



# EASA

European Aviation Safety Agency

# AIRCRAFT HEALTH MONITORING (AHM)

Ralf Schneider, EASA MRB Expert

2017 EASA MRB WORKSHOP  
Cologne, 4-6 April 2017

**Your safety is our mission.**

An agency of the European Union





# Aircraft Health Monitoring

- AHM Working group established by MPIG
  - Supported by major airframe manufacturers
    - Airbus (civil/military), Boeing, Bombardier, Embraer
  - Supported by EASA, FAA and TCCA
  - Supported by IATA, A4A and Aeronova
  - Supported by several operators
    - American, Air Canada, KLM, FedEx, Turkish Airlines
- Scope well defined in a „Tasking Statement“ document



# Aircraft Health Monitoring

- Goal of the AHM working group
  - Prepare a CIP for the 2018 IMRBPB
  - CIP to propose changes to MSG-3 2018 and IMPS Rev. 1 to allow use of AHM
  - Wording and concept to be harmonized with the MSG-3 philosophy and existing regulation and requirements to facilitate approval of operators maintenance programs which make use of AHM



# Aircraft Health Monitoring

## ➤ More Details...

- Use of AHM data for interval escalation is explicitly not envisaged
- Working group shall identify criteria and aspects which need to be considered to enable use of AHM
  - Qualification/Certification of equipment used
  - Qualification of Personnel analysing data
  - Means and minimum frequency by/at which data is assessed
  - Means of data transfer (continuous, scheduled downloads...)
  - Actions to be taken should AHM fail
  - Clearly specifying the equipment/features needed (on board, on ground) e.g. by mod number, option number, part number etc.



# Aircraft Health Monitoring

- AHM should be optional
  - Individual operators may not see the cost benefit to invest in the necessary equipment (on board and on ground) or pay for the service
  - Operators may not want to run a mixed fleet with only some aircraft having AHM capability
  - AHM may fail, data may be lost
- Alternative scheduled MRBR task to be provided
  - e.g. in an MRBR appendix
  - Still to be clarified what is „standard“ and what is „alternative“, what is „minimum“, what is „optional“



# Aircraft Health Monitoring

## ➤ Timeframe / Activities

- MPIG AHM WG kicked off in December 2016
- CIP candidate to be available for MPIG meeting 2017
- 2 face to face meetings
  - Hosted by IATA in Montreal
- 6 WebEx meetings so far  
held regularly now every 2-3 weeks
- Regular update of MPIG and IMRBPB (Cologne Meeting)
- Currently identifying required/most appropriate changes to MSG-3



# Aircraft Health Monitoring

- Term, acronym and definition still not fixed
  - SAE and others are working on similar issues
  - AHM, Aircraft Health *Monitoring* or *Management*?
  - Different term for the AHM (the Philosophy) and the AHMS (the System)?
  - IVHM, Integrated Vehicle Health Management ?



# Aircraft Health Monitoring

## ➤ HUMS (Health & Usage Monitoring System)

Used for rotorcraft, proposed for MSG-3 Volume 2 inclusion

### ➤ There are some parallels, but also some differences to AHM:

#### ➤ Try to harmonize where possible

- Identical wording as for MSG-3 Volume 2 may be used

- Learn lessons from IMRBPB reaction/comments to “HUMS for Credit” CIP raised by RMPIG in 2017

#### ➤ HUMS also affects items (e.g. gearboxes) with certified limitations, AHM *only* affects scheduled maintenance ICA

- No formal “credit” from certification required ?

- Less stringent software requirements (DAL) ?

#### ➤ AHM mainly makes use of already existing aircraft system sensors/parameters/data (e.g. used for cockpit indications), HUMS uses special additional sensors (e.g. for bearing vibrations)





# Aircraft Health Monitoring

## ➤ Engine Trend Monitoring

## Engine Condition Monitoring

Already in use today

### ➤ There are lessons to be learned for AHM:

#### ➤ Operators use it already for their reliability programmes

- Obviously in line with regulations and approved by NAAs
- Philosophy obviously accepted
- Equipment (on board/ground) obviously certified / approved
- Software levels obviously acceptable
- Personnel obviously qualified

### ➤ There are also clear restrictions existing

- Explicitly excluded for MSG-3 use
- Not used to relax airworthiness limitations



# Aircraft Health Monitoring

- Basically 3 different approaches identified
  - Tasks may be more adequately scheduled making use of AHM Data
    - e.g. use of optimised usage parameters, e.g. power corrected engine hours (already in use today for helicopter gearboxes, “Power Usage Hours”)
    - e.g. scheduling SVC task by fluid level, not by APU hours
  - Scheduled Tasks may make use of AHM Data
    - e.g. Functional checks without using special equipment for measurement, just read out existing data / sensors
    - Better data may allow for higher intervals, as the P to F interval increases with the lower detectability threshold
  - Scheduled Tasks may be fully replaced by AHM
    - e.g. no more check required, as AHM will alert the operator if failure will happen in the near future



# Aircraft Health Monitoring

- Some examples for possible AHM candidate tasks were presented by Boeing, Airbus, Bombardier and Embraer
  - All Examples made use of already existing data
    - e.g. fluid levels, pressures, temperatures
    - already on board and certified
    - typically also indicated in cockpit
      - “If it is good for the pilot, it should be good for the mechanic”
- The new features of the system therefore just affect storage, transmission, processing and analysis of the data to give maintenance relevant information



# Aircraft Health Monitoring

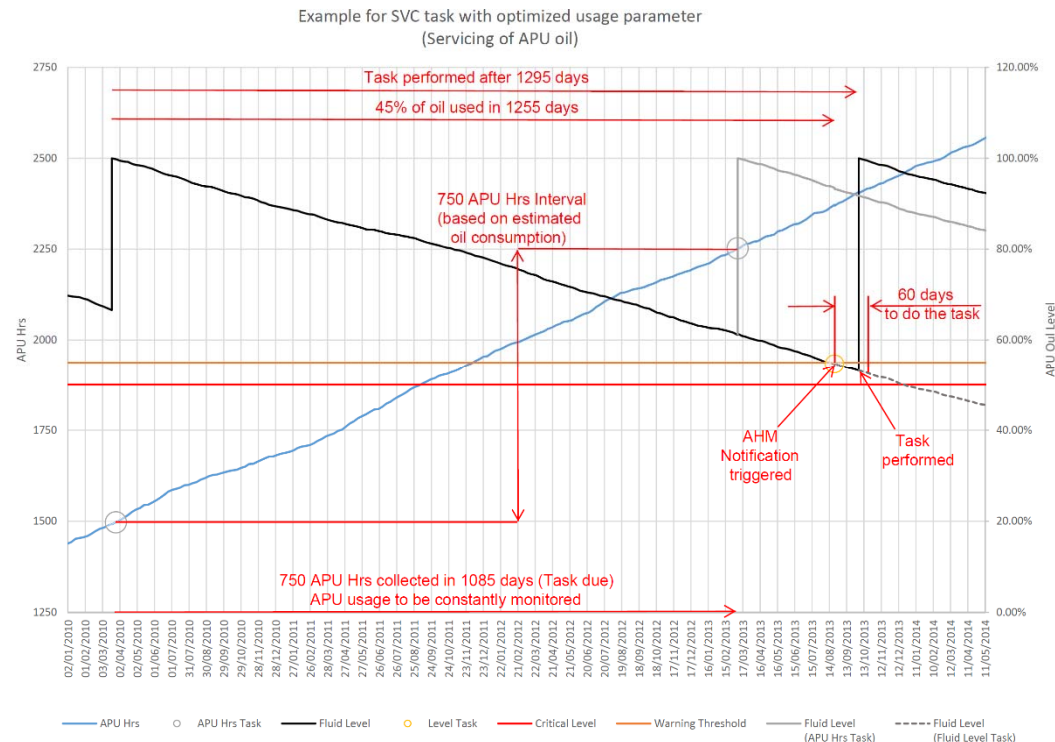
- Example for an AHM scheduled task, Servicing of APU Oil
  - Conventional task is scheduled in APU Hrs, based on an estimated oil consumption
  - Alternative task is monitoring oil level and triggers task with a selected margin
  - If oil consumption was estimated conservatively, the AHM based task has an economic (and environmental) benefit
  - If oil consumption was underestimated, the AHM based task has a safety benefit

## ➤ Conventionally scheduled task

- Critical oil level known
- Average oil consumption estimated
- APU hours need to be (reliably) recorded
- APU hours need to be monitored
- Task is due when APU reaches hours

## ➤ Improve task using AHM

- Critical oil level known, AHM threshold selected
- Oil level is measured, indicated in cockpit, recorded and transmitted to the operator
- Oil level needs to be monitored (manually or by computer tools)
- If oil level reaches threshold, a warning is triggered (with a margin to the critical level)
- Task is due within the next 60 days





# Aircraft Health Monitoring

- The operators are not interested in a system, which tells them that their aircraft does **now** require maintenance and is grounded
  - Want to have a notification, that the aircraft requires some action within a reasonable timeframe which allows for maintenance preparation.
    - e.g. a filter requires replacement within the next 200 hours
    - mainly applies to SVC, RST and DIS tasks
- The good aspect of this is, that the task in this case still is *scheduled* maintenance, so no major conflict with existing MSG-3 / regulations / approvals



# Aircraft Health Monitoring

- Some Aspects/Ideas of MSG-3 updates
  - Basic Philosophy, basic system analysis to remain
  - Scope to be ammended
  - Leave specific details to be clarified on PPH level
  - Specific AHM System Items to be included in the MSI selection, specific AHM maintenance functions to be identified (if applicable)
  - System Description to include all AHM features
  - No change to the evident/hidden asspect (level 1 analysis)
  - Main consideration of AHM application at functional failure level during level 2 analysis
  - Tracking of alternative AHM use similar to Zonal? („AHM candidates“, List of precluded tasks)



# Aircraft Health Monitoring

- Different philosophy for different task types
  - LUB/SVC, RST, DSC can obviously not be replaced by AHM
    - May be triggered as unscheduled tasks by AHM
    - May be scheduled using optimized usage parameters
  - GVI, VCK can very obviously not be replaced by AHM
    - they are visual by definition, involving an inspector/mechanic
    - May be scheduled using optimized usage parameters
  - FNC, OPC can maybe be fully replaced by monitoring the system or certain parameters (continuously/downloaded/transmitted)
  - FNC, SDI may make use of built in sensors / stored parameters instead of using dedicated equipment
  - AHM may be applicable and more effective than discrete inspections/checks  
(even where no task was found effective before)



# Aircraft Health Monitoring

## ➤ Issues / Risks

- Defining alternative tasks (Conventional / AHM) counteracts the idea of developing the “minimum” required maintenance or the most effective task
- Certification/Qualification of equipment  
Software (on board/on ground) design assurance
- Responsibilities, Approval  
(Operator/NAA is responsible for maintenance)
- Parallel activities (SAE, Engines, Helicopters)
- Need for more guidance / interpretative material in the regulations





**EASA**  
European Aviation Safety Agency

**Thank you**

**Your safety is our mission.**

An agency of the European Union 