RA 5726 – Integrity Management

Rationale

The technical and organizational uncertainties associated with military aviation contribute to a complex range of Hazards that may compromise Air System Integrity. ►Failure to satisfactorily manage Air System Integrity may compromise Airworthiness, potentially increasing Risk to Life and reduced operational effectiveness.◄ A comprehensive, through-life, Integrity Management (IM) approach enables these potential Airworthiness threats to be managed. Whilst support from various stakeholders is needed for effective IM, the overall Responsibility is assigned to the Type Airworthiness Authority's (TAA)[1]. This Regulatory Article (RA) details these TAA IM Responsibilities and will be read in conjunction with the Manual of Air System Integrity Management (MASIM)[2].

Contents

Definitions

Definitions Relevant to this RA

1. **Integrity**. The ability of an Air System to retain its design intended properties and function throughout its Service Life when maintained and operated in accordance with (iaw) the Air System Document Set (ADS).

2. **Integrity Baseline**. The Artefacts that define the Design Organization's (DO) contribution to the ADS for an Integrity discipline. In a Claim-Argument-Evidence approach, the Integrity Baseline (the 'Claim') is underpinned by Integrity Assertions (the 'Argument') of the Integrity Evidence (the 'Evidence'). Integrity Baselines are established prior to entry of the Air System to service and are updated through-life.

3. **Integrity Assertions**. Declarations made in the Integrity Baseline that a feature of the design has Integrity. The Integrity Assertions within the Integrity Baseline (the 'Claim) are the outcome of an assessment (the 'Argument') of the Integrity Evidence (the 'Evidence').

4. **Integrity Evidence**. The design and Certification products that underpin the Integrity Assertions stated explicitly / implicitly in the Integrity Baseline. In the first instance Integrity Evidence is produced to support the Air System entering service and may be based upon design assumptions and / or service operating intent. When In-Service, the Integrity Evidence is continuously updated according to analysis of Service Data. It is captured in an Integrity Evidence record.

5. **Service Data**. The information relating to the usage, condition, failures or loads experienced by an Air System that, when collected and analysed, needs to be tested against the Integrity Evidence to support the Integrity Baseline.

6. **IM Systems**. The IM programmes, tools and processes, established by the TAA, that are necessary to assure the Integrity of the Air System. These Systems capture and assess Service Data to better understand the usage of the Air System, the failures of systems, and / or the loads that it experiences. Programmes are established to better understand the condition of the Air System.

[1] Where the Air System is not UK MOD-owned, Type Airworthiness (TAw) management regulatory Responsibility by either the TAA or Type Airworthiness Manager (TAM) needs to be agreed within the Sponsor's approved model; refer to RA 1162 – Air Safety Governance Arrangements for Civilian Operated (Development) and (In-Service) Air Systems, or refer to RA 1163 – Air Safety Governance Arrangements for Special Case Flying Air Systems. Dependant on the agreed delegation of TAw Responsibilities TAM may be read in place of TAA as appropriate throughout this RA.
[2] Refer to the Manual of Air System Integrity Management (MASIM).

Definitions

7. **Independent Airworthiness Advisor (IAA)**. An IAA is a Competent individual, independent of the DO, who provides independent Air System technical advice to the TAA[3]. To be considered a Suitably Qualified and Experienced Person (SQEP), they will be a Chartered Engineer and have a minimum of 5 years' experience in Air System design, Safety Assessment, IM or Maintenance; relevant to both the Air System type and the specialization for which advice will be given.

8. **Independent Structural Airworthiness Advisor (ISAA)**. An ISAA is a competent individual, independent of the DO, who acts as the specialist IAA►[4]◄ to the TAA regarding Aircraft Structures and Structural Integrity Management.

Regulation 5726(1)

Integrity Management

5726(1) The TAA **shall** be responsible for IM, for all Air System types within their Area of Responsibility, to maintain Integrity.

Acceptable Means of Compliance 5726(1)

Integrity Management

9. As a key enabler of the Air System Safety Case[5], the TAA **should** ensure an IM programme is in place prior to the Air System In-Service Date (ISD) and is maintained throughout the life of the Air System.

10. The Establish-Sustain-Validate-Recover-Exploit management framework **should** be used to confirm the Integrity Assertions to provide confidence in the Integrity Baseline and counter threats to Integrity identified by evolving Integrity Evidence.

11. The TAA **should** consider the most effective and efficient strategy for managing IM activities. As a minimum, consideration **should** be given to the need for separate activities for the three most commonly used Integrity disciplines (Structural, Systems and Propulsion), including Integrity Working Groups (IWG). The overall approach **should** be recorded in the Air System Integrity Strategy Document (AISD).

12. Where threats to Integrity are identified, they **should** be managed and continually reviewed in response to In-Service developments and Service Data.

13. All those with Responsibilities which impact on, or which contribute to Integrity **should** identify to the TAA at the earliest opportunity any decision, activity or change in circumstances that has the potential to pose a threat to Integrity.

14. Delivery Team (DT) personnel with specific Integrity Responsibilities **should** be identified by the TAA and attend the appropriate Integrity course[6].

15. IM for ►Uncrewed◄ Air Systems **should** be iaw the Remotely Piloted Air System Manual (RPASM)►◄.

Guidance Material 5726(1)

Integrity Management

16. For guidance on all aspects of IM, refer to the MASIM[2].

Regulation 5726(2)

Establishing Integrity Management

5726(2) The TAA **shall** establish IM to demonstrate that the Air System is airworthy to operate through all conditions detailed in the Release To Service (RTS), Military Permit To Fly (MPTF) (In-Service) or MPTF (Special Case Flying) and reflect the usage set out in the Statement of Operating Intent (SOI).

[3] The IAA is not to be confused with the Independent Technical Evaluator or Independent Safety Auditor.
[4] ►Refer to paragraph 7.◄
[5] Refer to RA 1205 – Air System Safety Cases.
[6] For further training details see RA 1440 – Air Safety Training.

Acceptable Means of Compliance 5726(2)

Establishing Integrity Management

Integrity Governance

17. The TAA **should** establish an IM Strategy that is:

a. Communicated to stakeholders through the AISD prior to Full Business Case Approval of the project.

b. Managed through an IM Plan (IMP) initiated prior to ISD.

c. Implemented through a 6-monthly IWG initiated prior to the ISD.

d. Implemented with defined boundaries and interfaces between various IM disciplines.

e. Implemented with defined mechanisms for reporting on the status of Integrity of the Air System within Defence Equipment & Support and to the Aviation Duty Holder (ADH) / Accountable Manager (Military Flying) (AM(MF)).

18. The AISD **should** be owned by the TAA and endorsed on first release and following any significant amendment.

19. The IWG **should** be chaired by the TAA or a holder of a delegated Letter of Airworthiness Authority (LoAA) that refers specifically to the role of IWG Chair, who is at least OF4 (or equivalent).

20. The IWG Chair **should** ensure that the IWG comprises a quorum of SQEP stakeholders (identified below), and additional stakeholders as necessary.

a. DO / Coordinating DO.

b. DT[7] member(s) responsible for IM.

c. Service provider / Support Contractor (if applicable).

d. Continuing Airworthiness Management Organization (CAMO) member responsible for IM.

e. Civil Aviation Authority for military registered Aircraft subject to civil oversight[8].

f. DT Safety Manager.

g. IAA(s) with the requisite SQEP[9].

h. RTS Authority or Sponsor representative.

i. ►◄

21. ►The MAA **should** be invited to the IWG although the MAA **should not** form part of the quorate SQEP stakeholders list.◄

Integrity Evidence and Baseline

22. The TAA **should** identify the Integrity Baseline, including the underpinning Integrity Evidence and Integrity Assertions.

23. The SOI (AP101X-XXXX-15S or equivalent) **should** be owned and authorized by the ADH or AM(MF) and **should** include requirements for all relevant disciplines, to be published in the ADS no later than the issue of the Type Certification Basis[10]. The TAA and ADH or AM(MF) **should** ensure that an SOI for all new Air System types and significant Marks, is developed in consultation with, and formally conveyed to, the Air System DO. In turn, the Air System DO **should** communicate this information to the Type Certified Product DOs (ie Propulsion System DO).

24. Where an Air System is operated, or intended to be operated, by multiple Operating Duty Holders (ODH) / AM(MF), the SOI **should** be owned and authorized

[7] Where the term DT or Commodity DT is used in this RA, this may include the TAM and organizations supporting the TAM where appropriate.
[8] Refer to RA 1165 – UK Civil Aviation Authority Oversight of UK Military Registered Aircraft.
[9] Recognizing the long-standing requirement for the ISAA role to support IM, an experienced ISAA may be regarded as SQEP in pan-discipline IM matters from a regulatory compliance perspective, but an IAA in the required field **should** address specific issues in disciplines other than structures where the TAA requires that SQEP.
[10] Refer to RA 5810 – Military Type Certificate (MRP Part 21 Subpart B).

Acceptable Means of Compliance 5726(2)

by the lead end-user ADH or AM(MF) and ►◄ encompass the full scope of activities to be conducted by all ODH / AM(MF).

25. The TAA **should**, in consultation with the DO, ensure that the design static and fatigue loads and Design Usage Spectrum (DUS), obtained during design substantiation and Certification of the Air System, is available as part of the Integrity Baseline. The DUS **should** include the intended usage and associated loads developed in the design of the Air System. Where the DUS has not been derived from a UK specific SOI, the TAA **should**, in consultation with the DO, use the SOI to identify the implications of any deviation between the design assumptions and expected In-Service usage.

26. The TAA **should** ensure that all critical or significant items[2], eg Structural Significant Items or Functionally Significant Items, have appropriate associated Maintenance activities derived by suitable methodology, in consultation with the DO, as part of the Integrity Baseline.

27. The TAA **should** authorize the component lives (Critical and Non-Critical) and, where applicable exchange rates identified by the DO, and promulgate these in AP101X-XXXX-5A1 or equivalent Maintenance schedule.

28. The TAA **should** ensure that Commodity DT Chief Engineers (DT CE) establish the lifing details and Continuing Airworthiness requirements of components for which they are responsible and present their Integrity Evidence and Integrity Assertions to the TAA for final Authorization.

IM Systems

29. The TAA, in consultation with the DO, **should** identify any IM Systems requirements necessary to assure the Integrity of the Air System.

30. The TAA **should** establish:

a. Health monitoring and usage monitoring systems and ensure that thresholds for acceptable capture rate of usage data are defined, to enable inspection and replacement of components to be scheduled with adequate confidence.

b. An Individual Aircraft Tracking (IAT) system to capture usage against sortie profiles throughout the life of the Air System, and a means to quantify unmonitored sorties.

c. An approach to validate the usage data In-Service usage[11] against the DUS through engagement with the DO during the design and introduction to service of the Air System.

d. In consultation with the DO, an exceedance monitoring system in order to capture events that may be a threat to the Integrity of the Air System.

e. An Air System Fault Reporting, Analysis and Corrective Action System.

f. A Configuration Status Record (CSR)[12] for the Air System.

31. The CSR **should** detail the Configuration of each Air System Type Design and its components in sufficient detail to maintain Configuration Control (CC) and to support Integrity decisions.

32. The TAA **should** ensure that IM programmes, or the capability to conduct them, are in place in order to understand the condition of the Air System In-Service. The nature of these programmes of activity are likely to be particular to an Integrity discipline.

33. The TAA **should** agree with the CAMO and DO stakeholder, access to, and the means of providing, Service Data from the Forward and Depth domains.

34. The TAA **should** define limits for investigation / urgent action on any data loss from monitoring systems and implement a process to monitor and react. Limits may differ depending on the complexity, reliability and criticality of the monitoring system.

[11] Usage including In-Service loads and engine usage.
[12] Refer to RA 5301 – Air System Configuration Management.

Acceptable Means of Compliance 5726(2)

35. The TAA **should** ensure that an Environmental Damage (ED) Prevention and Control (EDPC) programme, including measures to manage the Risk to Airworthiness arising from ED, is established in cooperation with the DO.

36. The TAA **should** ensure IM is supported by an Examination Programme (EP), established prior to the ISD, which **should** include:

a. Classification of significant items as either At Risk (AR) or Not at Risk (NAR) from Accidental Damage (AD) or ED.

b. Scheduled examinations based on this classification, and examination and retirement of components according to their fatigue clearances or component lives.

c. A Sampling Programme (SP), for components not normally inspected during scheduled examinations, which includes any requirements for teardown[13] to inform the Maintenance schedule.

d. An inspection of all critical or significant items, iaw the Preventive Maintenance and EP / SP programmes, before the fleet leader reaches 80% of its original design life (or revised life, if less).

37. The TAA or Commodity DT Leader (DTL) **should** ensure appropriate arrangements are in place for the SP with the DO. The DO **should**:

a. Notify the TAA or Commodity DT CE of the date, time and location scheduled for the tests and / or strip examination of SP materiel subject to fault action.

b. Submit a report to the TAA or Commodity DTL, covering the following points:

(1) The deterioration in performance and / or the degree of wear which has occurred.

(2) The recommended future Service Life for this type of item and whether further sampling is required.

(3) Those features of design which limit life extension and whether Modification action is feasible and economic.

38. The TAA **should** ensure, where appropriate, that experience and data from other operators of the same Air System type, or Air Systems in similar roles, is used to inform the IM of their Air System.

Guidance Material 5726(2)

Establishing Integrity Management

39. For guidance refer to the MASIM[2].

Regulation 5726(3)

Sustaining Integrity Management

5726(3) The TAA **shall** ensure that IM is sustained, and In-Service Data used, to continuously monitor and counter threats to Integrity.

Acceptable Means of Compliance 5726(3)

Sustaining Integrity Management

Integrity Governance

40. The TAA **should** review and monitor outputs from the IM Systems and report key issues to the IWG.

41. The AISD and the IMP **should** be reviewed by all stakeholders prior to every IWG and both ►◄ be ratified by the quorate members of the IWG.

[13] Refer to Military Aircraft Structures Airworthiness Advisory Group (MASAAG) Paper 105 Guidance and Best Practice for Teardown Inspections.

Acceptable Means of Compliance 5726(3)

42. The TAA **should** identify any unmitigated or unquantified Airworthiness Risks, associated with IM which have been accepted by the relevant IWG, and raise them to the Type Airworthiness Safety Panel[14] and / or the Air System Safety Working Group.

Integrity Evidence and Baseline

43. All changes to component lives, Maintenance thresholds or intervals **should** be:

a. Supported by a Risk Assessment.

b. Conveyed to the IWG and reviewed periodically.

c. Considered within the Type Airworthiness Safety Assessment.

d. Authorized by personnel with the appropriate delegated authority supported by independent assessment as required.

44. Stakeholders **should** report any significant changes in usage or operation to the IWG.

IM Systems

45. The TAA **should**:

a. Ensure that IM systems created in the Establishing phase are implemented correctly and periodically reviewed, with significant findings, including data loss, unmonitored sorties and CC issues, reported to the IWG.

b. Maintain IM systems in an effective condition in order to maximize the capture, use and monitoring of Service Data by the CAMO, the DT and the IWG, respectively.

c. Ensure that lost usage data is restored if possible; if not, a technical assessment of the loss **should** be carried out. The TAA / TAM **should** ensure that procedures, or appropriate fill-in rates for lost usage data, are in place and applied as required.

d. Ensure that the Air System Airworthiness Information[15] reflects the 'as flown' Configuration is maintained for the life of the Air System and is populated with all relevant arisings that have the potential to impact Integrity.

e. Ensure that any IM Programmes created in the Establishing phase are implemented correctly and periodically reviewed, and a summary of the results reported to each IWG.

Guidance Material 5726(3)

Sustaining Integrity Management

46. For guidance refer to the MASIM[2].

Regulation 5726(4)

Validating Integrity

5726(4) The TAA **shall** ensure that Integrity Evidence, Assertions and Baseline are periodically validated.

Acceptable Means of Compliance 5726(4)

Validating Integrity

Integrity Governance

47. The TAA **should** use the IWG to validate the Integrity Baseline against the most up to date Service Data and analysis available.

48. The TAA **should** ensure that the validity of the Integrity Baseline is confirmed on completion of the IWG.

Integrity Evidence, Assertions and Baseline

49. The Integrity Evidence and Baseline **should** be reviewed and updated, with the support of the DO, in response to findings occasioned by validating activities.

[14] The Type Airworthiness Safety Panel may have different naming conventions within different programmes.
[15] Refer to RA 1223 – Airworthiness Information Management.

Acceptable Means of Compliance 5726(4)

50. The TAA **should** ensure that cleared life is reviewed in response to changes to fleet planning assumptions.

51. The TAA **should** ensure that component lifing, recording processes and metrics, are periodically reviewed.

52. The TAA **should** ensure that the Maintenance schedule is reviewed[16] ►◄.

IM Systems

53. The TAA, with the assistance of the Military Continuing Airworthiness Manager and DO, **should** review and validate Maintenance processes.

54. The TAA **should** support the ADH or AM(MF) to ensure that the first usage data Validation (conversion of the SOI into an SOI and Usage (SOIU)), which forms the baseline for comparison against future Validation data, is undertaken once usage is considered to be stable or no later than 3 years after ISD. The ADH or AM(MF) **should** authorize the amendment to each issue of SOIU.

55. The TAA **should** support the ADH or AM(MF) review of the SOI / SOIU and make the results available to the IWG. These reviews **should** be undertaken by the ADH or AM(MF) as follows:

a. A basic annual review by the appropriate ADH or AM(MF), to confirm that the SOI or SOIU (as appropriate) remains an accurate record.

b. A detailed qualitative and quantitative triennial review is conducted using Aircrew interviews, data obtained via the Aircraft log, on-board Systems and / or instrumented flights to confirm future intent and validate usage against the DUS assumptions.

c. Establishing the implications to Air System integrity to anticipated changes in future usage intent.

d. The review confirms that the expected and validated usage is within the RTS, MPTF (In-Service) or MPTF (Special Case Flying) limits.

56. Following SOI / SOIU reviews:

a. The TAA **should** task DO support to determine the effect of any SOI / SOIU changes on the Integrity Baseline and their recommended operating limitations and Maintenance instructions.

b. The TAA **should** retain an Audit trail of all changes made to any of their TAw limitations, instructions or arrangements as a result of the SOI / SOIU review iaw current Regulations[17].

c. The ADH or AM(MF) **should** make Aircrew familiar with the changes that have been made to sortie profile codes within the SOI / SOIU and the need for both accurate recording and efficacy of reporting of any changes in usage.

57. The ADH or AM(MF) **should** ensure that the SOI / SOIU (AP101X-XXXX-15S or equivalent) is updated in the ADS.

58. The TAA **should** ensure that results from the EP (including scheduled examinations, and where necessary, the SP and teardown[13] and forensic examination) are collated, reviewed and subjected to trend analysis to inform Maintenance Schedule Reviews, update the IWG on the efficacy of the EP and permit the DO to update lifing predictions.

59. The TAA **should** verify the ability of a system or component to: retain its function within defined limits, function without undue frequency of failure and function without adverse effect on other Systems or components.

60. The TAA **should** ensure that where a Safety-critical system relies upon measurement of a parameter (such as temperature or pressure) this system **should** have an appropriate calibration policy and procedure defined in the ADS.

[16] Refer to RA 5320 – Air System Maintenance Schedule – Design and Validation.
[17] Refer to RA 1225 – Air Safety Documentation Audit Trail.

Acceptable Means of Compliance 5726(4)

61. A programme for Validation of the In-Service usage against the DUS demonstrated fatigue capability **should** be conducted through engagement with the DO. A system **should** be developed to:

a. Obtain operational loads and usage data that can be used for comparison with the DUS,

b. Identify In-Service usage changes that necessitate re-evaluation of the Integrity Baseline evidence,

c. Provide the data needed to establish or update fatigue clearances and support any Life Extension Programmes.

62. Each IAT system **should** obtain sufficient data to validate the DUS by means of a Structural Health Monitoring System, Health and Usage Monitoring System or similar system accepted by the DO. Where an IAT system does not deliver sufficient data, or requires its own Validation programme, then an Operational Loads Measurement / Operational Data Recording Programme **should** be conducted on a representative sample of In-Service Air Systems.

63. The TAA **should** ensure the timing of usage Validation programmes is being determined by its aims. The requirement to carry out the Validation **should** be reviewed at least every 6 years by the TAA (concurrently with a triennial SOIU review) with the decision and rationale supported by evidence and documented in the AISD.

64. The usage Validation programme **should** be considered following any Major Change in usage or rate of life consumption or in conjunction with any plans for a Major Type Design change, significant change in usage or life extension, ie where re-Validation of significant parameters is necessary, decisions on usage data Validation requirements **should** be documented in the AISD.

65. The TAA **should** initiate an Ageing Air System Audit[18].

Guidance Material 5726(4)

Validating Integrity

66. For guidance refer to the MASIM[2].

Regulation 5726(5)

Recovering Integrity

5726(5) The TAA **shall** ensure that any loss or potential compromise of Integrity is recovered.

Acceptable Means of Compliance 5726(5)

Recovering Integrity

Integrity Governance

67. The TAA **should** treat a loss or potential compromise of Integrity as an Airworthiness Issue and act to recover Integrity.

68. Any recommendations at an IWG to amend inspection intervals **should** be ratified by the LoAA holder prior to incorporation in the Maintenance schedule.

Integrity Evidence, Assertions and Baseline

69. The TAA **should** ensure that IM Systems are established and implemented where the Integrity Evidence and Assertions no longer supports the Integrity Baseline.

70. The TAA **should** ensure that the need for measures to conserve life is considered where life may be insufficient to reach the planned Out of Service Date.

71. The TAA **should** consider the need for design change, Reconditioning or component replacement to mitigate fatigue damage in order to meet fleet planning objectives.

72. The TAA **should** ensure that Repairs are:

a. Developed by an approved DO.

[18] Refer to RA 5723 – Ageing Air System Audit.

Acceptable Means of Compliance 5726(5)

b. Assessed against the appropriate Design Standard, with lifing and inspection requirements clearly established, and consideration given to the effect of adjacent and / or previous Repairs.

c. Recorded in the Air System Airworthiness Information[15].

73. Remedial action **should** be taken, and the IWG notified, if significant deviation in individual Air System weight and balance is identified by the CAMO.

Guidance Material 5726(5)

Recovering Integrity

74. For guidance refer to the MASIM[2].

Regulation 5726(6)

Exploiting Integrity

5726(6) The TAA **shall** ensure that Integrity is exploited to make best use of the inherent capabilities of the Air System.

Acceptable Means of Compliance 5726(6)

Exploiting Integrity

75. The TAA **should** ensure activities are put in place to record, report and, if required, act where the Service Data and analysis suggests there may be an opportunity to relax requirements within the Integrity Baseline without introducing new threats to Integrity.

76. Any recommendations at an IWG to relax requirements within the Integrity Baseline **should** be ratified by the LoAA holder prior to incorporation in the Maintenance schedule.

Guidance Material 5726(6)

Exploiting Integrity

77. For guidance refer to the MASIM[2].

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