REPUBLICA DE CABO VERDE

AGÊNCIA DE AVIAÇÃO CIVIL

Instruction Nº 12/DSV/2015

SUBJECT: RELIABILITY PROGRAM REQUIREMENTS

DATE: 24/07/2015

1. PURPOSE

The purpose of this Instruction is to provide guidance for a reliability program for an aircraft that requires a reliability program under regulation CV-CAR 9.

2. APPLICABILITY

2.1.1 This directive applies to all operators of Cabo Verde registered aircraft, engaged in the commercial operations / commercial air transport, that are required to have in place a reliability program, as part of the maintenance program for those aircraft, if any one of the following conditions is met:

(1) The aircraft's maintenance program is based on MSG-3 logic process; or

(2) The aircraft's maintenance program includes condition monitored components; or

(3) The aircraft's maintenance program does not contain overhaul time periods for all significant system components; or

(4) It is required by the Maintenance Review Board (MRB) report; or

(5) It is required by the manufacturer's Maintenance Planning Document (MPD).

2.1.2 For other operators, maintenance reliability programs (or equivalent programs which meet the intent), should depend on the size of the operator, type of operations and other factors.

3. REFERENCE

CV-CAR 9

4. GENERAL REQUIREMENTS

4.1 Reliability program

4.1.1 The purpose of a reliability programme is to ensure that the aircraft maintenance programme tasks are effective, and their recurrence at regular intervals is adequate. The reliability programme therefore may give rise to the optimization of a maintenance task interval, as well as the addition or deletion of a maintenance task. In this respect, the reliability programme provides an appropriate means of monitoring the effectiveness of the

maintenance programme. Reliability programmes are designed to supplement the operator's overall programme for maintaining aircraft in a continuous state of airworthiness.

4.1.2 The reliability program must:

(1) be in writing; and

(2) define the meaning of any unique terms or acronyms used in the program; and

(3) contain the records of approval of:

(a) the program; and

(b) any subsequent variations to the program.

Note: Common terms used throughout the industry need not be defined as long as the same meaning is intended.

4.2 Identification and applicability of the program

4.2.1 The reliability program must contain the following information:

(1) the type, model, serial number and registration mark of the aircraft controlled by the program;

(2) the name and address of the registered operator of the aircraft controlled by the program;

(3) the name and approval certificate reference number of the organization responsible for the program.

4.3 Objective of the program

4.3.1 The objective of the reliability program must be described in the program:

(1) A statement should be included in the program summarising the scope and prime objectives. As a minimum it should include the following:

(a) To recognise the need for corrective action; and

(b) To establish when and what corrective action is needed; and

(c) To determine the effectiveness of that action

(2) The extent of the objectives should be directly related to the scope of the program. The manufacturers Maintenance Planning Data (MPD) may give guidance on the objectives and should also be consulted.

(3) In case of a MSG-3 based maintenance program, the reliability program should provide a monitor that all MSG-3 related tasks from the maintenance program are effective and their periodicity is adequate.

4.3.2 The applicable instructions for continuing airworthiness must be followed to establish the objective of the program.

4.3.3 As a minimum, the reliability program must provide a means of ensuring maintenance program tasks are effective and their periodicity is adequate for continuing airworthiness of the aircraft.

4.4 Identification of items controlled by the program

4.4.1 The aircraft parts, systems and structural elements controlled by the reliability program must be clearly defined and identified in the program. The reliability program should state items being controlled, e.g. by ATA Chapters. Where some items such as aircraft structure, engines, APU, etc. are controlled by separate programs, the associated procedures (e.g. individual sampling or life development programs and manufacturers structure sampling programs) should be cross-referenced in the program

4.4.2 The maintenance program tasks controlled by the program must be clearly identified in the program.

4.4.3 Where some items, such as aircraft structure, engines, and auxiliary power units, are controlled by a separate program, such as a manufacturer structural sampling or life development program, this must be referenced in the program.

4.5 Administration of the program

4.5.1 In approving the operators maintenance and reliability program, AAC expects that the organisation which runs the program, or an approved maintenance organisation (AMO under contract) employs or contracts the services of sufficiently qualified personnel with appropriate engineering experience and understanding of reliability concepts. Trained and experienced personnel enable the interpretation of the data analysis to be made correctly.

4.5.2 The individuals responsible for the administration of the reliability program must be identified and their responsibility must be described in the program.

4.5.3 An approved reliability program can include full or partial utilisation of the services of aircraft manufacturers. Such utilisation needs to be described with the reliability program document.

4.5.4 Failure to provide appropriately qualified personnel for the reliability program may lead AAC to reject the approval of the reliability program and therefore the aircraft maintenance program.

4.6 Data collection

4.6.1 A description of the data collection system for the items controlled by the reliability program must be included in the program. Such a description must include the following:

(1) identification of sources of data;

(2) procedures for transmission and receiving of data from each source;

(3) steps of data development from source to analysis;

(4) organisational responsibilities for each step of data development.

4.6.2 The data collected must be:

(1) obtained from items functioning under operational conditions; and

(2) accurate and factual to support a high degree of confidence in any derived conclusion; and

(3) directly related to the established levels of performance.

4.6.3 Sources of information should be listed and procedures for the transmission of information from the sources, together with the procedure for collecting and receiving it, should be set out in detail.

4.6.4 The type of information to be collected should relate to the program objectives. Following are examples of the normal sources of reliability data:

(1) Pilots Reports.

(2) Technical Logs.

(3) Aircraft Maintenance Access Terminal/On-board Maintenance System readouts

(4) Maintenance Worksheets

(5) Workshop Reports/findings.

(6) Reports on Functional Checks.

(7) Unscheduled removals and confirmed failures.

(8) Reports on Special Inspections

(9) Stores Issues/Reports.

(10) Air Safety Reports/Service Difficulty Reports/Major Defect and occurrence reports.

(11) Reports on Technical Delays and Incidents.

(12) Other sources: ETOPS/EDTO/EDTO, RVSM, CAT II/III operations.

Note: All of the above sources may not necessarily be covered in each and every program. The scope and objective of the program, and items controlled by the program, will dictate the nature and source of data.

4.7 Performance standards and alert levels

4.7.1 A performance standard or reliability alert level is an indicator (expressed in mathematical terms), which when exceeded indicates that there has been an apparent deterioration in the normal behaviour pattern of the item with which it is associated.

4.7.2 When an alert level is exceeded an assessment should be made to determine if corrective action must be taken. Performance standard or alert or equivalent title (e.g. Control Level, Reliability Index, Upper Limit etc.) require engineering judgement for their application.

4.7.3 It is important to realise that alert levels are not minimum acceptable airworthiness levels. When alert levels are based on a representative period of safe operation (during which failures may well have occurred) they may be considered as a form of protection against erosion of the design aims of the aircraft in terms of system function availability. In the case of a system designed to a multiple redundancy philosophy it should not be misunderstood that, as redundancy exists, an increase in failure rate can always be tolerated without corrective action being taken.

4.7.4 Performance standards

4.7.4.1A Reliability Program must contain a section on the performance standards, describing what type of alert levels will be used, how the levels will be established, how the levels will be re-established if required, how the system would know if the levels have been exceeded and what corrective action(s) would be taken and how.

4.7.4.2The reliability program must include a performance standard expressed in mathematical terms for each item covered by the program that defines the acceptable level of reliability for the item. The following are some of the commonly used performance standards:

(1) premature removal rates for an item;

(2) confirmed failure rates for an item;

(3) in-flight shutdown rates for engine;

(4) flight delays or cancellation rates due to defect in, or failure of, an item;

(5) internal leakage rates for an item.

4.7.4.3Upper and lower limits may be used to express performance standards. This represents a reliability band or range by which the reliability is interpreted.

4.7.4.4The program must describe the methods and data to be used for establishment of the performance standard.

4.7.4.5The performance standard must be responsive and sensitive to the level of reliability experienced. It must not be so high that even abnormal variations would not cause an alert, or so low that it is constantly exceeded in spite of corrective action measures.

4.7.4.6The performance standards must be based on the operator's own operating experience with the exceptions mentioned in subsection 5.7.F. The period of experience will be dependent on fleet size and utilisation.

4.7.4.7If the operator's operating experience of an aircraft type or model is non-existent or limited, performance standards may be based on 1 or more of the following as applicable:

(1) the experience of other operators of the same or a similar aircraft type or model;

(2) the operator's own experience of a similar aircraft type or model;

(3) the performance of a similar product or system on another aircraft type or model;

(4) the expected in-service reliability values used in the design of the aircraft.

Note For paragraph (4), the values are normally quoted in terms of mean time between unscheduled removals or mean time between failure, for both individual product and complete systems.

4.7.4.8The program must contain procedures for monitoring and reviewing performance standards at regular intervals to reflect the operating experience, product improvement and changes in procedures.

4.7.4.9 The program must provide for the review of the performance standards set in accordance with subsection 5.7.F, after the operator has gained sufficient operating experience.

4.7.5 Establishing Alert Levels

4.7.5.1 Alert levels should, where possible, be based on the number of events, which have occurred during a representative period of safe operation of the aircraft fleet. They must be up-dated periodically to reflect operating experience, product improvement, changes in procedures, etc.

4.7.5.2 The alert levels should usually be so calculated as to be appropriate to events recorded in one-monthly or three- monthly periods of operation. Large fleets will generate sufficient information much sooner than small fleets.

4.7.5.3 When establishing alert levels based on operating experience, the normal period of operation taken should be for one year at least, preferably more (2 – 3 years) depending on the fleet size and utilisation.

4.7.5.4 Where there is insufficient operating experience, or when a program for a new aircraft type is being established, the following approach may be used:

(1) For a new aircraft type, during the first two years of operation, alert levels should be established in conjunction with the aircraft type certificate holder and operators experience if appropriate and should be closely monitored for effectiveness during the induction period. Program data should still be accumulated for future use.

(2) For an established aircraft type with a new operator, the experience of other operators may be utilised until the new operator has accumulated a sufficient period of own experience. Alternatively, experience gained from operation of a similar aircraft model may be used.

(3) While setting alert levels for the latest aircraft designs, computed values based on the degree of system and component in-service expected reliability assumed in the design of the aircraft might also be used. These computed values are normally quoted in terms of Mean Time Between Unscheduled Removals (MTBUR) or Mean Time Between Failure (MTBF), for both individual components and complete systems. These initial predictions should be replaced when sufficient in-service experience has been accumulated.

4.7.5.5 There are several recognised methods of calculating alert levels, any one of which may be used provided that the method chosen is fully defined in the operator’s program documentation.

4.7.6 Re-calculation of alert levels

4.7.6.1 Both the method used for establishing an alert level, and the associated qualifying period, apply when the level is re-calculated to reflect current operating experience. However if, during the period between re-calculation of an alert level, a significant change in the reliability of an item is experienced which may be related to the introduction of a known action (e.g. modification, changes in maintenance or operating procedures) then the alert level applicable to the item should be re-assessed and revised on the data subsequent to the change.

4.7.6.2 Procedures for changes in alert levels must be outlined in the reliability program and the procedures, periods and conditions for re-calculation should also be defined.

4.7.7 Establishing standards using other analysis (non-alert type)

4.7.7.1 Data on the maintenance programme that are compiled on a day-to-day basis may be effectively used as a basis for continuous performance analysis. Mechanical interruption summaries, flight log reviews, engine monitoring reports, incident reports, and engine and component analysis reports are some examples of the types of information suitable for this monitoring method.

4.7.7.2 For this arrangement to be effective the quantity and range of information should be satisfactory in order to provide a basis for analysis equivalent to that of a statistical standards programme. The operator's organization should have the capability of evaluating the information and summarizing the data to arrive at a meaningful conclusion. Actuarial analysis should be periodically performed to ensure that current process classifications are correct.

4.8 Analysis and interpretation of information

4.8.1 The reliability program must provide for the regular analysis and interpretation of information generated by the program.

4.8.2 The method employed for analysing and interpreting the information must be explained in the program.

4.8.3 The methods used must:

(1) enable the performance of the items controlled by the program to be measured; and

(2) facilitate recognition, diagnosis and recording of significant problems.

4.8.4 The procedures for data analysis must be such as to enable the performance of the items controlled by the program to be measured. The whole process should be such as to enable a critical assessment to be made of the effectiveness of the program as a total activity. Such a process may involve:

(1) comparisons of operational reliability with established or allocated standards (in the initial period these could be obtained from in-service experience of similar equipment of aircraft types);

(2) Analysis and interpretation of trends

(3) The evaluation of repetitive defects

(4) Confidence testing of expected and achieved results

(5) Studies of life-bands and survival characteristics

(6) Reliability predictions

(7) Other methods of assessment.

4.8.5 The range and depth of engineering analysis and interpretation should be related to the type and scope of operations. The following should be taken into account:

(1) Flight defects and reductions in operational reliability;

(2) Defects occurring at line and main base ;

(3) Deterioration observed during routine maintenance;

(4) Workshop and overhaul facility findings ;

(5) Modification evaluations ;

(6) Sampling programs;

(7) The adequacy of maintenance equipment and technical publications;

(8) The effectiveness of maintenance procedures ;

(9) Staff training ;

(10) Service literature such as Service Bulletins, SIL, SL, technical instructions, etc.

4.8.6 Where the operator relies upon contracted maintenance and/or AMOs as an information input to the program, the arrangements for availability and continuity of such information should be established and details should be included

4.9 Investigation and corrective action

4.9.1 The program must provide for an active investigation and, if applicable, implementation of corrective action when a performance standard is exceeded.

4.9.2 If upper and lower limits are used to express performance standards, the follow up requirements for each limit must be fully described in the program.

4.9.3 The procedures for implementing corrective actions and for monitoring the effectiveness of the corrective actions must be described in the program.

4.9.4 The procedures must include provision of periodic feedback to the individual responsible for taking the corrective action until such time as performance has reached an acceptable level.

4.9.5 Corrective actions must correct any reduction in reliability revealed by the program and may take the form of 1 or more of the following:

(1) changes to maintenance, operational procedures or techniques;

(2) changes to maintenance program tasks, including escalation or de-escalation of tasks, addition, modification or deletion of tasks, which will require amendment of the scheduled maintenance periods or tasks in the AMP;

(3) Amendments to approved manuals (e.g. Maintenance Manuals, Crew Manual)

(4) special inspections for the fleet;

(5) initiation of modifications to aircraft and aeronautical products;

(6) changes to provisioning of spare parts for maintenance;

(7) changes to manpower and equipment planning for maintenance;

(8) training of maintenance personnel.

4.9.6 The procedures for effecting changes to the AMP must be described, and the associated documentation should include a planned completion date for each corrective action, where applicable.

4.9.7 Some of the above corrective actions may need the AACs approval before implementation.

4.9.8 If despite having a signal/alert for the need of corrective action generated by the maintenance reliability system, and the operator opts not to change the maintenance program or implement a correction, that decision should be justified objectively and documented.

4.10 Evaluation and review of the program

4.10.1 The reliability program must provide for continuous monitoring of the effectiveness of the program as a whole and identify each individual who is responsible for this monitoring.

4.10.2 The program must contain procedures for implementing changes to the program and identify the individual responsible for proposing and preparing the changes.
Note: There may be more than 1 responsible individual.

4.10.3 The reliability program must describe the procedures and individual responsibilities in respect of continuous monitoring of the effectiveness of the reliability program as a whole. The time periods and the procedures for both routine and non-routine reviews of maintenance control must also be detailed (e.g. progressive, monthly, quarterly, or annual reviews; or procedures following reliability alert levels being exceeded, etc.).

4.10.4 Although not exhaustive, the following list gives guidance on the criteria to be taken into account during the review.

(1) Utilisation (high/low/seasonal)

(2) Fleet commonality

(3) Alert level adjustment criteria

(4) Adequacy of data

(5) Reliability procedure audit

(6) Staff training

(7) Operational and maintenance procedures.

4.10.5 The program areas requiring AAC's approval may include changes to the program that involve:

(1) Any procedural and organisational changes concerning program administration

(2) Adding or deleting aircraft types

(3) Adding or deleting components/systems

(4) Procedures relating to performance standards

(5) Data collection system

(6) Data analysis methods and application to the total maintenance program

(7) Procedures for aircraft maintenance program amendment.

4.11 Display of information

4.11.1 The reliability program must provide for a format of display that allows easy identification of trends, events and when performance standards are exceeded.

4.11.2 The display may be in graphical or in a tabular format or a combination of both.

4.11.3 The rules governing any separation or discarding of information before incorporation into the display must be stated in the program.

4.11.4 The display of information must include provision for “nil returns” to aid the examination of the total information.

4.11.5 The displayed information should provide the operator and AAC with a clear indication of the aircraft fleet’s reliability. The rules governing any separation or discard of information prior to incorporation into these displays and reports should be stated.

4.11.6 The format, frequency of preparation and the distribution of displays and reports should be fully detailed in the program documentation.

4.11.7 Where “standards” or “alert levels” are included in the program, the displayed information should be oriented accordingly.

4.12 Reliability reports

4.12.1 When approving a reliability program AAC will require that the program includes procedures for providing reliability reports to AAC .

4.12.2 A reliability program, must also contain following information:

(1) The format and content of routine reports (A sample report would be preferred).

(2) The time scales for the production of reports together with their planned distribution list

(3) The format and content of reports supporting request for increases in periods between maintenance (escalation) and for amendments to the approved maintenance program (Again, a sample report would be preferred).

4.12.3 The periodicity for report submission would normally be on a monthly basis but other arrangements may be agreed or required. For a low use aircraft (eg some corporate aircraft) the report may be submitted on a yearly basis or as agreed with the AAC.

4.12.4 The report is required to be indicative of the fleet’s reliability and overall effectiveness of the aircraft’s maintenance program.

4.12.5 The sample reports must contain sufficient detailed information to enable the Authority to make its own evaluation where necessary.

4.12.6 Reliability reports typically display the following:

(1) Fleet reliability summary : This summary relates to all aircraft of the same type, and should contain the following information for the defined reporting period:

(a) Number of aircraft in fleet and Number of aircraft in service;

(b) Number of operating days (less maintenance checks)

(c) Total number of flying hours;

(d) Average daily utilisation per aircraft and average flight duration;

(e) Total number of cycles/landings;

(f) Total number delays/cancellations; and

(g) technical incidents.

(2) ***Dispatch reliability*** *(Aircraft technical delays/cancellations):* All technical delays more than 15 minutes and cancellation of flight(s), due to technical malfunction, are required to be reported. The report must include the delay/cancellation rate for the defined reporting period, the three-monthly moving average rate and, where appropriate, the alert level. The air operator should present the information for a minimum period of 12 consecutive months, but need not repeat the occurrences in descriptive form. This information should be presented in such a way as to show the trend over a 2 to 3 year period.

(3) ***In-flight diversions due to technical malfunction or failures (known or suspected).*** While all in- flight diversions due to technical malfunction or failures (known or suspected) should be reported through normal Service Difficulty Reporting (SDR); a summary of all in-flight technical diversions also needs to be reported upon. If the summary references the SDRs, then it need not repeat the occurrences in descriptive form.

(4) ***Engine unscheduled shut-down or propeller feathering.*** All In-Flight Shut Down (IFSD) and IFSD rates or propeller feathering in flight, if applicable, listed by type of engine and aircraft for the reporting period should be reported and presented in graphical form. If this information references the SDRs, then it need not repeat the occurrences in descriptive form. When dealing with small numbers of IFSD, IFSD rate, or propeller feathering in flight, this information should be presented in such a way as to show the trend over a 2 to 3 year period

(5) ***Incidents involving inability to control engine/obtain desired power***. All incidents involving inability to control/obtain engine desired power during the reporting period should be reported and presented in graphical form. If this information references the SDRs, then it need not repeat the occurrences in descriptive form. When dealing with small numbers of such incidences, this information should be presented in such a way as to show the trend over a 2 to 3 year period.

(6) ***Unscheduled engine removals due to technical failures.*** All unscheduled engine removals and rates due to technical failures, listed by type of engine and aircraft for the reporting period should be reported and presented in graphical form. If this information references the SDRs, then it need not repeat the occurrences in descriptive form. When dealing with small numbers of unscheduled engine removals, this information should be presented in such a way as to show the trend over a 2 to 3 year period.

(7) ***Component unscheduled removal.*** All unscheduled removal of maintenance significant components, by ATA chapter, during the defined reporting period should be reported and presented in graphical form. Some operators may monitor hundreds of components and it may not be feasible for them to graph all data. The format of component removal information should be such that:

(a) both unscheduled removals and confirmed failures rates should be compared with the alert levels; and

(b) current and past periods of operation should be compared.

(8) ***Operation of aircraft with multiple Minimum Equipment List (MEL) items invoked*** A periodic reliability report should include trend reporting of dispatch of aircraft with multiple MEL items invoked and shall present the information for a minimum period of 12 months. The report need not repeat the occurrences in descriptive form.

(9) ***Pilots Reports (PIREPS)***. Pilot Reports should be reported to the AAC by ATA chapters in graphical and/or tabular form as a count and rate for the defined reporting period, and comparison thereof with the alert level. For certain types of aircraft pilot reported defects are not a valid reliability indicator. In such situations, reporting of PIREPS will not be required.

(10) ***ETOPS/EDTO specific operations.*** In addition to non-ETOPS/EDTO reliability reporting requirements, the following information should be provided for ETOPS flights:

(a) number of ETOPS/EDTO flights during the defined reporting period

(b) aircraft/engine type/combination involved in the program, e.g. B767/CF6-80C2

(c) details of aircraft involved in the program during the reporting cycle

(d) Average fleet utilisation time and cycles during the reporting cycle

(e) ETOPS/EDTO critical component failures or malfunctions, by ATA chapter, and

(f) ETOPS/EDTO critical system failure reporting.

4.12.7 The reports must explain changes, which have been made or are planned in the aircraft's maintenance program, including changes in maintenance and task intervals and changes from one maintenance process to another. It should discuss continuing over-alert conditions carried forward from previous reports and should report the progress of corrective action programs.

4.12.8 The operator is required to make available all reliability reports during audits or when required by the AAC. The Reliability program should therefore specify the procedure for periodic distribution of the reports as well as for their storage at a safe place and retrieval, when required.

4.13 Pooling of data

4.13.1 In some cases, it may be desirable to "pool" data (i.e. collate data from a number of operators of the same type of aircraft) for adequate analysis. For the analysis to be valid, the aircraft concerned, mode of operation, and maintenance procedures applied must be substantially the same. Variations in utilisation between two operators may fundamentally corrupt the analysis. Although not exhaustive, the following list gives guidance on the primary factors, which need to be taken into account

4.13.2 For the analysis to be valid, the following things for the aircraft from which data is pooled must be substantially the same:

(1) certification factors, such as aircraft type certificate data sheet (TCDS) compliance (variant)/modification status, including SB compliance;

(2) operational factors, such as operational environment/utilisation, e.g. low/high/seasonal/respective fleet size operating rules applicable (e.g. EDTO/RVSM/All Weather operations etc.)/operating procedures/MEL and MEL utilisation

(3) maintenance factors, such as aircraft age, maintenance procedures; maintenance standards, applicable lubrication/servicing procedures, MPD revision or escalation applied or Aircraft maintenance program applicable

4.13.3 Although it may not be necessary for all of the foregoing to be completely common, it is necessary for a substantial amount of commonality to prevail. AAC makes its approval decisions on a case-by-case basis.

4.13.4 For a reliability program for a small fleet of aircraft, it is permitted to "pool" data, that is, to collate data from a number of operators of the same type of aircraft.

4.13.5 For this section, a small fleet of aircraft is a fleet of less than 6 aircraft of the same type.

4.13.6 In case of a short-term lease agreement (less than 6 month) AAC may grant more flexibility against the above criteria to allow the operator to operate the aircraft under the same program during the lease agreement.

4.13.7 The reliability related functions that may be delegated are:

(1) Developing the aircraft maintenance and reliability programs

(2) Performing the collection and analysis of the reliability data

(3) Providing reliability reports; and

(4) Proposing corrective actions to the operator.

4.13.8 Despite the above, the decision to implement a corrective action (or the decision to request from the AAC the approval to implement a corrective action) remains the operator's responsibility. If an operator decides not to implement a corrective action (proposed by a CV-CAR 6 Organisation) then that decision should be justified and documented.

4.13.9 The arrangement between the operator and the Approved Maintenance Organisation (AMO) and the types and extent of data to be pooled must be specified in the maintenance contract and the relevant Maintenance Control Manual and procedures manual of the AMO.

João dos Reis Monteiro
President of the Board