units are to be assessed
- independent checking of calculations that may have a affect on structural airworthiness are carried out
- a determination is made that—
 - a product or appliance incorporating a design change, when operated in accordance with the flight manual or other prescribed operating limitations and conditions, amended as required by the design change—
 - meets the airworthiness design standards, or the provisions not complied with are provided for by equivalent levels of safety; and
 - has no unsafe feature or characteristic that makes it unsafe for its intended use;

and

- the maintenance data provided is adequate for the proper maintenance of the product, component, or appliance incorporating the change.

Appendix B – Drawing system

The drawing system of a design organisation is a key element in the design control system. Drawings may range from sketches to fully draughted drawings to computer produced drawings. The design organisation should ensure that the media it chooses to use is appropriate for the considerations of the drawing standards the organisation wishes to maintain. The drawing system may use one or more of the following media for drawing it produces—

- paper
- acetate
- microfiche
- computer

In all instances the design organisation should ensure that the system provides security, safety, integrity, and backup of the design data. Personnel should be fully trained on the system used. A blank or an example drawing would aid in any references to the drawing in an organisation's procedures.

The drawing system detailed in a design organisation's exposition should include the following features—

- a description of the drawing system and the standards the drawings are to, such as BS 5070, Mil-STD 100, or a suitable aviation specific drawing standard
- a method of identification of company drawing sheets
- a definition of the company drawing numbering system. The numbering system should be logical, provide a reference on each drawing to the modification package it is approved under, and utilise, as necessary, international recognised numbering standards such as ATA
- drawing certification procedures that include—
 - drawing checks
 - stress checks and agreements
 - a list of persons authorised to certify company documents
- procedures for the approval of designs and design changes after a drawing amendment
- the distribution of new or amended drawings to all personnel or customers requiring the use of the information. This may be an update service that identifies those drawing that have changed but should provide sufficient information for the person using the drawing to determine the relevant changes and their consequences
- temporary drawings control
- amendment control
- a drawing list that—
 - is adequately identified by the designation and by the issue number or date
 - lists all drawings or enables all drawings to be traced easily from the listed drawings
 - clearly identifies the designs covered
 - contains the approving persons signature

- procedures to ensure that—
 - if final drawings are not those used during the prototype stage, the approving person confirms that any new drawings are compatible with the drawing list
 - any amendment of the drawing list to incorporate modifications or to incorporate new designs follows the process detailed in the exposition.