Advisory Circular

U.S. Department of Transportation
Federal Aviation Administration

Subject: Operational Authorization of Integrated Aircraft Health Management Systems

Date: 7/8/22 **AC No:** 43-218
Initiated by: AFS-300 **Change:**

1 **PURPOSE OF THIS ADVISORY CIRCULAR (AC).** Aircraft health monitoring for maintenance uses onboard sensors, data transmission, and data analysis to provide information regarding aircraft system performance and structural condition. The result is then used to make aircraft airworthiness determinations that provide economic efficiencies while maintaining or enhancing operational safety. This end-to-end process is known as Integrated Aircraft Health Management (IAHM). This AC provides guidance for developing an operator's IAHM program. This AC describes an acceptable means, but not the only means, to comply with the applicable sections of Title 14 of the Code of Federal Regulations (14 CFR). However, if you use the means described in this AC to show compliance, you should follow it in all important respects. This guidance is not legally binding in its own right and will not be relied upon by the Federal Aviation Administration (FAA) as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with the guidance is voluntary only and nonconformity will not affect rights and obligations under existing statutes and regulations.

2 **AUDIENCE.** The audience for this AC is 14 CFR parts 91 subpart K (part 91K), 121, 125, and 135 aircraft operators and maintenance, repair, and overhaul (MRO) organizations.

3 **WHERE YOU CAN FIND THIS AC.** You can find this AC on the FAA's website at https://www.faa.gov/regulations_policies/advisory_circulars and the Dynamic Regulatory System (DRS) at https://drs.faa.gov.

4 **RELATED 14 CFR PARTS.** The following 14 CFR parts apply to this AC:

- Part 21, Certification Procedures for Products and Articles.
- Part 23, Airworthiness Standards: Normal Category Airplanes.
- Part 25, Airworthiness Standards: Transport Category Airplanes.
- Part 27, Airworthiness Standards: Normal Category Rotorcraft.
- Part 29, Airworthiness Standards: Transport Category Rotorcraft.
- Part 33, Airworthiness Standards: Aircraft Engines.
- Part 35, Airworthiness Standards: Propellers.

- Part 39, Airworthiness Directives.

- Part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration.

- Part 65, Certification: Airmen Other Than Flight Crewmembers.

- Part 91, General Operating and Flight Rules.

- Part 119, Certification: Air Carriers and Commercial Operators.

- Part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations.

- Part 125, Certification and Operations: Airplanes Having a Seating Capacity of 20 or More Passengers or a Maximum Payload Capacity of 6,000 Pounds or More; and Rules Governing Persons On Board Such Aircraft.

- Part 135, Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons On Board Such Aircraft.

- Part 145, Repair Stations.

5 DEFINITIONS.

5.1 Airworthiness Determination. For the purpose of this AC, an airworthiness determination is made by using a certified-for-credit IAHM system's data or an IAHM displayed status as a sole source to determine if an aircraft's root system is in a condition for safe operation.

5.2 Certified for Credit. Means to give design approval to an IAHM system that adds to, replaces, or intervenes in industry-accepted maintenance practices currently performed by parts 65, 121, 135, and 145 certificated entities. For the purpose of this AC, aircraft with an IAHM onboard system certified for credit will be referred to as an IAHM aircraft.

5.3 Root System. The aircraft system that will benefit from IAHM use. For example, aircraft landing gear system maintenance benefitting from the tire pressure information from IAHM with tire pressure as the root system.

6 RELATED READING MATERIAL (current editions):

- AC 20-174, Development of Civil Aircraft and Systems.

- AC 23.1309-1, System Safety Analysis and Assessment for Part 23 Airplanes.

- AC 25-19, Certification Maintenance Requirements.

- AC 25.1309-1, System Design and Analysis.

- AC 27-1, Certification of Normal Category Rotorcraft.

- AC 29-2, Certification of Transport Category Rotorcraft.

- AC 33.4-1, Instructions for Continued Airworthiness.

- AC 33.28-1, Compliance Criteria for 14 CFR § 33.28, Aircraft Engines, Electrical and Electronic Engine Control Systems.

- AC [43-9](), Maintenance Records.

- AC [119-1](), Operational Authorization of Aircraft Network Security Program (ANSP).

- AC [120-16](), Air Carrier Maintenance Programs.

- AC [120-17](), Reliability Program Methods—Standards for Determining Time Limitations.

- AC [120-77](), Maintenance and Alteration Data.

- AC [120-78](), Electronic Signatures, Electronic Recordkeeping, and Electronic Manuals.

- AC [120-79](), Developing and Implementing an Air Carrier Continuing Analysis and Surveillance System.

- AC [121-22](), Maintenance Review Boards, Maintenance Type Boards, and OEM/TCH Recommended Maintenance Procedures.

- SAE Aerospace Recommended Practice (ARP) 5987, A Process for Utilizing Aerospace Propulsion Health Management Systems for Maintenance Credit.

- SAE ARP 6803, IVHM Concepts, Technology and Implementation Overview.

Note: SAE publications are available online at https://www.sae.org/.

- Final Report [DOT/FAA/AR-06/2](), Flight-Critical Data Integrity Assurance for Ground-Based COTS Components.

- FAA Policy Statement [PS-AIR-21.16-02 Rev. 2](), Establishment of Special Conditions for Aircraft Systems Information Security Protection.

- FAA Policy Statement [PS-AIR-33.70-02](), Guidance for Usage Based Lifing of Life-Limited Parts, § [33.70]().

7 **BACKGROUND.** Early adaptation of health monitoring in aircraft maintenance is commonly known as:

- Aircraft Health Monitoring (AHM),

- Aircraft Condition Monitoring System (ACMS),

- Rotorcraft Health and Usage Monitoring System (HUMS),

- Structural Health Monitoring (SHM),

- Engine Condition Monitoring (ECM), and

- Engine Health Monitoring (EHM).

7.1 Due to similarity of the early systems, IAHM is a concept that covers all previous programs but is not intended to mandate a name change in cases where the terminology is proprietary or has commercial value.

7.2 Previous programs, while providing useful information, often lacked design and operational implementation standards. This AC provides guidance for operational authorization, while the Aircraft Certification Service (AIR) specifies aircraft design standards. Design approval and operational authorization is required in cases where IAHM use is intended as the single source of information for making airworthiness determinations and adjusting maintenance or inspection program's interval or scope. This is considered IAHM for maintenance credit.

8 IAHM CONCEPT. Comprehensive IAHM is an end-to-end concept that encompasses aircraft systems, data transmission, and data analysis/implementation, often on ground-based equipment.

8.1 Aircraft Systems. As with any aircraft system, the design approval holder (DAH) should provide an analysis of the IAHM system and the intended purpose during certification for credit. Criticality classification of the root system based on the system functional failure is the first consideration during the certification process. Root system criticality is also considered in every phase throughout the operator's end-to-end application of IAHM.

Note: If IAHM is fulfilling a regulatory requirement such as ECM under part 121, § 121.374(j), airworthiness limitation (AL) from the Airworthiness Limitation Section (ALS), Certification Maintenance Requirement (CMR), Airworthiness Directive (AD), or Configuration, Maintenance, and Procedures (CMP), the related system functional failure criticality defaults to "Critical."

8.2 Data Transmission. After the DAH establishes root system criticalities, it should determine data transmission minimum standards such as sampling rates and data transmission frequencies to be used. Allowable interruptions in communication and procedures for missing information are also considered by the DAH during initial certification. Systems classified as critical may require additional data security during transmission.

8.3 Data Analysis and Implementation. Various entities, including DAHs, operators, and third parties, can perform data analysis from the IAHM system. The DAH should establish data analysis minimum standards based on root system criticality and intended use of the data. These standards should include data security during transmission, analysis, and storage. The DAH should provide the means for the operator to decrypt, decode, and otherwise receive in an interpretable format, and in engineering units, all measured data generated on board the aircraft, paying special attention to any and all such data used in an IAHM application. In cases where operator-generated data is used to revise DAH source documents such as a Maintenance Review Board Report (MRBR), data should eventually be available to the DAH.

8.4 Ground-Based Equipment. For purposes of this AC, ground-based equipment is equipment and infrastructure that is typically used to process and display data collected during aircraft operation. The ultimate use of the processed data is to make decisions pertaining to some intervention action or provide data to other processing means to make the intervention action determination. Since the ground-based equipment is an important part of the process for determination of intervention actions, its integrity and accuracy

requirements should be equivalent to other parts of the IAHM process. In some cases, the ground-based system is provided by the DAH. However, the majority of ground-based systems are comprised of commercial off-the-shelf (COTS) devices that may be required to conform to a minimum performance standard specified by the IAHM DAH when intended for maintenance credit. Ground-based systems are not part of the aircraft minimum equipment list (MEL) process but should be considered for missing or latent data.

9   **OPERATOR'S IAHM PROGRAM.** An operator's IAHM program that is intended to take credit for maintenance should follow the DAH documents created during certification of the IAHM system. In addition to following the applicable instructions in the DAH documents, each operator should develop procedures for:

- Gaining authorization for the use of IAHM.

- Training for personnel involved in the IAHM program.

- Inducting an IAHM-capable aircraft into its fleet.

- Using MEL procedures for missing IAHM parameters.

- Data transmission compliant with the DAH recommendations.

- Data security and retention relevant to the root system criticality.

- Use of IAHM in approval of maintenance or inspection program adjustments.

Note: IAHM will not be used as a substitute for the performance of a Required Inspection Item (RII).

9.1   **Operator IAHM Program Authorization.** In accordance with part 119, § 119.49(a), an operator's IAHM program is accepted by its FAA oversight office and authorized by issuance of operations specifications (OpSpecs) or management specifications (MSpecs). The program may be in a standalone IAHM document or a section of a General Maintenance Manual (GMM) or General Procedures Manual (GPM).

9.1.1 The operator's manual should specify the aircraft fleet and DAH source document citing the aircraft's IAHM system certification. This can be found in a DAH Service Bulletin (SB), Service Letter (SL), or by a Type Certificate Data Sheet (TCDS) reference. In cases where IAHM capability is obtained on an aircraft after initial type certification, the system certification statement will be made in the Supplemental Type Certificate (STC) or original DAH documents.

9.1.2 A listing of the root systems monitored by the IAHM program for each aircraft type is necessary to determine the scope of the operator's program. Operators may choose to manage the IAHM program aligned with aircraft fleet types, by ATA chapter, or by specific components.

9.1.3 In order to gain authorization under OpSpec/MSpec D302, Integrated Aircraft Health Management Program, it is essential that the intended use of IAHM data be specified in

the operator's maintenance or inspection program. This is due to the various levels of data availability and operator implementation. There may be cases where an operator will pursue IAHM credit beyond established maintenance or inspection program intervals and make airworthiness determinations using IAHM as the single source of information.

9.2 **IAHM Training.** An effective IAHM program relies on properly trained personnel. It is recommended that operators will have a dedicated staff assigned to the IAHM program. As operators gain experience, they will have the ability to enhance basic DAH recommendations and take advantage of information availability to reduce delays, cancellations, and unscheduled events. This level of safety and cost benefit can be obtained by a trained and experienced IAHM staff.

9.2.1 In cases where airworthiness determinations are made using IAHM data, appropriate part 65 certification is required for the individual responsible for making the determination. Certification may be in the form of an Airframe and Powerplant (A&P) certificate or, for parts 121, 135 (10 or more passengers), and 145 certificate holders (CH), a Repairman Certificate. Examples of using IAHM to make airworthiness determinations are:

1. Verifying system functions instead of gaining component access and testing for troubleshooting, and

2. Performing a dispatch deviation guide (DDG) procedure for MEL relief.

9.2.2 Individuals responsible for parts 121 and 135 maintenance or inspection program adjustments may not require part 65 certification since these actions are conducted under the operator's certificate. However, pursuant to part 91, § 91.1111, part 121, § 121.375 and part 135, § 135.439, training for these individuals is still required for an IAHM program.

Note: An example of a program escalation is using IAHM data to escalate or de-escalate a scheduled task based on the aircraft's MRBR that recognizes IAHM alternatives following the guidance contained in AC 120-17.

9.3 **IAHM Aircraft.** An operator should have a procedure to induct an IAHM aircraft into its maintenance or inspection program. There should also be a procedure for an operator to obtain IAHM aircraft from another operator; this procedure may require a bridging program. A more complex procedure may be necessary when an IAHM aircraft is obtained from an operator without an existing IAHM authorization. Special considerations should be given to the transfer of IAHM data and electronic records required to meet regulatory requirements.

9.4 **MEL.** IAHM interaction with the MEL process is twofold. The first consideration is how a fully functioning IAHM can be used in an MEL deferral of another aircraft system. For IAHM use in MEL deferrals, see paragraph 10.6.3. The second consideration is how the partial or total loss of the aircraft IAHM system should be included in the host aircraft's Master Minimum Equipment List (MMEL). Ground-based systems defined in paragraph 8.4 are not included in the MEL process. Any loss of ground-based

functionality should be handled by the procedures found in paragraphs 9.4.2–9.4.5 and 10.2.7.

9.4.1 For aircraft initially certified with an IAHM system for credit or in cases where an aircraft is modified after initial type certification by a DAH SB or SL, the DAH will apply for MMEL relief through the standard Flight Operations Evaluation Board (FOEB) process. When the system installation is by an STC, the STC applicant or owner may submit for relief through the FOEB for an STC Relief Approval Letter. It is highly recommended that applicants apply for relief early on in the certification process, so that relief can be available upon certification.

9.4.2 Any loss of IAHM data should be identified at the earliest opportunity. This may be accomplished by an automated process alert or by a trained and authorized IAHM technician. The operator's MEL program should interface with the IAHM program to account for data loss.

9.4.3 Missing data should be considered when using IAHM to make airworthiness determinations or for credit in a maintenance or inspection program. It may be necessary to fall back to manual technician intervention to perform a classic, non-IAHM maintenance task.

9.4.4 The loss of data may have a bearing on fleetwide maintenance or inspection programs based on aggregate information used for program management and task escalations. The operator should have a procedure to account for gaps in data based on DAH allowable levels for missing information.

9.4.5 In cases where data transmission is automated, it may be allowable for a system to fill gaps during instances of data transmission lapses if that system holds data in suspense on board the aircraft.

9.5 **Data Transmission.** The DAH's recommended data transmission method should be based on root system criticality. The operator should demonstrate that the system meets the DAH recommendations based on sampling rates, data speed, and reliability.

9.6 **Data Security.** Secure transmission, storage, and analysis of IAHM data is essential in maintaining program integrity. Programs that rely on uninterrupted information may be rendered ineffective or questionable if the data is altered or deleted. It is expected that IAHM data used for airworthiness determinations are protected and retained in a manner similar to how electronic aircraft maintenance records are protected.

9.6.1 It is recommended that a detailed review of the aircraft's certification basis be used to determine if the aircraft currently has a special condition (SC) related to electronic system security for internal and external connectivity. An aircraft with these types of SCs may require additional security measures and authorizations.

9.6.2 Aircraft modified post-delivery with an IAHM system may also be subject to electronic security SCs. In both cases, an operator may be required to create an Aircraft Network Security Program (ANSP) (refer to AC 119-1).

9.7   **Maintenance or Inspection Programs.** In accordance with OpSpec/MSpec D302, the use of IAHM for airworthiness determinations or maintenance or inspection program adjustments requires FAA acceptance and authorization. If operators use IAHM for self-induced tasks that have no influence on airworthiness, FAA authorization is not required. Self-induced tasks may include items that are unique to an operator or environment, or limited to a specific operation.

9.7.1   The FAA grants maintenance or inspection program IAHM authorization through OpSpec/MSpec D302, in accordance with paragraph 10 of this AC.

9.7.2   For purposes of this AC, an alert level is a predetermined value representing system degradation established during initial aircraft or system certification. It is common practice for operators to adjust alert levels to identify a trend or wear before it becomes a valid fault. For example, an operator may elect to remove a landing gear brake assembly at 5 percent wear remaining instead of a DAH alert level of 2 percent to avoid additional repair costs.

9.7.3   Procedures for documentation of maintenance actions may require revision since an IAHM alert level exceedance may not be evident to maintenance technicians. In other cases, an IAHM alert level may not be exceeded, but intervention is needed to prevent an in-service interruption. In this case, an actual discrepancy is not present until corrective action is initiated.

9.7.4   Established alert levels or performance parameters produced by IAHM systems that serve as the basis of an approved maintenance or inspection program may be escalated in accordance with AC 120-17. In accordance with OpSpec/MSpec D302 and AC 120-17, such escalations are allowed only for IAHM systems that are certified for credit.

10   **IAHM PROGRAM AUTHORIZATION.** An operator's program is authorized by the FAA issuing OpSpec/MSpec D302. In accordance with OpSpec/MSpec D302, an operator will notify its regulatory oversight office of its intent to use IAHM for credit no less than 90 days prior to intended use. This advanced notice will give the oversight office sufficient time to consult with the responsible AIR office, the relevant Aircraft Evaluation Group (AEG), and the Aircraft Maintenance Division for additional guidance, if needed. Additionally, in order for an operator to maintain OpSpec/MSpec D302, the operator's submission must address all sections of the DAH source documents and the aspects of paragraphs 10.1–10.7 below. Paragraphs 10.1–10.7 are preconditions to IAHM authorization contained in OpSpec/MSpec D302.

10.1   **Fleet Identification.** The operator must identify the specific fleet on which it intends to implement IAHM in accordance with § 135.23(c).

10.1.1   The cited fleet must be identified by the DAH document as having FAA approval of the IAHM system. This may be in the form of a TCDS note, SB, SL, or STC.

10.1.2   The operator will disclose its intent to use all or partial IAHM capabilities per fleet. Partial application may be the result of limited resources or aircraft configuration options.

10.1.3   There must be a change impact analysis procedure for changes to the operator's IAHM fleet that may affect their existing authorization or approved certified for credit configured aircraft.

  10.2   **Supporting Documentation.** The operator's submission should include the following information from the DAH in support of a certified-for-credit IAHM system. Paragraphs 10.2.1–10.2.7 identify the information that should be obtained from the DAH and included in the operator's submission.

10.2.1   The intended function and end use of the data obtained by IAHM.

10.2.2   Data transmission performance standards such as transfer speed, sampling rates, and allowable latency.

10.2.3   Data security during transmission and storage.

10.2.4   Data and analysis methods and minimum performance standards for end-user computer systems, to include accuracy and integrity of ground-based systems.

10.2.5   Instructions for continued airworthiness (ICA) for the aircraft IAHM systems.

10.2.6   MEL relief for total or partial IAHM system failure on the aircraft.

10.2.7   Method(s) to account for missing data.

  10.3   **Operator Organization.** The operator must identify the part of its organization that will be responsible for executing the IAHM program in accordance with §§ 91.1413, 121.365, and 135.413.

10.3.1   It may be advantageous for an operator to contract its IAHM program to the DAH or another entity. However, the operator is still ultimately responsible for the program due to the impact on airworthiness pursuant to §§ 91.1413, 121.363, and 135.413.

10.3.2   The operator should explain the method of alert notification within its organization. This includes:

1. Alert level exceedance of an individual aircraft, and

2. Alerting if part of the end-to-end process is missing.

10.3.3   IAHM should interface with an operator's Continuing Analysis Surveillance System (CASS) for operators required to comply with § 91.1431, § 121.373, or § 135.431.

10.3.4   Operators that are not required to have a CASS should provide a means acceptable to the FAA for reporting failures or malfunctions to the DAH and FAA where:

1. An IAHM system did not detect a fault it was certified to identify that was confirmed by maintenance actions; or

2. An IAHM system detected a fault that was not confirmed by testing in a shop.

10.3.5 Configuration control of parts should be considered where an operator may have a mixed IAHM and non-IAHM fleet. This is especially important when parts are exchangeable between fleets. It may be necessary to create a tracking system or segregation procedure to maintain the integrity of an IAHM program. IAHM parts may have additional information that would accompany the component through the repair cycle.

10.4 **Data Retention.** The method for data retention, including security safeguards, must be specified and reflected in the operator's OpSpec/MSpec A025, Electronic Signatures, Electronic Recordkeeping Systems, and Electronic Manual Systems, in accordance with §§ 91.1113, 121.380, and 135.439. Special attention should be given to ensure maintenance records comply with part 43, § 43.9; part 121, § 121.709(a); part 125, § 125.411(a); and part 135, § 135.443(a).

10.4.1 IAHM data used for airworthiness determinations must be available for inspection by the Administrator or any representative of the National Transportation Safety Board (NTSB) to comply with §§ 91.1439(c), 121.380(d), and 135.439(c).

10.4.2 In the event of an accident or incident, the operator should have a procedure to safeguard IAHM data to prevent manipulation or loss of information that could be essential to an investigation.

10.5 **Training.** A comprehensive training program must include the end-to-end process and all personnel involved in the IAHM program in accordance with §§ 91.1111, 121.375, and 135.433.

10.5.1 Personnel should be knowledgeable in the following areas:

- Eligible fleets. This is critical in instances where operators have mixed IAHM and non-IAHM aircraft.

- Personnel should know when IAHM is used for credit and when it is being utilized for non-credit purposes.

- Use of IAHM for MEL Maintenance (M) procedures.

- MEL relief for an inoperative IAHM system.

- Recognition and responses to IAHM alert level exceedances.

- Aircraft record documentation requirements unique to IAHM.

- Mitigating actions in cases where IAHM data is missing due to aircraft or ground system issues.

- Configuration control of parts that may be exchanged between IAHM and non-IAHM fleets.

10.5.2 The operator's IAHM personnel should include, but are not limited to:

- Program administrator,

- Maintenance control personnel,

- Maintenance or inspection program personnel,

- Engineering department,

- Aircraft maintenance technicians,

- Aircraft inspectors, and

- Data analysis personnel.

10.5.3 IAHM training should identify the DAH documents and relevant operator manuals during the initial and recurring training. The training program should be revised when there are significant technology changes or CASS findings.

   10.6 **Airworthiness Determinations.** In cases where IAHM will be used to determine airworthiness, the operator should develop detailed procedures as presented in this AC.

10.6.1 In accordance with OpSpec/MSpec D302, the GMM or equivalent must recognize the use of IAHM for airworthiness determinations.

10.6.2 The GMM should allow the use of an IAHM alert level to trigger a maintenance action.

10.6.3 The DAH may provide for the use of IAHM for MEL deferral M action in a DDG or an Aircraft Maintenance Manual (AMM).

10.6.4 There may be cases where an IAHM alert level is adjusted by the operator and is more restrictive than the DAH alert. This may be common when an operator does not want to incur additional overhaul/restorative costs. An economic alert level is not necessarily a fault until corrective action is initiated.
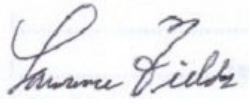
10.6.5 In accordance with OpSpec/MSpec D302, the use of IAHM to conduct approval for return-to-service tests must be part of the DAH's aircraft ICA.

   10.7 **Maintenance or Inspection Program.** The GMM or equivalent should specify how an operator uses IAHM to affect its maintenance or inspection program.

10.7.1 In accordance with OpSpec/MSpec D302, an IAHM system that is certified for maintenance credit is an acceptable data input to an operator's approved reliability program.

10.7.2 IAHM data related to DAH maintenance schedules, such as an MRBR, should be shared with the DAH to assist with global maintenance or inspection program adjustments.

11 AC FEEDBACK FORM. For your convenience, the AC Feedback Form is the last page of this AC. Note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this AC on the Feedback Form.

Lawrence Fields
Acting Executive Director, Flight Standards Service

Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Standards Directives Management Officer at 9-AWA-AFB-120-Directives@faa.gov.

Subject: AC 43-218, Operational Authorization of Integrated Aircraft Health Management Systems

Date: _____

Please check all appropriate line items:

An error (procedural or typographical) has been noted in paragraph _____ on page _____.

Recommend paragraph _____ on page _____ be changed as follows:

_____

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In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

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_____

Other comments:

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_____

I would like to discuss the above. Please contact me.

Submitted by: _____   Date: _____