**MALDIVES CIVIL AVIATION AUTHORITY**

Republic of Maldives

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**Notice of Proposed Rule Making**
**NPRM 2024-03**

# MCAR-26 Additional Airworthiness Specifications for Operations
**Issue 2.00**

## Appendix 1: Rationale

**29 April 2024**

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# 1 Executive Summary

This Notice of Proposed Rule Making (NPRM) addresses safety and regulatory harmonisation issues related to the need of in-flight recordings for accident investigation and accident prevention purposes. Four safety recommendations were addressed to the Maldives Civil Aviation Authority (CAA) by Maldives Accident Investigation Co-ordination Committee (AICC), recommending an in-flight recording capability for all air aircraft models involved in commercial air transport operations. In addition, new Standards (recently introduced in ICAO Annex 6) require the carriage of lightweight flight recorders for light aeroplanes and light helicopters.

This NPRM proposes to mandate the carriage of combined recorders and establishing an operational flight data monitoring system by the operators for some categories of aeroplanes and helicopters when they are used in commercial operations.

The proposed changes are expected to increase safety with limited economic and social impacts.

# 2 In summary — why and what

## 2.1 Why we need to change the rules — issue/rationales

In the context of this NPRM, the following terms are used:

— ‘light aeroplane’ means an aeroplane of a maximum certified take-off mass (MCTOM) of 5 700 kg or less;
— ‘light helicopter’ means a helicopter of an MCTOM of 3 175 kg or less;
— ‘light aircraft’ means a light aeroplane, a light helicopter, a balloon or a sailplane.

Accidents and serious incidents that occur over the territory of Republic of Maldives must be subject to safety investigation. However, all categories of light aircraft currently operated in the Maldives fall outside the scope of current requirements to carry flight recorders. In the absence of data on the aircraft condition and operation, it is very difficult to reconstruct the sequence of events that led to an accident or a serious incident; knowing the sequence of events though is essential for defining actions in order to prevent future occurrences.

The CAA and the AICC has investigated occurrences involving breach of regulations, suspected unstable approaches and unsafe manoeuvres and level busts. The CAA has also been receiving occurrence reports of TCAS RAs and other air space conflict issues. Without the availability of data, reaching a conclusion on some of the occurrences have proven to be extremely challenging and in some cases rather impossible. Having flight data available for further analysis would help us improve safety by learning from exactly what happened during those operations.

This is why recent Standards in ICAO Annex 6 prescribe, for some categories of light aeroplanes and helicopters operated for commercial air transport (CAT), the carriage of in-flight recording equipment. In addition, 4 safety recommendations related to in-flight recording for light aeroplanes were addressed to the CAA by Maldives AICC.

Finally, CAT statistics indicate a significantly higher rate of accidents with non-large aircraft, which raises the question of the need for in-flight recording on-board these aircraft engaged in commercial air transport.

A Flight Data Monitoring Program assists an operator to identify, quantify, assess and address operational risks. It can be effectively used to support a range of airworthiness and operational safety tasks. Without an effective data monitoring system, the data collected by a recorder would only be useful in identifying the causes of an accident after it has already happened. Therefore, it is logical to use the data, process and implement mitigations when necessary to prevent accidents before it happens.

FDM provides the capacity to analyze a wide range of parameters and to identify contributing factors that will help to assess and understand the root causes of in-service incidents – in complement to flight crew reports or interviews.

Since FDM gathers the data of the complete airline or fleet, the analysis provided in a weekly or monthly report enables one event to be analyzed in a general context instead of being focused on that single particular event.

The objective of setting up an FDM process in an airline is to transition from a purely reactive mode (incident analysis based on flight crew reporting) to a more proactive mode (early identification of undesired events and implementation of mitigation measures).

In light of review of CAA Rule making on the subject and the conclusions sighted to make CAA rules, it is the conclusion of Maldives CAA that this rulemaking should be focused on those light aircraft used for commercial operations and capable of transporting several passengers instead of all kinds of light aircraft operated in the Maldives.

## 2.2 What we want to achieve — objectives

The specific objectives of this rulemaking task are to:

1. enhance the identification of safety issues affecting light aircraft by means of voice and data recorded in flight;
2. increase flight safety and operational efficiency;
3. achieve harmonisation with ICAO Annex 6;

## 2.3 How we want to achieve it – overview of the proposals

### 2.3.1 Changes to the requirements

The proposed requirements, AMCs and GMs are presented in detail in MCAR-26 Issue 2.0.

#### *2.3.1.1 New concepts and definitions*

The concept of 'flight recorder' is extended to in-flight recording equipment for light aircraft, which requires limited crash protection. The definitions for 'flight data recorder' (FDR) and 'cockpit voice recorder' (CVR) in MCAR – Air Operations Issue 5 have this concept incorporated.

The new concept of flight recorders now encompasses 'crash-protected' flight recorders and 'lightweight' flight recorders. A crash-protected flight recorder is capable of withstanding very severe crash conditions such as those encountered during some accidents of large aeroplanes and large helicopters (FDRs and CVRs are crash-protected flight recorders). A lightweight flight recorder is designed to meet less demanding crash-protection requirements, and therefore it can be lighter.

#### *2.3.1.2 New recording requirements for commercial operations with light aeroplanes and light helicopters*

New rules are created in MCAR-26. The rules require that aeroplanes and helicopters which:

— are commercially operated;
— are not within the scope of MCAR – Air Operations CAT.IDE.A.185, CAT.IDE.A.190, CAT.IDE.A.191, CAT.IDE.H.185, CAT.IDE.H.190, CAT.IDE.H.19,
— are Turbine-engined with an MCTOM of 2250 kg or more and aeroplanes with an MOPSC of more than 9,

be equipped with a combination flight recorder which records voice, flight data and/or images that are sufficient to determine the flight path and the aircraft speed (ground speed or indicated airspeed). The flight recorder shall have a minimum recording duration of 5 hours and an automatic start-and-stop logic.

#### *2.3.1.3 Continued serviceability of the flight recorder*

Paragraph MCAR-26.A.510 requires Handling of flight recorder recordings: preservation, production, protection and use should be performed in compliance with the applicable paragraphs of MCAR – Air Operations CAT.GEN.MPA.195

#### *2.3.1.4 Protection of image recordings*

Paragraph MCAR-26.A.510 requires handling of flight recorder recordings: preservation, production, protection and use should be performed in compliance with the applicable paragraphs of MCAR – Air Operations CAT.GEN.MPA.195

### 2.3.2 Benefits of in-flight recording

The retained option includes promoting the benefit of in-flight recording, in particular, the recording of flight parameters, images and audio in the flight crew compartment for aeroplanes and helicopters.

In addition, operators are required to implement a flight data monitoring system. Flight Data Monitoring (FDM) offers an efficient solution to achieve safety improvement. FDM is to some extent a quality assurance process but also has a vital Safety Management dimension. It involves the downloading and analysis of aircraft flight recorder data on a regular and routine basis. It is widely used by aircraft operators throughout the world to inform and facilitate corrective actions in a range of operational areas by offering the ability to track and evaluate flight operations trends, identify risk precursors, and take the appropriate remedial action.

The potential of FDM programmes has been materially enhanced by the rapid expansion in the number of data parameters which can be captured using digital recorders now routinely carried on aircraft. [https://skybrary.aero/articles/flight-data-monitoring-fdm]

FDM strongly contributes to increased flight safety and operational efficiency by:

- Providing data to help in the prevention of incidents and accidents. Fewer flight accidents not only reduce material losses and insurance costs, but also keep passengers' confidence high.
- Improved operational insight: providing the means to identify potential risks and to modify pilot training programs accordingly.
- Improved fuel consumption: FDM provides the ability to identify and make adjustments to company operating procedures or specific aircraft with unusually high fuel burn rates.
- Reduction in unnecessary maintenance and repairs: FDM data can be used to help reduce the need for unscheduled maintenance, resulting in lower maintenance costs and increased aircraft availability.
- Improved ground conditions and airports: in certain cases, airlines can use the data captured from their FDM program to support requested changes to air traffic control and airport procedures.

- Reduced number of ACARS messages: non-critical data (e.g. take-off reports, stable cruise reports) that are sent via ACARS messages, can be acquired, recorded and transmitted via flight data monitoring equipment
- Reduced reliance on flight data recorders: flight-monitoring data can be transmitted automatically over the Internet and be analysed without delay.
- Adherence to noise restrictions: flight data monitoring helps airlines demonstrate adherence to noise restrictions in terms of being able to verify or deny actual infringement, and avoid incurring fines.
- Improved monitoring of flight crew's cosmic radiation exposure: flight data monitoring can assist in tracking radiation exposure
- Flight Data Monitoring (FDM) programmes provide a powerful tool for the proactive hazard identification.

## 2.4 What are the expected benefits and drawbacks of the proposals

### 2.4.1 Summary of the impact assessment (refer to Chapter 4)

With regard to aeroplanes and helicopters, the following options were considered:

— Option A.1: Promote the recording of basic flight parameters, audio and/or a view of the instruments panel for all models of light aeroplanes and light helicopters and for all types of operation

— Option A.2: Strictly transpose ICAO Standards in Annex 6 for newly manufactured light turbine-engined aeroplanes and newly manufactured light turbine-engined helicopters operated for CAT. (no change to existing rules)

— Option A.3: Transpose ICAO Standards in Annex 6 with some differences:

  - Require installation of a combination recorder for aeroplanes involved in commercial air transport (CAT) operations which have an MOPSC of more than 9 or turbine-engined aircraft with an MCTOM of 2250 kg or more;

Considering proportionality and cost, the current and immediate future operations in the Maldives and the resolution of impact on safety and safety investigations, it was not found appropriate to develop options for balloons and sailplanes as part of this Rule making process.

Regarding aeroplanes and helicopters, Option A.3 is the preferred one because it promotes safety and includes rulemaking. Option A.3 has a significant positive safety impact while limiting the economic impact for CAT operations.

### 2.4.2 Proposal for aeroplanes and helicopters

The proposal imposes a requirement to record voice and a small set of flight parameters for certain categories of aeroplanes and helicopters.

This proposal is expected to have a medium positive to very positive impact on safety (by supporting official safety investigations and operational safety monitoring), a slightly positive impact on rules harmonisation (better alignment with ICAO Annex 6), limited social impact moderate economic impact (requirement limited to CAT and newly manufactured aircraft), and no impact on proportionality issues (requirement limited to turbine-engined aircraft with an MCTOM of 2250 kg or more and aeroplanes with an MOPSC of more than 9).

### 2.4.3 Proposal considerations for balloons

Since there are no balloon operations currently conducted in the Maldives, balloons are not considered under this rule making process.

# 3 Proposed amendment and rationale in detail

## 3.1 Draft Regulation

### 3.1.1 Draft resulting text

Refer to MCAR-26 Issue 2.0 for the resulting text of draft with this NPRM.

### 3.1.2 Rationale

#### *3.1.2.1 Definitions*

The term 'flight recorder', was used in the Air Operations rules to designate crash-protected flight recorders required to be carried on-board large aircraft, such as the flight data recorder or the cockpit voice recorder. Crash-protected flight recorders are capable of withstanding very severe crash conditions and they can record a wealth of data from multiple sensors and sources. In the recent amendments to ICAO Annex 6, the term 'flight recorder' encompasses lightweight equipment as well, which meets less demanding crash-protection requirements and records only a smaller set of data.

Definition of 'flight recorder' is included in MCAR-1 and MCAR – Air Operations. This definition complies with the concept used in ICAO Annex 6. As a consequence, the provisions applicable to the preservation of the recordings after an accident or a serious incident become de facto applicable to the recordings of all types of flight recorders as well (please refer to EASA Air Operations AMC2 ORO.MLR.100(q), AMC3 ORO.MLR.100(g), AMC4 ORO.MLR.100(a)(A)(11), CAT.GEN.MPA.105(a)(10), CAT.GEN.MPA.195(a), SPO.GEN.107(a)(9), and SPO.GEN.145(a)).

#### *3.1.2.2 MCAR-26 Subpart D*

##### *3.1.2.2.1 New recording requirements for commercial operations with light aeroplanes and light helicopters*

New rules are included in MCAR-26 Subpart D entitled "Flight Recorders" for both aeroplanes and helicopters.

— According to the new rule,

(a) Turbine-engined aircraft with an MCTOM of 2250 kg or more and aeroplanes with an MOPSC of more than 9 shall be equipped with a combination recorder if all of the following conditions are met:

(1) they are not within the scope of MCAR – Air Operations CAT.IDE.A.185, CAT.IDE.A.190, CAT.IDE.A.191, CAT.IDE.H.185, CAT.IDE.H.190, CAT.IDE.H.191

(2) they are used in Commercial Air Transport (CAT) operations

#### *3.1.2.2.2 Continued serviceability of the flight recorder*

Paragraph MCAR-26.A.510 entitled “Handling of flight recorder recordings: preservation, production, protection and use” requires compliance with the applicable paragraphs of MCAR – Air Operations CAT.GEN.MPA.195, that covers the requirements of the newly introduced MCAR-26.A.500

Indeed, experience with crash-protected flight recorders installed on large aircraft has shown that without rules the continued serviceability of the flight recorders is not consistently addressed. Flight recorders are considered ‘maintenance-significant items’ in accordance with the MSG-3 methodology; however, the instructions for continued serviceability vary — in particular, they do not always include checking of the quality of the recorded data (i.e. that the values of flight parameters are reasonable and consistent with each other, and that images are of sufficient quality to be able to read instrument indications). In addition, since a flight recorder failure has no effect on the safe conduct of the flight, repairing it is not considered priority if it is not required by law.

#### *3.1.2.2.3 Protection of image recordings*

Paragraph MCAR-26.A.505 entitled “Protection of recordings and transcript” requires compliance with the requirements stipulated and MCAR-26.A.510 entitled “Handling of flight recorder recordings: preservation, production, protection and use” requires compliance with the requirements of applicable paragraphs of MCAR – Air Operations CAT.GEN.MPA.195, that covers the requirements of the newly introduced MCAR-26.A.500

## 3.2 Draft Acceptable Means of Compliance (AMC) and Guidance Material (GM) ()

### 3.2.1 Draft resulting text

Refer to MCAR-26 Issue 2.0 draft included with this NPRM

# 4 Impact Assessment

Note:

In this chapter, the following terms are used:

'Crash-protected flight recorder' means any type of recorder installed in the aircraft and recording in a crash-survivable recording medium for the purpose of facilitating accident/incident safety investigations. Crash-protected flight recorders comprise one or more of the following systems: a flight data recorder (FDR), a cockpit voice recorder (CVR), an airborne image recorder (AIR), and/or a data-link recorder (DLR).

— 'Lightweight flight recorder' means a system installed in the aircraft and recording in a robust recording medium primarily for the purpose of facilitating accident/incident safety investigations. Lightweight flight recorders comprise one or more of the following systems: an aircraft data recording system (ADRS), a cockpit audio recording system (CARS), an airborne image recording system (AIRS), and/or a data-link recording system (DLRS).

— 'In-flight recording' means recording by an airborne system of data that can be easily used to reconstruct the history of the flight for the purpose of a safety investigation. In-flight recording solutions include but are not limited to crash-protected flight recorders and lightweight flight recorders, and they do not necessarily rely on dedicated equipment.

— 'combination recorders' or 'combined recorders' are recorders that combine two functions: the FDR function and the CVR function. They may also have other recording functions (such as data link or image recording).

— 'Light aeroplane' means an aeroplane of a maximum certified take-off mass (MCTOM) of 5 700 kg or less.

— 'Light helicopter' means a helicopter of an MCTOM of 3 175 kg or less

— 'Large aeroplane' means an aeroplane of an MCTOM of more than 5 700 kg.

— 'Large helicopter' means a helicopter of an MCTOM of more than 3 175 kg.

— 'Complex aeroplane' means an aeroplane:
  - with an MCTOM of more than 5 700 kg; or
  - certificated for a maximum passenger seating configuration of more than 19; or
  - certificated for operation with a minimum crew of at least two pilots; or

- equipped with one or more turbojet engines or two or more turboprop engines.

— 'Complex helicopter' means a helicopter certificated:
  - for a maximum take-off mass of more than 3 175 kg; or
  - for a maximum passenger seating configuration of more than nine or
  - for operation with a minimum crew of at least two pilots.

## 4.1 What is the Issue?

### 4.1.1 Definition of the issue

#### *4.1.1.1 The need for investigation*

In the absence of recording of the aircraft condition and operation, it can be very difficult to reconstruct the sequence of events that led to an accident or a serious incident. Moreover, this sequence of events is essential for defining actions in order to prevent future occurrences. Many investigations of aircraft accidents and serious incidents are hindered by the absence of accurate data on what happened.

The analysis of other types of evidence (witness statements, accident site examination, etc.) is usually time-consuming and does not provide such complete and accurate data as in-flight recording does.

In the Maldives, aircraft below 5,700 kg used in commercial air transport operations fly a huge number of passengers to and from the main international airport. This number keeps growing each year. To provide a reliable air transport service for the flying public it is essential for the investigation authorities to have sufficient amount of data to make reasonable conclusions to further improve safety of the air transport network.

Moreover, aircraft below 5,700 kg involved in commercial air transport make up to 70% of the civil air fleet in the Maldives

According to MCAR-12 initially issued on 21 April 2009, all accidents and serious incidents that occur within or over the territory of the Republic of Maldives must be subject to safety investigation. However, many aircraft categories and types of operation fall outside the scope of current requirements to carry a crash-protected flight recorders. Those are for instance:

— aeroplanes with an MCTOM of 5 700 kg or less (hereinafter called 'light aeroplanes');
— helicopters with an MCTOM of 3 175 kg or less (hereinafter called 'light helicopters');
— balloons; and
— sailplanes.

Light aircraft is the dominant type in the great majority of occurrences requiring safety investigations by the CAA or AICC that occurred from 2009 involving aircraft registered in the Maldives.

Looking into EASA community on the same subject area, more than 80% of the occurrences requiring a safety investigation and that happened in 2012, 2013 or 2014 with aircraft registered in an EASA MS involved a light aeroplane, a light helicopter, a sailplane or a balloon.

#### *4.1.1.2 The drivers*

##### *4.1.1.2.1 ICAO Standards*

The Standards recently introduced in ICAO Annex 6, Part I and Part III, prescribe that future light turbine-engined aeroplanes and helicopters operated for CAT shall be equipped with a means to record flight data and, under certain conditions, a means to record cockpit audio.

##### *4.1.1.2.2 Safety recommendations*

The Maldives Accident Investigation Co-ordination Committee has issued 5 (five) recommendations, so far, regarding flight recordings for light aircraft used in commercial operations.

| Report # | Recommendation |
|---|---|
| **2004/01** | The CAD should re-examine the criteria for the carriage of flight recorders by aircraft, which have in force a certificate of airworthiness in the Transport Category (Passenger) and are certified to carry more than 9 passengers with a view to requiring all aircraft, whether piston or turbine powered, to carry at least a Cockpit Voice Recorder. |
| **2009/01** | CAD to mandate installation of CVR on all aircraft used for commercial operations. |
| **2015/04** | Review and consider recommendation 4.3 in the accident report of 8Q-MAG (Twin Otter) crash of 2 June 2009 on mandating installation of cockpit voice recorders on all aircraft used for CAT operations |
| **2021/01** | MCAA to re-examine the criteria for carriage of flight data recorders on transport category aircraft, flight data recording in particular. |
| **2021/02** | To re-examine the criteria for carriage of recorders on transport category aircraft certified to carry more than 9 passengers |

When looked at the data from EASA community on the provision of the following can be noted from the EASA Analysis.

12 safety recommendations addressed to EASA recommend the introduction of in-flight recording for light aeroplanes and helicopters and these safety recommendations are within the scope of EASA RMT.0271. These safety recommendations were issued in the framework of official safety investigations of 10 accidents. Below is the list of safety recommendations with reference information on the accidents:

1. Safety Recommendation FINL-2014-001 (Cessna 206 registered OH-AAA, 8.11.2012);
2. Safety Recommendation FRAN-2009-008 (Beech C90 registered F-GVPD, 18.10.2006);
3. Safety Recommendation FRAN-2013-012 (Cessna 208 registered F-OIXZ, 5.9.2010);
4. Safety Recommendation HUNG-2008-002 (Eurocopter EC135 registered HA-ECE, 31.7.2008);
5. Safety Recommendation NETH-2012-001 (Pilatus PC12 registered PH-RUL, 16.10.2009);
6. Safety Recommendation NORW-2012-010 (Aerospatiale AS350 registered LN-OXC, 4.7.2011);
7. Safety Recommendation SPAN-2012-011 (Swearingen SA226 registered EC-GDG, 18.2.1998);
8. Safety Recommendation UNKG-2005-101 (Bell 206 registered G-BXLI, 22.1.2005);
9. Safety Recommendation BELG-2015-001 (Pilatus PC6 registered OO-NAC, 19.10.2013);
10. Safety Recommendation UNKG-2015-035 (Eurocopter EC135 registered G-SPAO, 29.11.2013);
11. Safety Recommendation FRAN-2016-045 (TBM700 registered N129AG, .6.8.2014);
12. Safety Recommendation FRAN-2016-046 (TBM700 registered N129AG, 6.8.2014).

In addition, 16 safety recommendations related to in-flight recording for light aeroplanes and light helicopters were issued by safety investigation authorities of the EASA MSs to authorities other than EASA.

With regard to the 12 safety recommendations addressed to EASA, it should be noted that:
7 out of the 12 safety recommendations concern CAT operations or parachuting activities, while 5 safety recommendations do not specify the type of operation;
7 out of 11 accidents involved aeroplanes and 4 involved helicopters;
10 out of 11 accidents involved a turbine-engined aircraft; and
9 out of 11 accidents involved a light aeroplane or a light helicopter with an MCTOM of 2250 kg or more.

With regard to the 16 safety recommendations addressed to the EASA MSs:

13 out of the 16 safety recommendations concern CAT operations, aerial work, police or parachuting activities, while 3 safety recommendations do not specify the type of operation;
7 out of 16 safety recommendations were issued after an accident or a serious incident which involved an aeroplane, and 9 safety recommendations after an accident or a serious incident which involved a helicopter;
15 out of 16 safety recommendations were issued after an accident or a serious incident involving a turbine-engined aircraft; and
13 out of 16 safety recommendations were issued after an accident or a serious incident involving a light aeroplane or a light helicopter with an MCTOM of 2250 kg or more.

Hence, the focus of European safety investigation authorities seems to be rather on light aeroplanes and light helicopters equipped with turbine engines, used for CAT or SPO operations, and have an MCTOM of 2250 kg or more.

Appendix C presents safety recommendations that have been issued by European safety investigation authorities since 2000 and relate to in-flight recording for light aircraft. Most of these safety recommendations address CAT operations with light aeroplanes and light helicopters.

#### *4.1.1.2.3 Commercial operations with balloons*

Since there are no commercial operations with balloons currently in the Maldives, this part is not included in this rule making activity. This topic is to be revisited before granting approval(s) for commercial operations with balloons.

### *4.1.1.3 Scope of the issue*

The need for in-flight recording is assessed for aircraft categories which are within the scope of MCAR – Air Operations, namely: aeroplanes and helicopters.

In addition, aeroplanes and helicopters of models already subject to crash-protected flight recorder carriage requirements in accordance with MCAR – Air Operations are outside the scope of this NPRM.

### 4.1.2 Safety risk assessment

#### *4.1.2.1 Principles of assessing the safety risk*

***Benefits for accident prevention***

The need for in-flight recording for investigation purposes should be assessed in light of its ultimate objective which is to improve aviation safety in the long term, i.e. decrease in the number of accidents. Therefore, when assessing the need for in-flight recording, the key criterion is the extent to which in-flight recording may contribute to accident prevention by providing information otherwise difficult to obtain.

However, when the accident causes are already known, accident prevention might be better served by measures other than recording data in flight.

*Possible* uses *for other than safety investigation*

Beyond the use by safety investigation authorities, in-flight recording may contribute to accident prevention through:

— operational safety monitoring (e.g. flight data monitoring);
— better data for the continuing airworthiness of products;
— engine or gearbox health monitoring; and
— dissuading against unnecessary risk-taking by pilots (because pilot actions are recorded).

The benefits of in-flight recording for light aircraft are presented in Appendix D.

***The proposed approach to assess safety risks***

One common method to assess safety risks is to apply a conventional method of risk assessment, such as the one reflected, for instance, in EASA CS 23.1309 'Equipment, systems and installations'. In simple terms, this approach is based on a two-dimensional risk assessment, where one dimension is related to the frequency of a failure (from 'frequent' to 'extremely improbable') and the other dimension reflects the potential severity of a failure (from 'no effect' to 'catastrophic').

In-flight recording is not meant for the safe conduct of the flight, and recording failure or absence of recorded data has no effect on the safe continuation of a flight. The conventional method of risk assessment is simply not appropriate because its focus is limited on the safe completion of one individual flight following a system failure. It excludes a macroscopic approach to safety which consists in taking safety-effective

actions based on data collected from day-to-day operations or from serious incidents and accidents.

In the case of in-flight recording equipment, the safety risk to be assessed is related to the non-realised safety benefit for an operator (when recorded data could be used for FDM or safety management) or for authorities (when recorded data would be useful to investigate a safety occurrence). In the absence of recorded data, it would be difficult to timely identify some of the hazards and, subsequently, to help preventing future accidents where these hazards will occur again.

***No one-size-fits-all safety risk assessment***

The safety risk assessment should take into account the category of aircraft and the type of operation considered because, for instance:

a) the acceptable level of safety risk is not the same when considering CAT operations and general aviation (refer to Appendix H for the principles of safety risk assessment);

b) the potential severity of an accident varies depending on aircraft passenger capacity (number of fatalities on board) or the aircraft mass (number of ground fatalities and level of damage on the ground).

Therefore, even when considering only the safety aspects, the risk assessment cannot be the same for all categories of aircraft and for all types of operation considered.

#### *4.1.2.2 Principle of proportionality*

In the case of light aircraft, the general principle of proportionality is of utmost importance. Requirements should be commensurate with the capability of those to which they apply. In particular, it should be observed to ensure that any proposed requirement will be manageable in the context of non-commercial operations.

In practice, this means for in-flight recording the following:

— When considering non-commercial operations, it is essential to have requirements that are easy to understand and implement, with an acceptable economic impact. The economic impact is not limited to purchase and certification costs, but also encompasses operational procedures and maintenance aspects. In addition, a possible new requirement on safety equipment should not be considered in isolation but together with all other requirements already applicable. This is because requirements are competing for limited human and financial resources.

— When considering the carriage of equipment on light aircraft, the mass of the equipment, its power consumption and size are critical aspects to be considered. For these aspects, not only the recording equipment per se, but also the dedicated sensors and controls and the installation kit should be considered.

#### *4.1.2.3 Preliminary safety targets*

Due to the diversity of aircraft categories and types of operation considered in the framework of this NPRM, a unique level of in-flight recording equipment cannot be considered for all possible cases. It is, therefore, proposed to define four levels of equipment for in-flight recording, independently of the considerations about the best way to reach this level of equipment (through rulemaking, safety promotion, or both):

1. **High:** the data collected should be exhaustive and allow getting a good picture of the sequence of events that occurred in the flight crew compartment. At least flight parameters related to the engines, to flight controls and to all essential aircraft systems should be recorded, including audio (and data-link communications, when applicable). The operational performance specifications of the dedicated in-flight recording equipment should be based on highly demanding industry standards (e.g. EUROCAE Documents ED-112 or ED-112A).

2. **Medium:** the data collected should help reconstruct the sequence of events that occurred in the flight deck and they should be collected by dedicated in-flight recording equipment; however, it is acceptable that only a reduced set of flight parameters is recorded or that audio is not recorded. Basic flight parameters related to aircraft attitude and trajectory and/or audio should be collected. Other means of collecting data, such as by means of image recording of the instruments, could be acceptable. The in-flight recording equipment may also fulfil other functions than recording data for investigation purposes; however, its operational performance specifications should be based on recognised industry standards (e.g. EUROCAE Document ED-155, ED-112 or ED-112A).

3. **Low:** the data collected should provide useful information for reconstructing a reliable history of the flight, which is the first step of a safety investigation. Typically, data computed by a GNSS receiver (aircraft position, ground speed, track and altitude) would serve this purpose, but alternative solutions could be acceptable. The collection of data would not need to be performed by dedicated equipment, and the data could also be transmitted to the ground in lieu of being recorded on board, or the aircraft could be tracked from the ground. The solution would, however, need to meet some minimum operational performance specifications.

4. **None:** not enough justification to require or promote in-flight recording.

When applying the principle of proportionality across categories of aircraft and types of operations, the following approach is proposed:

— The target level of equipment should be higher for commercial operations and lower for non-commercial operations; and

— The target level of equipment should be the highest for large aeroplanes (above 5 700 kg MCTOM) and large helicopters (above 3 175 kg MCTOM), followed by light complex aeroplanes and helicopters, followed by non-complex aircraft (light non-complex aeroplanes and light non-complex helicopters, as well as balloons and sailplanes).

Based on this principle and the drivers identified in Section 4.1.1, a preliminary mapping of target levels of equipment is presented in Table 2.

*Table 1: Preliminary target levels of in-flight recording equipment for aeroplanes and helicopters*

| **Target level of equipment (applicable Part of Air OPS rules)** | **Large aeroplanes and large helicopters** | **Light aeroplanes and light helicopters** |
|---|---|---|
| CAT operations (Part-CAT) | 'High' (already covered by the Air OPS rules). | High for multi-engined turbine-powered aeroplanes with MOPSC > 9 (already covered by the Air OPS rules with specific dates of first CofA).<br><br>'None' to 'high' for other aircraft categories depending on aircraft complexity and passenger capacity (e.g. 'none' for a small piston-engined aircraft capable of carrying just one passenger, may be 'high' if the aircraft is complex and/or carries a large number of passengers). |

#### *4.1.2.4 Assessing the safety risk*

***Limitations of an assessment based on safety recommendations***

While the several safety recommendations related to in-flight recording should be carefully considered, basing the safety risk assessment only on their review is not sufficient for the following reasons:

— Such safety recommendations were mainly triggered by the lack of data to analyse and explain the accidents, while the need for in-flight recording should be assessed against the ultimate objective of a safety investigation, which is to improve aviation safety. It is not obvious that if data had been available to facilitate those accident investigations (for which safety recommendations related to in-flight recording were issued and contributory factors could have been subsequently better identified), this would have resulted in corrective actions to prevent future accidents.

— There are many more cases where the absence of reliable data has hindered the investigation than those which have triggered a safety recommendation. It is not common practice among safety investigation authorities to issue a safety recommendation each time they are missing important data (except in the case of accidents with the largest category of aircraft).

— The majority of the safety recommendations were issued at a time when there was no industry standard for flight recorders, and very few such systems were offered on the market. The only available concept was that of conventional, ED-112-compliant, crash-protected flight recorders, which are relatively heavy and expensive and not designed for light aircraft.

— Most of the safety recommendations are rather generic. i.e. they do not specify what information should be recorded.

***Safety risk level***

When considering aviation activities in the Maldives potential fatalities caused by an accident involving light aircraft (MTOW less than 5700Kg) would have high consequences and therefore the severity of such an accident would be **'catastrophic'**

Statistics of accidents indicate that there has not been a fatal accident. Therefore the frequency is Improbable. This gives s safety risk of **Medium** as the safety risk of a fatal accident involving aircraft covering this NPRM

#### *4.1.2.5 Consolidated safety targets*

Knowing that the safety risk level associated with the absence of in-flight recording on board light aircraft is not higher than medium, the preliminary target levels of equipment presented in Tables 2 can be refined. Tables 3 present consolidated target levels of equipment.

**Table 3: Consolidated mapping of target levels of equipment for in-flight recording for aeroplanes and helicopters**

| Target level of equipment | Large aeroplanes and large helicopters | Light aeroplanes and light helicopters |
|---|---|---|
| **Annex IV (Part-CAT)** | 'High' (already covered by the Air OPS rules) | 'High' for multi-engined turbine-powered aeroplanes with an MOPSC of more than 9 (already covered by the Air OPS rules).<br><br>'Medium' for turbine-engined aeroplanes with an MCTOM equal to or greater than 2250 kg, and for aeroplanes with an MOPSC of more than 9.<br><br>'Medium' for turbine-engined helicopters with an MCTOM equal to or greater than 2250 kg.<br>'None' to 'low' for other light aeroplanes and light helicopters. |
| **Annex VIII (Part-SPO)** | 'High' for aeroplanes with an MCTOM exceeding 27 000 kg and helicopters with an MCTOM exceeding 7 000 kg (already covered by the Air OPS rules).<br><br>Medium for aeroplanes with an MCTOM between 5 700 and 27 000 kg and helicopters between 3 175 and 7 000 kg (already covered by the Air OPS rules). | 'Medium' for turbine-engined aeroplanes with an MCTOM equal to or greater than 2250 kg, and for aeroplanes with an MOPSC of more than 9.<br><br>'Medium' for turbine-engined helicopters with an MCTOM equal to or greater than 2250 kg.<br><br>'None' to 'low' for other light aeroplanes and light helicopters. |
| **Annex VI (Part-NCC) or Annex VII (Part-NCO)** | 'High' for aeroplanes with an MCTOM exceeding 27 000 kg and helicopters with an MCTOM exceeding 7 000 kg (already covered by the Air OPS rules). | 'None' to 'low' for other light aeroplanes and light helicopters. |

| | | |
|---|---|---|
| | 'Medium' for aeroplanes with an MCTOM between 5 700 and 27 000 kg and helicopters between 3 175 and 7 000 kg (already covered by the Air OPS rules). | |

### 4.1.3 Who is affected?

#### *4.1.3.1 Stakeholders*

The stakeholders affected by this issue are:

— manufacturers of light aircraft and equipment for such aircraft:
— commercial operators of light aircraft:
— private pilots and aircraft owners;
— safety investigation authority

#### *4.1.3.2 Affected fleet*

As of the date of this NPRM, there are 91 aircraft – all of them DHC-6-100/200/300/400 aircraft – on the Maldivian Civil Register, that would be affected by this Rule change.

**Table 4: Fleet numbers — light aircraft**

| Aircraft category | Total number in year 2024 |
|---|---|
| Light aeroplanes (MCTOM ≤ 5 700 kg) | 91 |
| Light helicopters (MCTOM ≤ 3 175 kg) | 0 |

### 4.1.4 How could the issue/problem evolve?

If the requirements for flight recorder carriage are not changed for commercial operations, the gap in the understanding of large aircraft and light aircraft accident causes and in the identification of relevant safety actions will grow. Indeed, more and more data are collected and analysed by operators of large aeroplanes and large helicopters on a day-to-day basis (for flight data monitoring, condition monitoring, continuing airworthiness). In addition, the capabilities of flight recorders required to be installed on large aircraft are being enhanced (e.g. with data-link recording, the advent of very long recording duration CVRs). Consequently, the gap in knowledge is expected to grow between large aircraft and light aircraft.

Because of this, while one can expect that the level of safety will further increase for commercial operators of large aircraft thanks to the increase of recorded data, it may

still remain at a lower level for commercial operators of light aircraft (operated under Part-CAT or Part-SPO) in spite of the demanding requirements they have to comply with anyway in terms of equipment, procedures, and training. Also, side safety benefits of continuously recording data (such as dissuasion against risk-taking by pilots, favouring retrospective occurrence reporting or earlier detection of performance issues with engines or systems) will not be reaped. These diverging trends are problematic when considering in particular the transportation of fare-paying passengers, as the general public may rightfully expect an equivalent level of safety when they are travelling, whatever the aircraft used.

One should also not rely on coincidental recordings from portable electronic devices (portable GNSS receiver, action camera, smartphone) to replace dedicated in-flight recording, because the data formats used by these devices are proprietary and data is encrypted; this makes retrieval of any useful data very challenging when the device is damaged (often the case after an accident). Also retrieving data from these devices on a day-to-day basis for operational purposes is difficult for technical and privacy reasons. The manufacturers of these electronic devices usually provide little assistance to the investigation authorities.

## 4.2 What we want to achieve — objectives

The operational objectives of this proposal are to:

— enhance the identification and prevention of safety issues affecting light aircraft by means of data recorded in flight;

— achieve harmonisation with ICAO Standards in Annex 6 Parts I, II and II;

## 4.3 How it could be achieved — options

### 4.3.1 Requiring, facilitating or promoting

When a target level of equipment cannot be achieved by introducing a new requirement due to cost impact and proportionality considerations despite the recognised safety benefit, then other ways to achieve it may facilitate or promote the installation of equipment.

In this context, ‘facilitate’ means modifying the regulatory framework so that in-flight recording equipment can be installed following a faster and cheaper approval process. ‘Promote’ means communicating the benefits of installing in-flight recording equipment in order to get buy-in from the industry and pilots.

#### *4.3.1.1 Facilitating the installation of in-flight recording equipment*

Voluntary installation of equipment recording data, audio or images can be facilitated by allowing it to be performed under a standard change, such as the one defined by the Certification Specifications for Standard Changes and Standard Repairs (CS-STAN). An installation performed under CS-STAN does not require an approval process if it is validated by an aircraft certificate of release to service (in accordance with Part-M, M.A.801) issued by the appropriate certifying staff.

The equipment for which the installation could be facilitated includes:

— video cameras;

— GNSS receivers;

— in-flight recording system when it relies on dedicated sensors (camera, GNSS receiver, accelerometer, etc.);

— transponder (because it allows the recording of a radar track on the ground).

#### *4.3.1.2 Promoting in-flight recording equipment*

In order for the promotion of in-flight recording equipment to be successful, benefits other than facilitating official safety investigations should be put forward. Indeed, from the perspective of small operators, pilots and aircraft owners, the probability of an accident is very remote; consequently, they are more inclined to invest in equipment that has a more direct impact on safety (e.g. an anti-collision system) than in in-flight recording equipment. Among other things, the benefits of in-flight recording equipment could be promoted among operators, flight schools and aero clubs in order to monitor the safe and cost-effective use of aircraft, prevent excessive risk-taking, and support training.

More details on the potential benefits of in-flight recording and the stakeholders which could be receptive to promotion of in-flight recording are presented in Appendix D.

### 4.3.2 The Options

Due to the fact that the context and the drivers are very different when considering aeroplanes, helicopters, sailplanes and balloons, different sets of policy options were established depending on the aircraft category. Table 5A and Table 5B present these options.

**Table 5A: Selected policy options for light aeroplanes and light helicopters**

| ***Option No*** | ***Short title*** | **Description** |
|---|---|---|
| A.0 | Do nothing | Baseline option (no change to the rules and no promotion); risks remain as outlined in the issue analysis. |
| A.1 | Safety promotion | Promote the recording of basic flight parameters, audio and/or a view of the instruments panel for all models of light aeroplanes and light helicopters and for all types of operations (no change to the rules). |
| A.2 | ICAO Annex 6 | Strictly transpose ICAO Standards in Annex 6 for newly manufactured light turbine-engined aeroplanes and newly manufactured light turbine-engined helicopters operated for CAT. |
| A.3 | ICAO Annex 6 with differences | Transpose ICAO Standards in Annex 6 with the following differences:<br>— With regard to aeroplanes, the applicability set is aircraft involved in Commercial Air Transport (CAT) which have an MOPSC of more than 9 or which are turbine-engined and have an MCTOM of 2250kg or more;<br>— The requirement to record basic flight parameters on board aeroplanes and helicopters is also applicable to commercial SPO;<br>— Recording of audio is ~~not~~ required. |
| A.4 | Combined solution | Option A.1 + Option A.3 |

Option A.0 means no change to the current rules and no promotion action.

Option A.1 means promoting the benefits of recording flight parameters, interactions between the pilots and the aircraft by means of a camera, as well as audio in the flight crew compartment. Promotion could take, for example, the form of a leaflet or of information on the ~~EASA~~ CAA website.

Option A.2 means strictly transposing the Standards of ICAO Annex 6 Parts I and III for lightweight flight recorders into MCAR-26. This means:

— newly manufactured turbine-engined light aeroplanes operated for CAT are required to record basic flight parameters by means of an FDR, an ADRS, a Class C airborne image recorder (AIR) or a Class C airborne image recording system (AIRS) (ICAO Standard 6.3.1.2.1 of Annex 6 Part I);

— newly manufactured turbine-engined light aeroplanes operated for CAT,
  - which have an MCTOM of more than 2250 kg; and
  - which are certified for operation with a minimum crew of at least two pilots, are required to record audio by means of a CVR or a CARS (ICAO Standard 6.3.2.1.1 of Annex 6 Part I); and

— newly manufactured turbine-engined light helicopters operated for CAT, which have an MCTOM of more than 2250 kg, are required to record basic flight parameters by means of an FDR, an ADRS, a Class C AIR or a Class C AIRS (ICAO Standard 4.3.1.2.4 of Annex 6 Part III, Section II).

Option A.3 means transposing the Standards in ICAO Annex 6 Parts I and III and adapting them to capture aeroplanes with an MOPSC exceeding 9 and turbine-engined aeroplanes with an MCTOM of 2250 kg or more, and to capture commercial SPO. In addition, the ICAO Standard prescribing the recording of audio for light aeroplanes is also transposed. This means:

— light aeroplanes operated for CAT or commercial SPO, which in addition:
  - have an MOPSC of more than 9; or
  - are turbine-engined and have an MCTOM of 2250 kg or more,

are required to install a combination recorder record basic flight parameters (by means of an FDR, an ADRS, a Class C AIR or a Class C AIRS);

— turbine-engined light helicopters operated for CAT or commercial SPO, which have an MCTOM of 2250 kg or more, are required to record basic flight parameters (by means of an FDR, an ADRS, a Class C AIR or a Class C AIRS).

Option A.4 means implementing Options A.1 and A.3 together.

**Table 6A: Target levels of equipment and identified options for aeroplanes and helicopters**

| Target level of equipment | Light aeroplanes and light helicopters | Options |
|---|---|---|
| Annex IV<br>(Part-CAT) | 'High' for multi-engined turbine-powered aeroplanes with an MOPSC of more than 9 (already covered by the AirOPS rules). | (Already covered by the Air OPS rules) |
| | 'Medium' for turbine-engined aeroplanes with an MCTOM equal to or greater than 2250 kg, as well as for aeroplanes with an MOPSC of more than 9. | Option A.2 or Option A.3 |
| | 'Medium' for turbine-engined helicopters with an MCTOM equal to or greater than 2250 kg. | Option A.2 or Option A.3 |
| | 'None' to 'low' for other light aeroplanes and light helicopters. | Option A.1 |
| Annex VIII<br>(Part-SPO) | 'Medium' for turbine-engined aeroplanes with an MCTOM equal to or greater than | Option A.3 |

| | | |
|---|---|---|
| | 2250 kg, as well as for aeroplanes with an MOPSC of more than 9.<br><br>'Medium' for turbine-engined helicopters with an MCTOM equal to or greater than 2250 kg.<br><br>'None' to 'low' for other light aeroplanes and light helicopters. | Option A.3<br><br>Option A.1 |
| Annex VI (Part-NCC) or Annex VII (Part-NCO) | 'None' to 'low' for other light aeroplanes and light helicopters. | Option A.1 |

## 4.4 Methodology and data

### 4.4.1 Methodology applied

The methodology applied for this Impact Assessment (IA) is the multi-criteria analysis (MCA) which allows comparing all options by scoring them against a set of criteria.

MCA covers a wide range of techniques that aim to combine a range of positive and negative impacts into a single framework to allow easier comparison of scenarios. Essentially, it applies cost-benefit thinking to cases where there is a need to present impacts that are a mixture of qualitative, quantitative, and monetary data, and where there are varying degrees of certainty. The MCA key steps generally include:

— establishing the criteria to be used to compare the options (these criteria should be measurable, at least in qualitative terms);
— attributing weight to each criterion to reflect its relative importance to the decision to be taken;
— scoring how well each option meets the criteria (the scoring needs to be relative to the baseline scenario);
— ranking the options by combining their respective weights and scores; and
— performing sensitivity analysis on the scoring to test the robustness of the ranking.

The criteria used to compare the options were derived from the Basic Regulation and the IA guidelines developed by EASA and in line with the principles of better regulation issued by the European Commission. The principal objective of EASA is to 'establish and maintain a high uniform level of safety' (Article 2(1) of the Basic Regulation). As additional objectives, the Basic Regulation identifies environmental, economic, proportionality, and harmonisation aspects, which are reflected below.

For the scoring of the impacts, a simple scale ranging from – 5 (very negative) to + 5 (very positive) is used to indicate the positive and negative impacts. The intermediate impact values are:

— – 3 (medium negative),
— – 1 (slightly negative),
— 0 (neutral),
— + 1 (slightly positive), and
— + 3 (medium positive).

This was found to be a simple way to assess the impacts. In addition, each criterion (safety, economic, environmental, etc.) was attributed an equal weight.

### 4.4.2 Data Collection

Maldives accident databases have been used to collect statistics on accidents and serious incidents with light aircraft, as well as safety recommendations related to in-flight recording.

In addition, four studies were performed by EASA in order to assess the potential safety benefits of in-flight recording for light aircraft. The results of these four studies are summarised in Section 4.1.2. The detailed results of these studies are presented in Appendix E.

With regard to the cost, operational impact and benefits of in-flight recording systems, EASA launched a survey from 7 May to 9 June 2015. The survey was focused on aircraft systems which are permanently installed on light aeroplanes and light helicopters, and whose primary function is to record data, audio or images for later analysis or investigation. The survey was addressed to the EASA advisory bodies and to equipment manufacturers. 12 organisations responded (8 aircraft manufacturers, 6 equipment manufacturers, and 1 aircraft owner). The results of this survey are presented in Appendix G.

When a target level of equipment cannot be achieved by introducing a new requirement due to cost impact and proportionality considerations despite the recognised safety benefit, then other ways to achieve it may facilitate or promote the installation of equipment.

## 4.5 What are the impacts?

### 4.5.1 Safety Impact

**Option A.0: Do nothing**

The safety impact of Option A.0 is expected to be negative for commercial operations and neutral for non-commercial operations (refer to Section 4.1.4).

Hence, the overall impact of Option A.0 is considered **slightly negative (– 1).**

**Option A.1: Safety promotion**

When considering Option A.1, the arguments for promoting the recording of basic flight parameters are the ones presented in Table D.1 of Appendix D. The arguments for promoting the recording of cockpit audio are presented in Table D.2 of Appendix D. The arguments for promoting the recording of images are presented in Table D.3 of Appendix D. Table D.4 of Appendix D presents the potential incentives for the various categories of stakeholders.

However, a number of factors may limit the effectiveness of promoting in-flight recording:

1) While organisations (aircraft operators, aero clubs, training organisations) may see benefits of equipping their aircraft with in-flight recording equipment, this may not be the case for individual aircraft owners if there is no return on investment.

2) Another possible hindrance is the protection of in-flight recordings, in particular audio and image recordings, because of their intrinsic privacy content. While a minimum level of protection should be required to avoid misuse, this could in turn make in-flight recording less interesting for day-to-day use, and therefore difficult to promote.

3) Given the limited financial capacity of the target audience and the small size of the aircraft, promotion of in-flight recording is more likely to be convincing if the advocated concept is less prescriptive and can be implemented with equipment primarily designed for other purposes (such as navigation equipment). On the other hand, this would have to be balanced with safety investigation needs (e.g. the memory should not be volatile, the data should not be encrypted, decoding documentation should be available, etc.). Reconciling these two objectives could be challenging.

4) The operational constraints and maintenance cost of installed equipment should be as low as possible. A fit-and-forget approach should be made possible. The equipment should also not be required to be maintained serviceable when it is installed on a voluntary basis, as this would work against promotion. This in return may affect the availability and consequently the safety benefits of the equipment.

It should be noted that CS-STAN could be amended to allow recording equipment to be installed under a standard change (refer to NPA 2016-17, published on 7 December 2016). Indeed, the cost of certifying the installation of such equipment is a major cost contributor. Given the limited financial capacity of operators and owners of light aeroplanes and helicopters, this change in the CS-STAN is important for the effective promotion of recording equipment. On the other hand, if a supplemental type certificate (STC) is required to install the in-flight recording equipment, most likely the certification cost will discourage voluntary installation. When a new part or appliance is installed on an aircraft, except when it is ELA1 or ELA2 aircraft, this requires an authorised release certificate (EASA Form 1) that only a production organisation approval (POA) holder is entitled to issue (refer to Part-21, points 21.A.163 and 21.A.307), unless an equivalent form recognised by bilateral agreements23 is used. In practice, this means that aeroplanes with an MCTOM above 2 000 kg and helicopters with an MCTOM above 600 kg or turbine-engined, or more than 2 occupants, require an EASA Form 1 when a new part or appliance is installed. However, EASA RMT.0018 & RMT.0571 'Installation of parts and appliances that are released without an EASA Form 1 or equivalent'24 should relax the conditions to allow aircraft release after installation of new parts and appliances without an EASA Form 1. This would make it possible for more categories of light aeroplanes and helicopters to benefit from the exemption of EASA Form 1.

In addition, while promotion activities might create an incentive for aircraft operators as well as flight schools and aero clubs to install dedicated in-flight recording equipment, the incentive for individual aircraft owners and private pilots is not strong. Therefore, the safety impact of Option A.1 is expected to be overall medium positive (+ 3) if rules are amended to allow installation of in-flight recording equipment under a standard change and without an EASA Form 1, slightly positive (+ 1) if installation of in-flight recording equipment is possible by means of a minor change, and neutral (0) if the installation requires an STC. For the purpose of scoring, a middle score is retained (+ 1) corresponding to a slightly positive impact.

**Option A.2: ICAO Annex 6**

Option A.2 would affect newly manufactured turbine-engined light aeroplanes and newly manufactured turbine-engined light helicopters operated for CAT.

— When considering the transposition of ICAO Standard 6.3.1.2.1 of Annex 6 Part I:

In accordance with Table B.2 of Appendix B, between 2012 and 2014 there were 134 accidents with aeroplanes registered in the EASA MSs, with an MCTOM of less than 5 700 kg and used for commercial operations (CAT or aerial work). In 5 out of these 134 accidents, the aeroplane was operated for CAT and of a model subject to FDR carriage in accordance with Part-CAT, CAT.IDE.A.190 (multi-engined turbine-powered and MOPSC of more than 9). In the same period, there were 12 accidents of a model subject to recording flight parameters in accordance with Standard 6.3.1.2.1 of Annex 6 Part I. Hence, the safety benefit of transposing Standard 6.3.1.2.1 is considered slightly positive: (12 – 5) = 7 additional accidents are captured (5 %) out of 134.

— When considering the transposition of ICAO Standard 6.3.2.1.1 of Annex 6 Part I:

For aeroplanes, transposing this Standard would in practice mean equipping few aircraft and therefore that would bring very little safety benefit. Indeed, transposing ICAO Standard 6.3.2.1.1 would mean adding a requirement for those aeroplanes which are:

- single-engined turbine-powered, with an MCTOM between 2250 and 5 700 kg and certified for operation with a minimum crew of at least two pilots: no aircraft model in this category is known; and
- multi-engined turbine-powered, with an MOPSC of 9 or less, with an MCTOM between 2250 and 5 700 kg and certified for operation with a minimum crew of at least two pilots. Few aircraft models belong to this category (Beech 90, Raytheon 390, Piper PA42, Cessna Citation I). Between 2006 and 2014, there were only 4 accidents involving aircraft of such models registered in an EASA MS and operated for CAT out of 377 accidents with light aeroplanes used for commercial operations (1 %), with 12 fatalities in total.

Hence, the safety benefit of transposing Standard 6.3.2.1.1 is considered negligible.
Refer to Table 7 for the comparison between current CVR requirements and ICAO Standard 6.3.2.1.1.

— When considering the transposition of ICAO Standard 4.3.1.2.4 of Annex 6 Part III, Section II:

In accordance with Table B.3 of Appendix B, between 2012 and 2014 there were 58 accidents with helicopters operated commercially, with an MCTOM of less than 3 175 kg. None of these helicopters were required to carry a crash-protected flight

recorder or any kind of in-flight recording system in accordance with the current Air Operations rules. In the same period, there were 5 accidents with helicopters operated for CAT and of a model within the scope of Standard 6.3.1.2.1 of Annex 6 Part I (turbine-engined helicopters with an MCTOM of over 2250 kg and operated for CAT). Hence, the safety benefit of transposing Standard 6.3.1.2.1 is considered slightly positive: 5 additional accidents are captured (8 %) out of 58.

**Table 7: Comparison between ICAO Annex 6 Part I and MCAR – Air Operations with regard to recording audio on aeroplanes with an MCTOM of less than 5 700 kg and operated for CAT**

| Reference regulation | CVR/CARS carriage requirement for aeroplanes with an MCTOM of 5 700 kg or less |
|---|---|
| **Regulation MCAR – Air Operations Part-CAT, CAT.IDE.A.185** | CVR required if:<br>— multi-engined turbine-powered aeroplanes,<br>— MOPSC > 9, and<br>— first issued with an individual CofA on or after 1 January 1990. |
| **ICAO Annex 6 Part I Standard 6.3.2.1.1** | CVR or CARS prescribed if:<br>— turbine-engined aeroplanes,<br>— MCTOM > 2250 kg,<br>— certified for operation with a minimum crew of at least two pilots, and<br>— application for type certificate on or after 1 January 2016. |

In conclusion, the safety impact of Option A.2 is considered overall slightly positive (+ 1).

**Option A.3: ICAO Annex 6 with differences**

— When considering aeroplanes:

In accordance with to Table B.2 of Appendix B, between 2012 and 2014 there were 27 accidents with aeroplanes used for commercial operations, and which either were turbine-engined with an MCTOM of 2250 kg or more or had an MOPSC of more than 9. Hence, the safety impact for aeroplanes is considered slightly to medium positive: (27 – 5) = 22 accidents are captured (16 %) out of 134.

— When considering helicopters:

In accordance with Table B.3 of Appendix B, there were 14 accidents with turbine-engined helicopters with an MCTOM of 2250 kg or more and used for commercial

operations. Hence, the safety impact for helicopters is considered medium positive: 14 accidents are captured (24 %) out of 58.

Hence, compared to Option A.2, Option A.3 captures 3 times more historical accidents with aeroplanes (22 instead of 7) and 3 times more accidents with helicopters (14 instead of 5).

In conclusion, the safety impact of Option A.3 is considered medium positive (+ 3).

**Option A.4: Combined solution**

Option A.4 combines Option A.1 and Option A.3, i.e. promotion and requirement for an extended set of aircraft models compared to Option A.2. Therefore, the safety impact of Option A.4 is expected to be overall very positive (+ 5) if the rules are amended to allow for the installation of in-flight recording equipment under a standard change and without an EASA Form 1, and medium positive (+ 3) otherwise. **For the purpose of scoring, a middle score of + 4 is retained (corresponding to medium positive to very positive impact).**

#### *4.5.1.1 Summary of safety impact*

**Table 8A: Comparative safety impact for aeroplanes and helicopters**

| | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Safety Impact** | **– 1**<br><br>Negative impact on commercial operations, and no impact on non-commercial operations | **+ 1**<br><br>— negligible effect if the installation requires an STC;<br>— slightly positive if installation can be made under a minor change approval;<br>— medium positive if the installation can be made by means of a standard change and without an EASA Form 1 | **+ 1**<br><br>Strictly transposing the ICAO Standards would result in a small proportion of accidents covered by in-flight recording | **+ 3**<br><br>Larger proportion of accidents covered than with Option A.2 | **+ 4**<br><br>Combines the safety benefits of A.1 and A.3:<br>— medium positive if the installation requires an STC;<br>— very positive if the installation can be made under a minor change approval or by means of a standard change |

### 4.5.2 Environmental Impact

Whichever the option, it has no foreseeable environmental impact: the environmental impact is considered neutral (0).

### 4.5.3 Social Impact

**Option A.0**

The social impact of Option A.0 is expected to be neutral (0).

**Option A.1**

Fitting a light aeroplane or a light helicopter with equipment capable of recording audio or images may raise questions related to the protection of pilot privacy. The current Air Operations rules only address the protection of the FDR recording and the CVR recording (refer to Appendix D).

However, with Option A.1, every aircraft operator and aircraft owner remains free to install or not such equipment.

Therefore, the social impact of Option A.1 is considered neutral (0).

**Option A.2**

Fitting a light aeroplane or a light helicopter with equipment capable of recording audio or images may raise questions related to the protection of pilot privacy. The current Air Operations rules only address the protection of the FDR recording and the CVR recording (refer to Appendix D).

In order to mitigate this issue, it is proposed that:

— images of the flight crew compartment recorded by a flight recorder (crash-protected or lightweight) cannot be used for purposes other than maintaining or improving safety, or ensuring the flight recorder serviceability;

— if such images are disclosed or used for maintaining or improving safety, then:
  - the flight crew shall give their prior consent, and
  - a procedure related to the handling of images shall be in place;

— when such images are inspected for ensuring the serviceability of the flight recorder:
  - these images shall not be disclosed or used for purposes other than for ensuring the flight recorder serviceability, and
  - if body parts of flight crew members may appear on the images, the operator shall ensure the privacy of these images.

Assuming that such principles are transcribed into rules, the social impact is considered slightly negative (–1).

**Option A.3**

Assuming that principles such as those proposed in Option A.2 are transcribed into rules, the social impact is considered slightly negative (–1).

**Option A.4**

Assuming that principles such as those proposed in Option A.2 are transcribed into rules, the social impact is considered slightly negative (–1).

#### *4.5.3.1 Summary of the Social Impact*

**Table 9A: Comparative social impact for aeroplanes and helicopters**

| | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Social Impact** | **0** | **0**<br><br>Aircraft operators and aircraft owners are free to make decisions with no social impact | **– 1**<br><br>Limited impact if audio and image recordings are protected by rules | **– 1**<br><br>Same as Option A.2 for images<br>No social impact if only flight data are recorded | **– 1**<br><br>Combines the social impact of A.1 and A.3 |

### 4.5.4 Economic Impact

Note: For the purpose of the economic impact assessment, 'recurring cost' means cost occurring once for each individual aircraft concerned.

**Option A.0**

The economic impact of Option A.0 is expected to be neutral (0).

**Option A.1**

Option A.1 would result in a number of stakeholders voluntarily installing some kind of in-flight recording equipment when it is economically reasonable. There is no direct economic benefit from installing an in-flight recording system (refer to Appendix D for the identified benefits). On the other hand, since each aircraft owner or aircraft operator may choose or not to install such equipment in accordance with to Option A.1, it is expected that they will perform such installation only when this is economical for them. For these reasons, the economic impact of Option A.1 is considered neutral (0).
From the safety investigation authorities' perspective, Option A.1 would result in more investigations where an in-flight recording of the sequence of events is available. This would accelerate the investigations, in particular by saving on test and research (refer to Study 1, presented in Appendix E). Study 1 also showed that test and research are performed in about a quarter of the investigations of light aircraft accidents, and in only

half of the cases where test and research were performed would a limited set of flight parameters (such as those recorded by a lightweight flight recorder) be sufficient to avoid performing test and research.

Hence, the overall economic impact of Option A.1 for safety investigation authorities is expected to be slightly positive (+ 1).

**Option A.2**

In accordance with the survey on cost, operational impact and benefits of in-flight recording systems (refer to Appendix G), implementing Option A.2 for the aeroplanes and helicopters involved would result in the cost presented in Table 10A.

These results consider the cost of an STC and the cost of a minor change. If the equipment could be installed under a standard change not requiring approval (performed in accordance with CS-STAN) and not requiring the issue of an EASA Form 1, then the non-recurring cost would be significantly reduced.

Table 10B presents a summary of the fees levied for a standard STC and for a minor change, for light aeroplanes and light helicopters, as set by Regulation (EU) No 319/201426. Table 10B shows that for the categories of aeroplanes and helicopters considered, the fees for an STC may be up to EUR 5 000. In addition, an STC usually requires an in-depth demonstration by the applicant, which adds costs. Based on the results of the survey presented in Appendix G, it is assumed that the cost for design, testing and certification ranges between EUR 100 000 and 300 000 in the case where an STC is required.

If the installation of in-flight recording equipment could be performed under a minor change (hence not requiring an STC), the certification fees would be below EUR 1 000. In addition, the other cost for the certification demonstration could be reduced by several tens of thousands of euros (given that the certification efforts would be much less). It is assumed that the cost for design, testing and certification ranges between EUR 10 000 and 50 000 in the case where a minor change approval is required. Further to that, a minor change is a change that has no appreciable effect 'on the mass, balance, structural strength, reliability, operational characteristics, noise, fuel venting, exhaust emission, or other characteristics affecting the airworthiness of the product' (refer to Part-21, point 21.A.91). Hence, the installation of equipment performed under a minor change is expected to be simple and therefore to require limited efforts in terms of design and testing. Consequently, design and test costs are also expected to be reduced compared to the installation of equipment that requires an STC.

If a standard installation of the in-flight recording equipment (under CS-STAN) was made possible, then there would be no cost for installation certification.

Given that Option A.2 is only applicable to aeroplanes and helicopters manufactured after a given date in the future, it is assumed that in practice this option will be implemented by aircraft manufacturers which will offer it as an option upon aircraft delivery (as it is already the case for some aircraft models). One may assume that a manufacturer is best positioned to play on scales in order to get a low unit purchase price and to distribute the installation design, test and certification costs over a large number of individual aircraft. In addition, for forward-fit, there is no additional cost generated by aircraft downtime, and the number of hours needed to install the equipment is reduced compared to a retrofit. For example, assuming that the equipment interacts with some aircraft systems in order to retrieve data, so that its installation is considered complex and requires three 8-hour days at 100 EUR/working hour, then the corresponding cost is EUR 2 400. If, on the other hand, the equipment does not interact with the aircraft systems, then one 8-hour day could be assumed, which corresponds to EUR 800 of installation cost. It is assumed that the installation cost ranges between EUR 500 and 3 000.

**Table 10A: Main cost items of installing a lightweight flight recorder compliant with EUROCAE Document 155**

| Cost item | Range of cost in USD | Recurring or non-recurring cost | Comment |
|---|---|---|---|
| Unit purchase price | from 18,100 to 45,000 | Recurring | Unit price depends on equipment model and effect scale |
| Equipment Cost | 1,600 - | Recurring | Eg Brackets, housing |
| Cost of Accessories | 2,600 - | Recurring | Eg. microphones |
| Installation design, installation test and installation certification (assuming that the installation requires an STC) | From 5,000 to 10,000 | Non-recurring | STC Cost |
| Equipment installation | Cost of Man-hours | Recurring | |

**Table 10B: Fees levied by Maldives CAA for Minor and Major Changes**

| Aircraft category | Type of certification approval | Fee levied by the CAA (in USD) |
|---|---|---|
| Any | Minor Change | 32.55 |

| | | |
|---|---|---|
| Any | Major Change | 65.11 |

Table 11 shows that the range of cost per individual aircraft varies between USD 24,000 and 37,000. This is considering the fleet size in the Maldives and the type of approval required.

Hence, the economic impact is considered medium negative (– 3) since an STC is required.

**Table 11: Example of cost computation of installing a lightweight flight recorder compliant with EUROCAE Document 155 based on different scenarios (year 2016 price)**

| Conditions | Total cost per individual aircraft | Comment |
|---|---|---|
| Cost for installation design, USD 5,000 (STC required)<br>Small series (15 aircraft)<br>Unit price is USD 32,000<br>Installation cost is USD 4,000 (complex installation) | Cost = 32,000 + (5,000/15) + 4,000<br>= USD 36,333.33 | STC with high cost, small series |
| Cost for installation design, USD 5,000 (STC required)<br>Small series (60 aircraft)<br>Unit price is USD 20,000<br>Installation cost is USD 4,000 (complex installation) | Cost = 20,000 + (5,000/15) + 4,000<br>= USD 24,333.33 | STC with median cost, large series |

With regard to safety investigation authorities, the economic impact is considered slightly positive (+ 1), similar to Option A.1.

**Option A.3**

The categories of aircraft considered are slightly different from those considered for Option A.2, but this difference is not expected to have any influence. Hence the economic impact for the industry is also considered medium negative (– 3) if an STC is required, and slightly negative (– 1) if it is not. A middle score of – 2 (medium to slightly negative) is retained.

With regard to safety investigation authorities, the economic impact is considered slightly positive (+ 1), similar to Option A.1.

**Option A.4**

The economic impact of Option A.4 for industry, being a combination of Option A.1 (no economic impact) and Option A.3 (economic impact medium negative), is expected to be medium negative (– 3) if an STC is required and slightly negative (– 1) if it is not. A middle score of – 2 (medium to slightly negative) is retained.

With regard to safety investigation authorities, the economic impact is considered medium positive (+ 3), since this Option combines Option A.1 and Option A.3, and it is

expected that more aircraft will be equipped with in-flight recording equipment than in any of the other options considered.

#### *4.5.4.1 Summary of the Social Impact*

**Table 13A: Comparative economic impact for aeroplanes and helicopters**

| | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Economic Impact** | **0** | **0 for industry**<br>Aircraft operators and aircraft owners are free to make decisions with no economic impact<br><br>**+1 for authorities**<br>In-flight recording equipment accelerates investigation | **– 2 for industry**<br>Impact is medium negative if STC is required, slightly negative otherwise<br><br>**+1 for authorities**<br>In-flight recording equipment accelerates investigation | **– 2 for industry**<br>Impact is medium negative if STC is required, slightly negative otherwise<br><br>**+1 for authorities**<br>In-flight recording equipment accelerates investigation | **– 2 for industry**<br>Combines the economic impact of A.1 and A.3<br><br>**+1 for authorities**<br>In-flight recording equipment accelerates investigation |

### 4.5.5 General aviation and proportionality issues

#### *4.5.5.1 Impact of the options for aeroplanes and helicopters*

**Option A.0**

The impact of Option A.0 is expected to be neutral (0).

**Option A.1**

Option A.1 is about promoting (not requiring) the installation of in-flight recording systems on aeroplanes and helicopters. In accordance with Option A.1, aircraft manufacturers, aircraft operators and aircraft owners remain free to install or not such systems. Hence, the impact of Option A.1 is neutral (0).

**Option A.2**

Option A.2 affects turbine-engined light aeroplanes and turbine-engined light helicopters with unit price typically ranging from EUR 1 500 000 to 5 000 000, and Option A.2 is applicable to CAT operations only.

Option A.2 includes a requirement to record basic flight parameters (by means of an FDR, ADRS or Class C AIR or AIRS) on board turbine-engined aeroplanes operated for CAT without any MCTOM or MOPSC threshold. Hence, potentially turboprop aeroplane models with an MCTOM of less than 2250 kg (such as Pilatus PC6, Cessna 206, Piper PA46 and PA34) could be subject to such a requirement if they were operated for CAT. While the cost of installing the equipment (between EUR 4 000 and 25 000; see Section 4.4.4) is low when compared to the purchase price of such aircraft models, their limited passenger capacity (e.g. only 5 passengers for the Cessna 206 or the Piper PA46) results in limited revenue per flight.

Therefore, the overall impact of Option A.2 is considered slightly negative (– 1).

**Option A.3**

Option A.3 only includes turbine-engined aeroplanes and helicopters with an MCTOM of more than 2250 kg and aeroplanes with an MOPSC of more than 9. Hence, Option A.3 does not affect those aeroplane and helicopter models which are usually operated for recreational activities, or whose passenger capacity is very small.
Unlike Option A.2, Option A.3 encompass, in addition to CAT operations, commercial SPO, i.e. aerial work activities which are remunerated and are either available to the public or performed under a contract between the aircraft operator and a customer that has no control over the operator. In summary, the stakeholders affected by Option A.3 are commercial operators selling passenger tickets or services related to aerial work activities.

Hence, the overall impact of Option A.3 is considered neutral (0).

**Option A.4**

The impact of Option A.4, being a combination of Option A.1 (no impact) and Option A.3 (neutral), is expected to be neutral (0).

#### *4.5.5.2 Summary of impact on general aviation and proportionality issues*

**Table 14A: Impact for aeroplanes and helicopters**

| | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Impact on general aviation and** | **0** | **0**<br>Aircraft operators and aircraft | **– 1**<br>Impact on very light | **0**<br>Does not impact turboprop | **0**<br>Combines the impacts of A.1 and A.3 |

| | | | | | |
|---|---|---|---|---|---|
| **proportionality issues** | | owners are free to make decisions with no impact | turboprop aeroplanes | aeroplanes of less than 2250 kg | on general aviation and proportionality issues |

### 4.5.6 Impact on better Regulation and Harmonisation

#### *4.5.6.1 Impact of the options for aeroplanes and helicopters*

**Option A.0**

The impact of Option A.0 is expected to be neutral (0).

**Option A.1**

Option A.1 is about promoting (not requiring) the installation of in-flight recording systems on aeroplanes and helicopters. Hence, the impact of Option A.1 on rules harmonisation and better regulation is considered neutral (0).

**Option A.2**

Option A.2 is about fully transposing ICAO Standards of Annex 6 Part I and III related to lightweight flight recorders. Hence, it would improve the harmonisation of Regulation (EU) No 965/2012 on Air Operations with ICAO Standards.

Option A.2 would not simplify the existing Air Operations rules. It would actually make the rules applicable to aeroplanes with an MCTOM between 2250 and 5 700 kg more complex, with multiple cases depending on the type and the number of engines, the number of passengers, and the number of pilots required (see Table 15A).

Option A.2 would not make the rules applicable to helicopters more complex (see Table 15B).

Option A.2 would not contradict the General Aviation Safety Strategy and Roadmap since only aircraft used for CAT operation are within the scope of this Option.

Hence, the overall impact of Option A.2 on rules harmonisation and better regulation is considered slightly positive (+ 1).

**Table 15A: Summary of in-flight recording requirements applicable to newly manufactured aeroplanes operated for CAT, if Option A.2 is elected (the new requirements appear in bold)**

| | **MCTOM < 2250 kg** | **2250 ≤ MCTOM ≤ 5 700 kg** | **MCTOM > 5 700 kg** |
|---|---|---|---|
| Not turbine-engined | NIL | – NIL | FDR and CVR required in all cases |
| Turbine-engined | **Record basic flight parameters (by means of an FDR or an ADRS or a Class C AIR or AIRS)** | – If multi-engined turbine-powered and MOPSC of more than 9: FDR and CVR required<br>– If turbine-engined and certified for operation with two or more pilots: record basic flight parameters by means of an FDR or an ADRS or a Class C AIR or AIRS) and record audio (by means of a CVR or CARS)<br>– In all other cases: record basic flight parameters only (by means of an FDR or an ADRS or a Class C AIR or AIRS) | FDR and CVR required in all cases |

**Option A.3**

Option A.3 is about introducing requirements which are not fully transposing ICAO Standards in Annex 6 Part I and III related to lightweight flight recorders. Hence, the harmonisation of the Air Operations rules with the ICAO Standards would be less improved with Option A.3 than with Option A.2.

On the other hand, compared to Option A.2, Option A.3 introduces less complexity into the Air Operations rules applicable to aeroplanes with an MCTOM between 2250 and 5 700 kg.

With regard to helicopters, there is no difference between Option A.2 and Option A.3. Option A.3 would not contradict the General Aviation Safety Strategy and Roadmap since only commercial operations and aircraft models which are not commonly used for recreational activities are within the scope of this Option.

Therefore, the impact of Option A.3 is considered slightly positive (+ 1).

**Table 16A: Summary of in-flight recording requirements applicable to aeroplanes if Option A.3 is selected (the new requirements appear in bold)**

<table>
<tr><th></th><th>MCTOM < 2250 kg</th><th>MCTOM between 2250 and 5 700 kg</th><th>MCTOM > 5 700 kg</th></tr>
<tr><td>No turbine engine</td><td rowspan="2">If MOPSC > 9 PAX: Record basic flight parameters (by means of an FDR or an ADRS or a Class C AIR or AIRS)</td><td>If MOPSC > 9 PAX: Record basic flight parameters (by means of an FDR or an ADRS or a Class C AIR or AIRS)</td><td rowspan="3">FDR and CVR required in all cases</td></tr>
<tr><td>One turbine engine</td><td>Record basic flight parameters (by means of an FDR or an ADRS or a Class C AIR or AIRS)</td></tr>
<tr><td>Multiple turbine engines</td><td colspan="2">If MOPSC > 9: FDR and CVR required</td></tr>
</table>

**Option A.4**

As Option A.4 is a combination of Option A.1 (no impact) and Option A.3 (impact slightly positive), its impact is expected to be slightly positive (+ 1).

#### *4.5.6.2 Summary of impact on better regulation and harmonisation*

**Table 17A: Impact for aeroplanes and helicopters**

| | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Impact on better regulation and harmonisation** | **0** | **0**<br>Promotion, no impact on regulations | **+ 1**<br>Fully transposes ICAO Standards; however, makes the rules slightly more complex with multiple conditions | **+ 1**<br>Partially transposes the ICAO Standards | **+ 1**<br>Combines the impact of A.1 and A.3 on better regulation and harmonisation |

## 4.6 Conclusion

### 4.6.1 Comparison of options

The strengths and weaknesses of each option are presented in Table 18A (for aeroplanes and helicopters) and Table 18B (for balloons).

In conclusion, when considering aeroplanes and helicopters, Option A.2 (strictly transpose ICAO Standards into requirements) would result in limited safety benefits, which would not outweigh the economic impact and the impact on proportionality issues. Option A.3 (transpose ICAO Standards with some differences) would result in somewhat greater safety benefits for a similar economic impact and impact on proportionality issues than Option A.2 would. Option A.1 (promote the recording of basic flight parameters, audio and/or a view of the instruments panel) would bring limited safety benefits, and would have no other kind of impact. Hence, Option A.4 (which is a combination of Option A.1 and Option A.3) seems to be the best option. It should also be noted that the overall score of any option may vary depending on whether the in-flight recording system installation would require an STC approval, a minor change approval or if the installation could be performed under CS-STAN.

With regard to balloons, Option B.1 (promote the installation of means to record the trajectory and images from the basket interior) would bring limited safety benefits, and would have no other kind of impact. Option B.2 (mandate means to record trajectory parameters and images from the basket interior for balloons with an MCTOM of 3 000 kg or more) would result in limited safety benefits, which would not outweigh the

economic impact and the impact on proportionality issues. In addition, it would introduce more requirements while the intent of EASA Opinion No 01/2016 is to simplify the requirements for balloon operations. Option B.3, which combines Option B.1 and Option B.2, would overall bring slightly more safety benefits than Option B.2 would — however, still not outweighing the negative economic impact nor the negative impact on proportionality issues and rules complexity. Therefore, B.1 seems to be the only appropriate option at this stage.

**Table 18A: Detailed comparison of impacts between the various options for aeroplanes and helicopters**

| Option | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Option description** | Baseline option (no change to the rules and no promotion); risks remain as outlined in the issue analysis | Promote the recording of basic flight parameters, audio and/or a view of the instruments panel for all models of light aeroplanes and light helicopters and for all types of operation (no change to the rules). | Strictly transpose ICAO Standards in Annex 6 for newly manufactured light turbine-engined aeroplanes and newly manufactured light turbine-engined helicopters operated for CAT. | Transpose ICAO Standards in Annex 6 with the following differences:<br>– With regard to aeroplanes, the applicability set is newly manufactured aeroplanes which have an MOPSC of more than 9 or which are turbine-engined and have an MCTOM of 2250 kg or more.<br>– The requirement to record basic flight parameters on board aeroplanes and helicopters is also applicable to commercial SPO.<br>– Recording of audio is not required. | Option A.1 + Option A.3 |
| **Safety impact** | **– 1**<br>Negative impact on commercial operations, no impact on non-commercial operations | **+ 1**<br>– — No effect if the installation requires an STC;<br>– — Slightly effective if installation can be performed under a | **+ 1**<br>Strictly transposing the ICAO Standards would result in a small proportion of accidents covered by in-flight recording | **+ 3**<br>Larger proportion of accidents covered than in Option A.2 | **+ 4**<br>Combines the safety benefits of A.1 and A.3: medium effective if the installation requires an STC; very effective if the installation can be |

| Option | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| | | minor change approval;<br>– — Medium effective if the installation can be performed by means of a standard change and without an EASA Form 1 | | | performed under a minor change approval or by means of a standard change |
| **Environmental impact** | **0** | **0**<br>No impact on environment | **0**<br>No impact on environment | **0**<br>No impact on environment | **0**<br>No impact on environment |
| **Social impact** | **0** | **0**<br>Aircraft operators and aircraft owners are free to make decisions with no social impact | **– 1**<br>Reduced social impact, assuming that some requirements are introduced to protect audio and image recordings | **– 1**<br>Same as for Option A.2 for images<br>No social impact if only flight data is recorded | **– 1**<br>Combines the social impact of A.1 and A.3 |
| **Economic impact** | **0** | **0 for industry**<br>Aircraft operators and aircraft owners are free to make decisions with no economic impact | **– 2 for industry**<br>Impact is medium negative if STC is required, slightly negative otherwise | **– 2 for industry**<br>Impact is medium negative if STC is required, slightly negative otherwise | **– 2 for industry**<br>Combines the economic impact of A.1 and A.3 |
| | | **+ 1 for authorities**<br>In-flight recording equipment accelerates investigation | **+ 1 for authorities**<br>In-flight recording equipment accelerates investigation | **+ 1 for authorities**<br>In-flight recording equipment accelerates investigation | **+ 3 for authorities**<br>In-flight recording equipment accelerates investigation |

| Option | Option A.0 | Option A.1 | Option A.2 | Option A.3 | Option A.4 |
|---|---|---|---|---|---|
| **Impact on general aviation and proportionality issues** | **0** | **0**<br>Aircraft operators and aircraft owners are free to make decisions with no impact | **– 1**<br>Impact on turboprop below 2250 kg | **0**<br>Does not impact on turboprop aeroplanes below 2250 kg | **0**<br>Combines the impacts on general aviation and proportionality of A.1 and A.3 |
| **Impact on better regulation and harmonisation** | **0** | **0**<br>Promotion, no impact on regulations | **+ 1**<br>Fully transposes the ICAO Standards; however, it makes the rules complex with multiple conditions | **+ 1**<br>Partially transposes the ICAO Standards | **+ 1**<br>Combines the impacts on general aviation and proportionality of A.1 and A.3 |
| **Total score (assuming all impact dimensions have a weight of 1)** | **– 1** | **+ 1** | **– 2** | **+ 1** | **+ 2** |

## 4.7 Monitoring and evaluation

Monitoring and evaluation is a continuous and systematic process of data collection and analysis about the implementation and effectiveness of a rule or activity. It generates factual information for future evaluations and impact assessments and helps to identify implementation problems.

The options retained by this IA are basically the following two categories:

1) Safety promotion: promoting the voluntary installation of in-flight recording equipment (Option A.1 for aeroplanes and helicopters, and Option B.1 for balloons); and

2) Equipment requirements: mandating the carriage of lightweight flight recorders (Option A.3, only applicable to aeroplanes and helicopters).

### 4.7.1 Monitoring implementation

With regard to the first category of options (safety promotion), it is proposed to monitor their impact by means of a survey conducted 1 year after initiating safety promotion in order to check:

— how many stakeholders have been reached by the safety promotion activities;

— what are the most and the least convincing arguments of the safety promotion material; and

— how many stakeholders have decided to install in-flight recording equipment as a consequence of the safety promotion activities.

With regard to the second category of options (equipment requirements), no monitoring is considered necessary because Option A.3 is about mandating the installation of equipment which is already commercially available on newly manufactured, light aeroplanes and helicopters. Hence, no technical implementation issue is expected.

### 4.7.2 Evaluating the effectiveness of options (after implementation)

All retained options serve the common objective of increasing the overall ratio of light aeroplanes, light helicopters and balloons which are fitted with in-flight recording equipment. The evaluation should consist in assessing whether the increase of the level of equipage has contributed to enhancing safety for light aircraft, either directly (by

making the use of light aircraft safer and better monitored by operators, flight schools, aero clubs, etc.) or indirectly (by facilitating more in-depth investigations and the identification of more effective corrective actions).
The evaluation of the effectiveness could be done by category of aircraft (aeroplanes, helicopters, balloons) because of the fundamental differences in the way of piloting, the operational context and the stakeholders involved.

Hence, it is proposed to check, for each category of light aircraft (light aeroplanes, light helicopters, and balloons):

— whether the carriage of in-flight recording equipment makes the day-to-day use of the aircraft safer; and

— whether the investigations of accidents and serious incidents involving light aircraft can identify causes (otherwise unknown or not well understood) thanks to in-flight recording equipment, and determine corrective actions with more significant influence on the prevention of future accidents.

# 5 Proposed actions to support implementation

Maldives CAA is committed to providing support for the implementation of the new rules. The range of activities developed in this regard will vary depending on the complexity of the rules, the affected stakeholders, as well as on the amount and type of resources allocated by stakeholders to ensure compliance with the new rules.

The feedback from stakeholders is crucial in determining the type of activities that will be developed. In this respect, any constructive feedback provided via different communication channels (e.g. regular meetings with the EASA advisory bodies, development of frequently asked questions published on the EASA website, or a combination of the above) will be taken into consideration once the new rules are applicable.

# 6 References

## 6.1 Affected regulation

— MCAR-26

## 6.2 Affected decisions

— Reserved

## 6.3 Other reference documents

— Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1), as last amended

— Decision N° 2012/015/Directorate R of the Executive Director of the Agency of 24th October 2012 on Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (Guidance Material to Annex I — Definitions)

— Decision 2014/017/R of the Executive Director of the Agency of 24 April 2014 adopting Acceptable Means of Compliance and Guidance Material to Part-ORO of Regulation (EU) No 965/2012 and repealing Decision 2012/017/R of 24 October 2012 'AMC and GM to Part-ORO — Issue 2'

— Decision 2014/015/R of the Executive Director of the Agency of 24 April 2014 adopting Acceptable Means of Compliance and Guidance Material to Part-CAT of Regulation (EU) No 965/2012 and repealing Decision 2012/018/R of the Executive Director of the Agency of 24 October 2012 ('AMC and GM to Part-CAT — Issue 2')

— Decision 2014/018/R of the Executive Director of the Agency of 24 April 2014 adopting Acceptable Means of Compliance and Guidance Material to Part-SPO of Regulation (EU) No 965/2012 ('AMC and GM to Part-SPO')

— ICAO Annex 6, Part I (Amendment 38)

— ICAO Annex 6, Part II (Amendment 33)

— ICAO Annex 6, Part III (Amendment 19)

— EASA Research Project 'Investigation of the technical feasibility and safety benefit of a light aeroplane operational Flight Data Monitoring (FDM) system', dated 16 December 2008

— European General Aviation Strategy, dated 30 August 2012

— EASA Management Board meeting 04/2012 of 11 December 2012, working paper 9a: Roadmap for Regulation of GA.

# 7 Appendices

## 7.1 Appendix A: Comparison of Maldives Air Operations rules and provisions of ICAO Annex 6

Table A.1 presents a comparative of MCAR – Air Operations and the provisions of ICAO Annex 6 related to in-flight recording capability for CAT with aeroplanes.

Table A.2 presents a comparative of MCAR – Air Operations and the provisions of ICAO Annex 6 related to in-flight recording capability for CAT with helicopters.

Note: In ICAO Annex 6 Part III, the MCTOM break for crash-protected flight recorder carriage requirements is set at 3 180 kg, while in Regulation (EU) No 965/2012 on Air Operations it is set at 3 175 kg.

## Table A.1 CAT aeroplanes

Aeroplanes operated for CAT

| Function | Reference text | MCTOM over 5 700 kg | MCTOM up to 5 700 kg |
|---|---|---|---|
| **Flight parameters** | MCAR – Air Operations Part-CAT | FDR required if:<br>– first issued with an individual CofA on or after 1 June 1990, or<br>– turbine-engined. | FDR required if:<br>– multi-engined turbine-powered, and<br>– MOPSC of more than 9, and<br>– first issued with an individual CofA on or after 1 April 1998. |
| | ICAO Annex 6 Part I Standards | FDR required if:<br>– first issued with an individual CofA on or after 1 January 1989, or<br>– turbine-engined. | FDR or ADRS or Class C AIR required if:<br>– turbine-engined, and<br>– application for TC submitted on or after 1 January 2016. |
| | ICAO Annex 6 Part I Recommended Practices | (No Recommended Practice on carriage of recording equipment) | FDR required if:<br>– multi-engined turbine-powered, and<br>– first issued with an individual CofA on or after 1 January 1990.<br><br>FDR or ADRS or Class C AIR required if:<br>– turbine-engined, and<br>– first issued with an individual CofA on or after 1 January 2016. |
| **Audio** | MCAR – Air Operations Part-CAT | CVR required | CVR required if:<br>– multi-engined turbine-powered, and<br>– MOPSC of more than 9, and |

| Function | Reference text | MCTOM over 5 700 kg | MCTOM up to 5 700 kg |
|---|---|---|---|
| | | | – first issued with an individual CofA on or after 1 January 1990. |
| | ICAO Annex 6 Part I Standards | CVR required if:<br>– turbine-engined and MCTOM of over 27 000 kg and prototype was certified after 30 September 1969, or<br>– first issued with an individual CofA on or after 1 January 1987. | CVR or CARS required if:<br>– turbine-engined, and<br>– MCTOM of over 2250 kg, and<br>– required to be operated by more than one pilot, and<br>– application for TC submitted on or after 1 January 2016. |
| | ICAO Annex 6 Part I Recommended Practices | CVR required if turbine-engined and prototype was certified after 30 September 1969. | CVR or CARS required if:<br>– turbine-engined, and<br>– MCTOM of over 2250 kg, and<br>– required to be operated by more than one pilot, and<br>– first issued with an individual CofA on or after 1 January 2016. |
| **Data-link messages** | MCAR – Air Operations Part-CAT | Recording required if:<br>– CVR is required, and<br>– capable to operate data-link messages, and<br>– first issued with an individual CofA on or after 8 April 2014. | Recording required if:<br>– CVR is required, and<br>– capable to operate data-link messages, and<br>– first issued with an individual CofA on or after 8 April 2014. |
| | ICAO Annex 6 Part I Standards | Recording required if:<br>– CVR is required, and<br>– aircraft utilise any of the data-link communication applications listed, and<br>– first issued with an individual CofA on or after 1 January 2016. | Recording required if:<br>– CVR is required, and<br>– aircraft utilise any of the data-link communication applications listed, and<br>– first issued with an individual CofA on or after 1 January 2016. |

| Function | Reference text | MCTOM over 5 700 kg | MCTOM up to 5 700 kg |
|---|---|---|---|
| | | + Recording required if:<br>– CVR is required, and<br>– aircraft modified on or after 1 January 2016 for the installation and utilisation of any of the data-link communication applications listed. | + Recording required if:<br>– CVR is required, and<br>– aircraft modified on or after 1 January 2016 for the installation and utilisation of any of the data-link communication applications listed. |
| | ICAO Annex 6 Part I Recommended Practices | (No Recommended Practice on carriage of recording equipment) | (No Recommended Practice on carriage of recording equipment) |

## Table A.2 CAT helicopters

Helicopters operated for CAT

| Function | Reference text | MCTOM over 3 175 kg | MCTOM up to 3 175 kg |
|---|---|---|---|
| **Flight parameters** | MCAR – Air Operations Part-CAT | FDR required if:<br>– MCTOM of over 3 175 kg and first issued with an individual CofA on or after 1 August 1999, or<br>– MCTOM of over 7 000 kg or MOPSC of more than 9, and first issued with an individual CofA on or after 1 January 1989. | No carriage requirement. |
| | ICAO Annex 6 Part III Standards | FDR required if:<br>– first issued with an individual CofA on or after 1 January 2016, or<br>– MCTOM of over 7 000 kg or passenger seating configuration of more than 19 and first issued with an individual CofA on or after 1 January 1989. | FDR or ADRS or Class C AIR required if:<br>– turbine-engined, and<br>– MCTOM of over 2250 kg, and<br>– application for TC submitted on or after 1 January 2018. |
| | ICAO Annex 6 Part III Recommended Practices | FDR required if first issued with an individual CofA on or after 1 January 1989. | FDR or ADRS or Class C AIR required if first issued with an individual CofA on or after 1 January 2018. |
| **Audio** | MCAR – Air Operations Part-CAT | CVR required if:<br>– MCTOM of over 7 000 kg, or<br>– MCTOM of over 3 175 kg and first issued with an individual CofA on or after 1 January 1987. | No carriage requirement. |

| Function | Reference text | MCTOM over 3 175 kg | MCTOM up to 3 175 kg |
|---|---|---|---|
| | ICAO Annex 6 Part III Standards | CVR required if MCTOM over 7 000 kg. | (No Standard on carriage) |
| | ICAO Annex 6 Part III Recommended Practices | CVR required if first issued with an individual CofA on or after 1 January 1987. | (No Recommended Practice on carriage) |
| **Data-link messages** | MCAR – Air Operations Part-CAT | Recording required if:<br>– CVR is required, and<br>– capable to operate data-link messages, and<br>– first issued with an individual CofA on or after 8 April 2014. | Recording required if:<br>– CVR is required, and<br>– capable to operate data-link messages, and<br>– first issued with an individual CofA on or after 8 April 2014. |
| | ICAO Annex 6 Part III Standards | Recording required if:<br>– CVR is required, and<br>– aircraft utilise any of the data-link communication applications listed, and<br>– first issued with an individual CofA on or after 1 January 2016.<br><br>+ Recording required if:<br>– CVR is required, and<br>– aircraft modified on or after 1 January 2016 for the installation and utilisation of any of the data-link communication applications listed. | Recording required if:<br>– CVR is required, and<br>– aircraft utilise any of the data-link communication applications listed, and<br>– first issued with an individual CofA on or after 1 January 2016.<br><br>+ Recording if:<br>– CVR is required, and<br>– aircraft modified on or after 1 January 2016 for the installation and utilisation of any of the data-link communication applications listed. |
| | ICAO Annex 6 Part III Recommended Practices | (No Recommended Practice on carriage) | (No Recommended Practice on carriage) |

## 7.2 Appendix C: Safety recommendations related to in-flight recording for light aircraft

Tables C.1 and C.2 present an inventory of safety recommendations related to in-flight recording for light aircraft and issued by safety investigation authorities of EASA MSs since 2000.

Table C.1 presents the reference information and the full text of the safety recommendations[1].

Table C.2 presents the application domain of these safety recommendations, as well as the characteristics of the aircraft actually involved in the investigated accidents and serious incidents that triggered safety recommendations.

[1] For convenience, some safety recommendations were translated into English. As accurate as the translation may be, the original text of the safety recommendation should be consulted when in doubt.

**Table C.1: Reference and text of safety recommendations related to in-flight recording, and issued by safety investigation authorities of the EASA MSs since 2000**

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| UNKG-2001-001 | No | N/A | No | 08/01/2001 | It is recommended that the CAA should: a. Encourage the development of a suitable lightweight and low-cost Voice, Data and Combined recorder and the installation of such equipment by operators. b. Consider whether such flight recorders should be introduced for operations such as dedicated police and HEMS operations involving as they do, the exposure of third parties to risk not present in normal Public Transport operations. | 26/07/1998 | UK |
| UNKG-2001-038 | No | N/A | No | 31/07/2001 | The CAA should take forward to the JAA a proposal to re-examine the criteria for the carriage of flight recorders by mult-piston engine aircraft, which have in force a certificate of airworthiness in the Transport Category (Passenger) and are certified to carry more than 9 passengers with a view to requiring all aircraft, whether piston or turbine | 03/09/1999 | UK |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | powered, to carry at least a Cockpit Voice Recorder. | | |
| FRAN-2001-038 | No | N/A | No | 01/07/2001 | Consequently, the BEA recommends that:<br>• the DGAC and the JAA make mandatory the installation of at least one flight recorder on board public transport aircraft authorized to carry more than nine passengers and whose maximum certified take-off weight is less than or equal to 5,700 kg, whatever the date of certification may be. | 24/03/2001 | France |
| GREC-2002-027 | No | N/A | No | 12/04/2005 | At national level, the HCAA should take care of equip the helicopters in subject with CVR, regardless to the provisions in ANNEX 6, part III, referring to helicopters operating in special conditions as the HELITALIA's helicopters do. | 14/01/2001 | Greece |
| FRAN-2003-012 | No | N/A | No | 21/08/2003 | Consequently, the BEA recommends that:<br>• the DGAC and the J.A.A. urgently take into account, for safety reasons, the need for flight recorders for the rapid determination of the causes and | 24/03/2001 | France |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | circumstances of accidents which occur in public air transport and that, to this end, these organizations:<br>- impose as soon as possible, without any possible exemptions, the carriage of at least one flight recorder on aircraft operating for public transport with a maximum certificated takeoff weight lesser than 5,700 kg and whose maximum approved passenger seating configuration is ten seats or more, whatever the date of certification may be;<br>- extend these provisions to airplanes of the same type transporting cargo; -<br>study the extension of these provisions to helicopters operated for public transport. | | |
| GREC-2003-029 | No | N/A | No | 12/04/2005 | CVR Despite ICAO restrictions as mentioned in ANNEX 6, Part III, referring to CVR installation, all Public Transport helicopters on a national level should be equipped with said equipment. The AAIASB after the helicopter accident on January 14, 2001, issued ist ASA 2002/2, | 16/06/2002 | Greece |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | dated 3-7-2002 and insists in the implementation of the aforementioned ASA once again. | | |
| FRAN-2003-012 | No | N/A | No | 21/08/2003 | Consequently, the BEA recommends that:<br>• the DGAC and the J.A.A. urgently take into account, for safety reasons, the need for flight recorders for the rapid determination of the causes and circumstances of accidents which occur in public air transport and that, to this end, these organizations:<br>- impose as soon as possible, without any possible exemptions, the carriage of at least one flight recorder on aircraft operating for public transport with a maximum certificated takeoff weight lesser than 5,700 kg and whose maximum approved passenger seating configuration is ten seats or more, whatever the date of certification may be;<br>- extend these provisions to airplanes of the same type transporting cargo; - study the extension of these provisions | 24/03/2001 | France |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | to helicopters operated for public transport. | | |
| GREC-2003-029 | No | N/A | No | 12/04/2005 | CVR Despite ICAO restrictions as mentioned in ANNEX 6, Part III, referring to CVR installation, all Public Transport helicopters on a national level should be equipped with said equipment. The AAIASB after the helicopter accident on January 14, 2001, issued ist ASA 2002/2, dated 3-7-2002 and insists in the implementation of the aforementioned ASA once again. | 16/06/2002 | Greece |
| GREC-2004-020 | No | N/A | No | 12/04/2005 | All h/c for public transportation should be equipped with CVR, FDR, ELT and ULT devices. | 11/02/2003 | Greece |
| UNKG-2004-084 | No | N/A | No | 19/11/2004 | The Department for Transport should urge the International Civil Aviation Organisation (ICAO) to promote the safety benefits of fitting, as a minimum, cockpit voice recording equipment to all aircraft operating with a Certificate of Airworthiness in the Commercial Air Transport category, regardless of weight or age. | 19/07/2003 | UK |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| UNKG-2004-085 | No | N/A | No | 19/11/2004 | The Department for Transport should urge the International Civil Aviation Organisation (ICAO) to promote research into the design and development of inexpensive, lightweight, airborne flight data and voice recording equipment. | 20/07/2003 | UK |
| N/A | No | N/A | No | 27/05/2005 | It is recommended to assess the opportunity to make mandatory the installation of a CVR and an FDR on all helicopters operating for HEMS and SAR. | 13/08/2003 | Italy |
| UNKG-2005-062 | Yes | Closed | No, it was addressed by creation of TSO 2C-197 on information collection and monitoring systems | 24/06/2005 | It is recommended that the European Aviation Safety Agency develop standards for appropriate recording equipment that can be practically implemented on small aircraft. | 27/06/2004 | UK |
| UNKG-2005-100 | Yes | Closed | No, it was addressed by EASA | 04/05/2006 | The EASA should promote research into the design and development of | 22/01/2005 | UK |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | Research Project EASA.2007.OP.18 | | inexpensive, lightweight, airborne flight data and voice recording equipment. | | |
| UNKG-2005-101 | Yes | Closed | Yes | 04/05/2006 | The EASA should promote the safety benefits of fitting, as a minimum, CVR equipment to all aircraft operated for the purpose of commercial air transport, regardless of weight or age. | 22/01/2005 | UK |
| DENM-2006-002 | No | N/A | No | 01/01/2006 | The Danish Civil Aviation Administration should consider whether a Flight Recorder should be required for all commercial aviation in order to improve the operator's opportunities for supervision. The data recorded for small aircraft should at least include time, position and flying altitude. | 06/08/2004 | Denmark |
| IRLD-2008-014 | Yes | Closed | No, it was addressed by EASA Research Project EASA.2007.OP.18 | 01/07/2008 | EASA should initiate a study of the necessity for aerial work aircraft in the General Aviation category to have installed a simple on-board device to record basic flight parameters. | 25/05/2006 | Ireland |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| HUNG-2008-002 | Yes | Closed | Yes | 03/11/2009 | The IC recommends the EASA to promote the safety benefits of fitting, as a minimum, of an aircraft data recording system (ADRS) and a cockpit audio recording system (CARS) to all twin-engine helicopters flying Category A missions. | 31/07/2008 | Hungary |
| FRAN-2009-008 | Yes | Closed | Yes | 27/05/2009 | [Unofficial English Translation: The BEA recommends that EASA expands the conditions of carriage obligation of flight recorders for public transport.] | 18/10/2006 | France |
| N/A | No | N/A | No | N/A | It is recommended that the International Civil Aviation Organisation establish as an essential requirement for skydiving operations that the aircraft utilized for this activity have onboard a flight data recorder capable of logging at least the basic parameters of the operation. | 30/05/2008 | Spain |
| FRAN-2009-010 | No | N/A | No | 13/11/2009 | En conséquence, le BEA recommande que l' OACI étende les conditions d'obligation d'emport d'enregistreurs de vol à tous les avions effectuant du transport public. | 28/06/2008 | France |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | As a consequence, the BEA recommends that ICO extend the conditions for mandating the carriage of flight recorders to all aeroplanes thet perform public transport. | | |
| UNKG-2010-016 | No | N/A | No | 16/04/2010 | It is recommended that the International Civil Aviation Organisation adopt the proposals of its Flight Recorder Panel for the requirement to install flight recorders on turbine-engine-powered aeroplanes of a maximum certified takeoff mass of 5,700 kg or less. | 30/03/2008 | UK |
| SPAN-2012-011 | Yes | Closed | Yes | 06/07/2012 | It is recommended that the European Aviation Safety Agency (EASA) study the viability of introducing a requirement into the operational regulations that cockpit voice and flight data recorders of given specifications be installed on turboprop aircraft authorized for IFR flights and used for the public transport or passengers or cargo, regardless of their weight or maximum number of seats. | 18/02/1998 | Spain |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| NORW-2012-010 | Yes | Closed | Yes | 01/11/2012 | The Accident Investigation Board Norway (AIBN) recommends that EASA considers introducing requirements regarding flight recorders on more aircraft than are covered by the current regulations. | 04/07/2011 | Norway |
| NETH-2012-001 | Yes | Closed | Yes | 21/12/2011 | It is recommended to EASA to make flight recorder equipment mandatory for High Performance Aircraft, designed for carrying persons and/or cargo for the purpose of accident investigation. | 16/10/2009 | Netherlands |
| FRAN-2013-012 | Yes | Closed | Yes | 23/05/2013 | The BEA recommends that EASA extend the obligation to carry at least one flight recorder on board any aircraft operated for public transport. | 05/09/2010 | France |
| FINL-2014-001 | Yes | Closed | Yes | 23/01/2014 | SIAF recommends that the EASA study the possibility of drawing up a proposal for a standard which would suggest that all GPS devices intended for use in aviation have a function that records the parameters of the route flown. Moreover, the memory of such devices should not require a power source to retain the stored data. A similar safety recommendation was already issued in | 08/11/2012 | Finland |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | 2009, in conjunction with Investigation Report B3/2008L. | | |
| BELG-2015-001 | Yes | Open | Yes | 09/07/2015 | It is recommended that EASA mandates the installation of a lightweight recording system in aircraft used for parachuting activities | 19/10/2013 | Belgium |
| UNKG-2015-032 | No | N/A | No | 16/10/2015 | It is recommended that the Civil Aviation Authority requires all helicopters operating under a Police Air Operators Certificate, and first issued with an individual Certificate of Airworthiness before 1 January 2018, to be equipped with a recording capability that captures data, audio and images in crash-survivable memory. They should, as far as reasonably practicable, record at least the parameters specified in The Air Navigation Order, Schedule 4, Scale SS(1) or SS(3) as appropriate. They should be capable of recording at least the last two hours of (a) communications by the crew, including Police Observers carried in support of the helicopter's operation, and (b) images of the cockpit environment. The | 29/11/2013 | UK |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | image recordings should have sufficient coverage, quality and frame rate characteristics to include actions by the crew, control selections and instrument displays that are not captured by the data recorder. The audio and image recorders should be capable of operating for at least 10 minutes after the loss of the normal electrical supply. | | |
| UNKG-2015-033 | No | N/A | No | 16/10/2015 | It is recommended that the Civil Aviation Authority requires all helicopters operating under a Police Air Operators Certificate, and first issued with an individual Certificate of Airworthiness on or after 1 January 2018, to be fitted with flight recorders that record data, audio and images in crash-survivable memory. These should record at least the parameters specified in The Air Navigation Order, Schedule 4, Scale SS(1) or SS(3), as appropriate. They should be capable of recording at least the last two hours of (a) communications by the crew, including Police Observers carried in support of | 29/11/2013 | UK |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | the helicopter's operation, and (b) cockpit image recordings. The image recordings should have sufficient coverage, quality and frame rate characteristics to include control selections and instrument displays that are not captured by the other data recorders. The audio and image recorders should be capable of operating for at least 10 minutes after the loss of the normal electrical supply. | | |
| UNKG-2015-035 | Yes | Open | Yes | 16/10/2015 | It is recommended that the European Aviation Safety Agency mandate the ICAO Annex 6 flight recorder requirements for all helicopter emergency medical service operations, regardless of aircraft weight. The last two hours of flight crew communications and cockpit area audio should be recorded. The cockpit area audio recording should continue for 10 minutes after the loss of normal electrical power. | 29/11/2013 | UK |
| FRAN-2016-045 | Yes | Open | Yes | 02/12/2016 | Consequently the BEA recommends that: | 06/08/2014 | France |

| Safety recommendation | | | | | | | Investigation |
|---|---|---|---|---|---|---|---|
| **EASA recommendation number** | **Addressed to EASA?** | **EASA status on 2.12.2016** | **Included in the terms of reference of RMT.0271?** | **Date of issue or receipt** | **Safety recommendation text** | **Date of occurrence** | **State of the safety investigation authority** |
| | | | | | EASA add this accident to the TBM700 registered N129AG on 6 August 2014 at Saint-Jean-les-Deux-Jumeaux in the terms of reference for regulatory task RMT.0271. | | |
| FRAN-2016-046 | Yes | Open | Yes | 02/12/2016 | Consequently the BEA recommends that:<br>EASA require or promote the installation of on-board recorders on aeroplanes categorised as high performance aircraft (HPA), depending on the type of operation of the aircraft. | 06/08/2014 | France |

## Table C.2: Scope of safety recommendations related to in-flight recording, and issued by safety investigation authorities of the EASA MSs since 2000

| EASA recommendation number | Accident aircraft | | | | | | | Application domain of the safety recommendation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aircraft registration | Aircraft make and model | Type of operation | Fixed wing or rotary wing | Turbine or piston (number) | MCTOM (kg) | Passenger capacity or payload | Type of operation | Fixed wing or rotary wing | Turbine or piston (and number of engines) | Forward-fit or retrofit | MCTOM (kg) | Passenger capacity | Recording function |
| UNKG-2001-001 | G-MASK | Aerospatiale AS355 F1 Ecureuil II | CAT (Emergency medical services) | RW | Turbine (2) | 2400 | 6 PAX | CAT (Emergency medical services) | RW | Not specified | Not specified | Not specified | Not specified | Not specified |
| UNKG-2001-038 | G-ILGW | Cessna 404 Titan | CAT (Passengers) | FW | Turbine (2) | 3810 | 10 PAX | CAT (Passengers) | Not specified | Multi-engined | Not specified | All | More than 9 pax | CVR |
| FRAN-2001-038 | F-OGES | De Havilland DHC6-300 | CAT (Passengers) | FW | Turbine (2) | 5670 | 20 PAX | CAT | Both | All | Retro fit | < 5 700 kg | More than 9 pax | FDR or CVR |
| GREC-2002-027 | SX-HDT | Agusta AW 109 | CAT (Emergency medical services) | RW | Turbine (2) | 3000 | 7 PAX | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified | CVR |
| FRAN-2003-012 | F-OGES | De Havilland DHC6-300 | CAT (Passengers) | FW | Turbine (2) | 5670 | 20 PAX | CAT | Both | All | Retro fit | < 5 700 kg | More than 9 pax | FDR or CVR |
| GREC-2003-029 | SX-HDR | Agusta AW 109 | CAT (EMS) | RW | Turbine (2) | 3000 | 7 PAX | CAT | RW | All | All | All | All | CVR |
| GREC-2004-020 | SX-HDV | Agusta AW 109 | CAT (EMS) | RW | Turbine (2) | 3000 | 7 PAX | CAT | RW | All | Retro fit | All | All | FDR + CVR |
| UNKG-2004-084 | G-CSPJ | Hughes 369HS | GA (Private) | RW | Turbine (1) | 1157 | 4 PAX | CAT | Both | All | Retro fit | All | Not specified | CVR |
| UNKG-2004-085 | G-CSPJ | Hughes 369HS | GA (Private) | RW | Turbine (1) | 1157 | 4 PAX | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified |
| N/A | I-SEIQ | Agusta Bell 412 SP | SAR | RW | Turbine (2) | 5400 | 13 PAX | CAT + AW | RW | All | Not specified | All | All | FDR + CVR |
| UNKG-2005-062 | G-BGED | Cessna U206F Stationair | AW | FW | Piston (1) | 1630 | 6 PAX | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified |

| EASA recommendation number | Accident aircraft | | | | | | | Application domain of the safety recommendation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aircraft registration | Aircraft make and model | Type of operation | Fixed wing or rotary wing | Turbine or piston (number) | MCTOM (kg) | Passenger capacity or payload | Type of operation | Fixed wing or rotary wing | Turbine or piston (and number of engines) | Forward-fit or retrofit | MCTOM (kg) | Passenger capacity | Recording function |
| UNKG-2005-100 | G-BXLI | Bell 206B | GA (Private) | RW | Turbine (1) | 1450 | 4 PAX | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified | FDR + CVR |
| UNKG-2005-101 | G-BXLI | Bell 206B | GA (Private) | RW | Turbine (1) | 1 450 | 4 PAX | CAT | Both | All | Retro fit | All | All | CVR |
| DENM-2006-002 | OY-CAK | SOCATA TB-10 | CAT | FW | Piston (1) | 1 150 | 5 PAX | CAT | Both | All | Not specified | All | All | FDR |
| IRLD-2008-014 | EI-CHM | Cessna 150M | AW (Training flight) | FW | Piston (1) | 730 | 1 PAX (+2 Children) | AW | Not specified | Not specified | Not specified | Not specified | Not specified | FDR |
| HUNG-2008-002 | HA-ECE | Eurocopter EC135 T2 | CAT (Emergency medical services) | RW | Turbine (2) | 2 835 | 2 pilots + 2 patients | CAT | RW | Multi-engined | Not specified | All | All | FDR+CVR |
| FRAN-2009-008 | F-GVPD | Beech 90 KING AIR | CAT | FW | Turbine (2) | 4 851 | 7 PAX | CAT | Not specified | Not specified | Not specified | Not specified | Not specified | FDR+CVR |
| N/A | EC-JXH | Pilatus PC6-B2H4 | AW (parachute dropping) | FW | Turbine (1) | 2 800 | 10 PAX | Skydiving | Not specified | Not specified | Not specified | Not specified | Not specified | FDR |
| FRAN-2009-010 | V2-LFL | De Havilland DHC6 | CAT | FW | Turbine (2) | 5 670 | 20 PAX | CAT | FW | All | Not specified | All | All | Not specified |
| UNKG-2010-016 | VP-BGE | Cessna Citation I (500) | CAT (Passengers) | FW | Turbine (2) | 5 375 | 6 PAX | Not specified | FW | Turbine | Not specified | All | All | Not specified |
| SPAN-2012-011 | EC-GDG | Fairchild SA-226-TC | CAT (Cargo) | FW | Turbine (2) | 5 665 | 19 PAX | CAT | FW | Turbine | Not specified | All | All | FDR+CVR |
| NORW-2012-010 | LN-OXC | Eurocopter AS 350 B3 | CAT (Passengers) | RW | Turbine (1) | 2 250 | 5 PAX | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified | Not specified |
| NETH-2012-001 | PH-RUL | Pilatus PC-12/47E | GA (Business flight) | FW | Turbine (1) | 4 740 | 6 PAX (business config.) | Not specified | Both | All | Not specified | All | All | Not specified |
| FRAN-2013-012 | F-OIXZ | Cessna 208B | CAT | FW | Turbine (1) | 3 630 | 9 PAX | CAT | Both | All | Not specified | All | All | FDR or CVR |

| EASA recommendation number | Accident aircraft | | | | | | | Application domain of the safety recommendation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aircraft registration | Aircraft make and model | Type of operation | Fixed wing or rotary wing | Turbine or piston (number) | MCTOM (kg) | Passenger capacity or payload | Type of operation | Fixed wing or rotary wing | Turbine or piston (and number of engines) | Forward-fit or retrofit | MCTOM (kg) | Passenger capacity | Recording function |
| FINL-2014-001 | OH-AAA | Cessna 206 | GA (Private) | FW | Piston (1) | 1 720 | 5 PAX | Not specified | Both | All | Not specified | All | All | GPS |
| BELG-2015-001 | OO-NAC | Pilatus PC6 | AW (parachute dropping) | FW | Turbine (1) | 2 800 | 10 PAX | Parachute dropping | Both | All | Retrofit | All | All | Not specified |
| UNKG-2015-032 | G-SPAO | Eurocopter EC135 T2+ | State flight (police) | RW | Turbine (2) | 2 835 | 2 pilots + 2 patients | Police | RW | All | Retrofit | All | All | FDR + CVR + Image |
| UNKG-2015-033 | G-SPAO | Eurocopter EC135 T2+ | State flight (police) | RW | Turbine (2) | 2 835 | 2 pilots + 2 patients | Police | RW | All | Forward-fit | All | All | FDR + CVR + Image |
| UNKG-2015-035 | G-SPAO | Eurocopter EC135 T2+ | State flight (police) | RW | Turbine (2) | 2 835 | 2 pilots + 2 patients | CAT (Emergency medical services) | RW | All | Not specified | All | All | FDR + CVR |
| FRAN-2016-045 | N129AG | Socata TBM700 | GA (Private) | FW | Turbine (1) | 2 984 | 5 PAX | Not specified | FW | Turbine | Not specified | Not specified | Not specified | Not specified |
| FRAN-2016-046 | N129AG | Socata TBM700 | GA (Private) | FW | Turbine (1) | 2 984 | 5 PAX | Not specified | FW | All | Not specified | Not specified | Not specified | Not specified |

## 7.3 Appendix D: The benefits of in-flight recording for light aircraft

### 7.3.1 Potential benefits of in-flight recording for stakeholders

Tables D.1, D.2 and D.3 present the benefits (for safety, cost, liability, etc.) of installing in-flight recording equipment that may be promoted to aviation stakeholders. Table D.1 addresses the flight parameters recording function of such in-flight recording equipment, Table D.2 addresses the audio recording function, and Table D.3 addresses the image recording function.

Table D.4 presents the potential incentives for each category of stakeholder using light aircraft.

**Table D.1: Potential benefits of recording the aircraft flight parameters**

| Type of benefit | Applicable categories of light aircraft | Nature of the benefits | Limitations |
|---|---|---|---|
| Safety/economic | Light aeroplanes and light helicopters | Flight parameters can be used for operational safety monitoring (such as performed as part of flight data monitoring (FDM)), analysis of incidents, educating on hazards (training). These processes can support with operational data the safety management system (SMS) of an aircraft operator28.<br>In addition, an evidence-based operational safety monitoring might justify reduced insurance premiums. This has been the case for FDM when implemented by aircraft operators. | Making this safety benefit real would not only require airborne equipment, but also ground infrastructure, human resources and procedures to process and analyse the data at regular time intervals. Therefore, this is not relevant for private owners.<br><br>Many other factors than the availability of recorded data are taken into account by an insurer for determining an insurance premium. There is no automatic reduction of insurance premium granted for installing an in-flight recording system. |
| Safety | Light aeroplanes, light helicopters, sailplanes | Getting more reliable data on the circumstances of incidents and accidents in order to better understand safety issues and to avoid that an aviation authority enacts conservative operational restrictions. | Applicable mainly to aircraft manufacturers, aircraft operators, and aircraft owner associations.<br>Not relevant when considering an individual aircraft owner. |
| Safety/economic /corporate image | Light aeroplanes, light | Getting clear answers to questions related to the airworthiness of a product and | Applicable to aircraft and engine manufacturers. |

| | | | |
|---|---|---|---|
| | helicopters, sailplanes | being able to determine quick corrective actions. | Not relevant when considering an individual aircraft owner. |
| Safety/economic /aircraft availability | Light aeroplanes and light helicopters | Engine and systems health monitoring in order to get a better insight into the circumstances of engines failure and systems failure, detect or confirm exceedance of limitations, and assess reliability or monitor trends29. | Assumes that more advanced flight parameters are recorded, not just basic trajectory parameters (hence implying that these advanced flight parameters are produced in the aircraft). |
| Safety/liability | Light aeroplanes, light helicopters, sailplanes, balloons | Monitor the compliance with airspace restrictions, airfield procedures and noise-abatement procedures by pilots. Aircraft users will take more care of the rules and procedures because the aircraft owner can check their flight afterwards. | |
| Economic | Light aeroplanes and light helicopters | Accurate fuel and usage cost billing, based on actual flight time. | For this purpose, a Hobbs meter is sufficient. |
| Warranty and liability claims | Light aeroplanes and light helicopters | Flight parameters can be used to set a datum for measurement of performance guaranteed by the aircraft manufacturer or an aircraft equipment manufacturer. If it can be shown with data that the actual performance is not at the specified levels then the aircraft owner/operator is in a position to claim compensation under the terms of the warranty. | This is assuming that a more extensive set of flight parameters than just trajectory parameters is recorded.<br>In addition, this could work for an aircraft operator or a pilot association, but a single private aircraft owner would probably not have sufficient resources nor enough weight to make a successful claim. In addition, for demonstrating performance issues, accurate knowledge of the conditions are needed (atmospheric conditions, loading, etc.). This is difficult to achieve for an individual owner or pilot. |
| Validation of skills | Light aeroplanes, light helicopters, sailplanes, balloons | Trajectory flight parameters of a trustable source (which cannot be altered) can be used for validating success in a test or a competition. Example: the standard developed by IGC for 'IGC-approved flight recorders' used for badges. | |

## Table D.2: Potential benefits of recording audio

| Type of benefit | Applicable categories of light aircraft | Nature of the benefits | Limitation |
|---|---|---|---|
| Safety | Light aeroplanes, light helicopters, sailplanes, balloons | Getting more reliable data on the circumstances of incidents and accidents in order to detect and address earlier a safety issue and to avoid that an aviation authority enacts operational restrictions. | Applicable mainly to aircraft manufacturers and aircraft operators, not relevant when considering aircraft owners. |
| Safety | Light aeroplanes and light helicopters | Engine/gearbox health monitoring. The audio recording may capture information on the speed, vibrations and transition modes of rotating parts, which are difficult to record with flight parameters (no sensor installed or too low sampling rate). | Mainly of interest for helicopters.<br><br>Data privacy may limit the possible access to the recordings by maintenance staff, especially when considering image and audio recording. |

## Table D.3: Potential benefits of recording images

| Type of benefit | Applicable categories of light aircraft | Nature of the benefits | Limitations |
|---|---|---|---|
| Safety | Light aeroplanes, light helicopters, sailplanes, balloons | Getting more reliable and complete data on the circumstances of incidents and accidents in order to detect and address earlier a safety issue and to avoid that an aviation authority enacts operational restrictions.<br>Information not recorded by audio or flight parameters includes:<br>– crew actions on flight controls, engine control, selectors and switches;<br>– non-verbal communication (for aircraft certified for operation with a minimum flight crew of at least two pilots);<br>– flight parameters indicated by aircraft instruments (when it is too difficult to | Applicable mainly to aircraft manufacturers and aircraft operators, not relevant when considering aircraft owners.<br>Capturing usable pictures of instruments and displays require good picture resolution, capability to cope with various lighting conditions and vibration-proofed installation.<br>This could significantly drive the cost up. |

| | | | |
|---|---|---|---|
| | | collect them from the aircraft sensors);<br>– displayed pictures (e.g. by a moving map, a TAWS, etc.) for glass cockpits;<br>– display settings;<br>– weather conditions. | |
| Safety | Light aeroplanes, light helicopters, sailplanes, balloons | Operational safety monitoring, analysis of incidents, educating on hazards (training). These processes can support with operational data the safety management system (SMS) of an aircraft operator. | Making this safety benefit real would not only require airborne equipment, but also ground infrastructure, human resources and procedures to process and analyse the data at regular time intervals. Therefore, this is not relevant for private owners.<br>Because of the privacy content, there are limitations to the use of image recording by the aircraft operator; however, they are less problematic if the view is limited to the instruments panel. |
| Safety | Light aeroplanes, | Pilot knows that they are recorded and | Experience has shown that some |
| Safety | Light aeroplanes, light helicopters, sailplanes, balloons | Pilot knows that they are recorded and this is dissuading them from taking unnecessary risk (flying low, risky manoeuvres). | Experience has shown that some pilots bring a camera in the flight crew compartment in order to share a recording of their feats afterwards, and this tends to favour risk-taking. However, when the camera is installed by the aircraft owner or operator, then it is assumed that it can help in preventing reckless behaviour. Because of the privacy content, there are limitations to the use of image recording by the aircraft owner. |
| Safety | Light aeroplanes, light helicopters, sailplanes, balloons | Video can be a good media for sharing lessons learnt among private pilots (social media). | Video can also be wrongly used to encourage excessive risk-taking by displaying unsafe manoeuvres.<br>For video to be used in a positive way, there probably is a need for control of the information. For example, this could work if an association of private pilots is administering the social medium. |

**Table D.4: Potential incentives for in-flight recording per category of stakeholder**

| Category of stakeholder | Potential incentives |
|---|---|
| Commercial aircraft operators | – Better data-driven operational safety monitoring, including better understanding of incidents.<br>– Smarter maintenance through engine and systems health monitoring and quantitative data on limitation exceedance.<br>– Reduced operation cost through better monitoring of the management of fuel and of the aircraft.<br>– Encourage better adherence to SOPs because pilots know they are monitored.<br>– Trustable source of data if an issue is raised by ATC/airport operator/airport neighbours.<br>– Might justify lower insurance premiums. |

### 7.3.2 The privacy issue

#### *7.3.2.1 Flight parameters*

Using recorded flight parameters for sanctioning a professional pilot or publishing identified flight data can have significant consequences on their career and it has been considered detrimental to the safety of commercial operations in the long term.

This is why, when considering the flight data recorder (FDR) mandated on board large aeroplanes and large helicopters, subparagraph (f)(2) of CAT.GEN.MPA.195 requires the following:

'Flight parameters or data link messages recorded by a flight recorder shall not be used for purposes other than for the investigation of an accident or an incident which is subject to mandatory reporting, unless such recordings meet any of the following conditions:

(i) are used by the operator for airworthiness or maintenance purposes only; or
(ii) are de-identified; or
(iii) are disclosed under secure procedures.'

#### *7.3.2.2 Audio and images*

Audio recordings and image recordings have an intrinsic privacy content (information that is private and unrelated to the accident might be recorded, and the human voice itself or images of body parts can be considered a privacy element). Therefore, the

recording of the cockpit voice recorder (CVR) mandated for large aircraft is considered sensitive, and its use is more restricted than it is for the FDR recording.

Paragraph (f) of CAT.GEN.MPA.195 requires the following:

'(f) Without prejudice to other Regulations:
(1) Except for ensuring flight recorder serviceability, audio recordings from a flight recorder shall not be disclosed or used unless all of the following conditions are fulfilled:
(i) a procedure related to the handling of such audio recordings and of their transcript is in place;
(ii) all crew members and maintenance personnel concerned have given their prior consent;
(iii) such audio recordings are used only for maintaining or improving safety.
(1a) When inspecting flight recorder audio recordings to ensure flight recorder serviceability, the operator shall protect the privacy of those audio recordings and make sure that they are not disclosed or used for purposes other than for ensuring flight recorder serviceability.'

Some level of protection would probably be justified for in-flight equipment recording audio or images on board a light aircraft. This could restrict the possible use of this equipment, making its promotion challenging.

Some dedicated in-flight recording systems only record a certain level of ambient noise. IGC specifications for the equipment designated by the IGC as 'IGC-approved flight recorders'31 also specify that just a certain level of ambient noise needs to be recorded. This solution resolves the privacy issue; however, the information content of ambient noise is much less, and it is not sufficient for engine/gearbox health monitoring.

## 7.4 Appendix G: Results of the survey on cost and benefits of dedicated in-flight recording

EASA conducted a survey between 7 May and 9 June 2015, which focused on aircraft systems that are permanently installed on light aeroplanes and light helicopters, and whose primary function is to record data, audio or image, for later analysis or investigation. The survey consisted in a questionnaire which was distributed to the Safety Standards Consultative Committee (SSCC) and to equipment manufacturers. 12 organisations responded (8 aircraft manufacturers, 6 equipment manufacturers and 1 aircraft owner). In addition, informal feedback was received from ECOGAS, the new European Helicopter Association ('common position'), a representative of sailplane manufacturers at the SSCC, and a flight school. The results of the survey are presented in Table G.1

## Table G.1: Summary of replies to the industry survey on cost, operational impact and benefits of dedicated in-flight recording systems

| Number | Question | Comment | Reply |
|---|---|---|---|
| 0 | Please provide contact information | – Following the receipt of a filled form, phone contact may be requested in order to obtain more background information or clarify some replies;<br>– The objective of this questionnaire is to support Rulemaking task RMT.0271. Individual replies to this questionnaire will be kept strictly confidential and only fully de-identified information will be shared. | (confidential information, the identity of responders and the organisations they represent is not provided here). |
| 1 | You are:<br>– An aircraft manufacturer<br>– An equipment manufacturer<br>– An aircraft operator or owner<br>– Other (please specify) | | Replies from<br>– 8 aircraft manufacturers (light aeroplanes and light helicopters).<br>– 6 equipment manufacturers<br>– 2 flight schools<br>– 3 industry associations |
| 2 | Applicable aircraft make(s) and model(s) | Only provide the aircraft models on which the equipment was successfully installed. | Many models were mentioned in the replies, including aeroplane models with less than 2250 kg MCTOM and reciprocating engines (example Piper PA-28, Diamond DA-40, Cessna 172, Socata TB20, etc.), and helicopters with MCTOM close to or less than 2250 kg (Bell 206, AS350, EC130). Heavier and more complex aircraft models were also mentioned. |
| 3 | Case considered: forward fit or retrofit | | For aircraft manufacturers: mainly forward-fit, standard installation on new light models. limited retrofit.<br><br>Equipment manufacturers: STCs mainly for light helicopter models<br><br>Flight school: retrofit. |

| Number | Question | Comment | Reply |
|---|---|---|---|
| 4 | Recording equipment model(s) | | For aircraft manufacturers: mainly ED-155 like recording equipment. Some install ED-112 crash protected CVFDR on the heavier models. One has aircraft manufacturer SD card on panel-mounted navigation equipment, another mentioned a lightweight Quick Access Recorder (QAR)<br><br>Equipment manufacturers: ED-155 like recording equipment<br><br>Flight school: ED-155 like recording equipment.<br><br>EHA: referred to airborne equipment installed for usage monitoring system (required by CAT.POL.H.305 i.e. for helicopters without an assured safe force landing possibility at take-off or landing). |
| 5 | Functions offered by the recording equipment model (flight parameters, audio, image, data-link messages, etc.) | Specify if some functions are not always included in the recording equipment (e.g. in the case of a modular system that can perform several recording functions). | Aircraft manufacturers: always flight parameters recording function. Some install equipment combining flight parameters + cockpit audio + image.<br><br>Equipment manufacturers: flight parameters and audio, or flight parameters, audio and image |
| 6a | Recording equipment: is it compliant with EUROCAE MOPS for crash-protected flight recorders or lightweight flight recorders? (ED55, ED56A, ED112, ED112A, ED155)? | – | Aircraft manufacturers: some equipment models are compliant with ED-155 or ED-112 (or ED-55/56A), others are not fully compliant with these industry standards.<br><br>Equipment manufacturers: some equipment models are compliant with ED-155 or ED-112, others are not fully compliant. |
| 6b | Recording equipment: does it have a TSO/ETSO authorisation? | Provide the TSO or ETSO number according to which the recording equipment was authorised | Aircraft manufacturers: one of the recording equipment models has TSO-C197. Others are deemed compliant with ED-155 yet they do not have TSO-C197. Others are not fully compliant with ED-155<br>Equipment manufacturers: no. |

| Number | Question | Comment | Reply |
|---|---|---|---|
| 7a | Cost of installation design and documentation (not including installation test) | – Normally once per aircraft model (non-recurring);<br>– Cost should include the installation drawings, Installation Instructions, Maintenance Instructions, AFM and the decoding documentation in the case of an FDR or, ADRS. | Aircraft manufacturers: very diverse assessment of cost depending on the company and the type of recording equipment assumed. As a minimum, around 10 000 € for 7a, 7b and 7c when considering recording equipment that is not fully ED-155 compliant. When considering a fully ED-155 compliant recording equipment, one manufacturer assessed the total cost for 7a, 7b and 7c at 300 000 Euros, another to more than 100 000 Euros, another to more than 150 000 Euros.<br><br>Equipment manufacturers: between 10 000 and 60 000 € for an STC |
| 7b | Cost of installation test | – Normally once per aircraft model (non-recurring)<br>– Cost should include flight-test and evaluation of recording quality.<br>– If applicable, indicate the cost of test for the flight parameter function only, the audio recording function only, and with all functions included | Aircraft manufacturers: See 7a.<br><br>Equipment manufacturers: between 2 000 and 5 000 € per individual aircraft. |
| 7c | Cost of certifying the installation | – Normally once per aircraft model (non-recurring);<br>– Indicate if this was a Major Change (STC) or a Minor Change and indicate the certification fees. | Aircraft manufacturers: installation was part of the aircraft TC and handled as a minor change.<br><br>Equipment manufacturers: in the range 10 000 to 60 000 € for an STC. |
| 8 | Unit price, including the recording equipment and its dedicated wires, connectors, sensors + the price of the installation kit and of voltage/current transformers (if applicable) | – Normally once per individual aircraft (recurring);<br>– Indicate unit price range if the number of units induce a significant difference in price;<br>– If applicable, indicate unit price for the flight parameter function only, the audio recording function only, and with all functions included. | Aircraft manufacturers: for ED-155 like recording equipment, the unit price is in the range from 4 000 to 8 000 Euros. For an ED-112 compliant crash-protected recorder, price in the range 30 000 to 50 000 Euros.<br><br>Equipment manufacturers: four gave price indications. one product is 'less than 10 000 €' including software for readout and internal memory retrieval, the three others are in the range 5 000 to 15 000 €, also depending on customer choices. |

| Number | Question | Comment | Reply |
|---|---|---|---|
| | | | Flight school: total cost of 20 000 € per individual aircraft, including recording equipment, installation on the aircraft, testing and documentation.<br><br>EHA: cost associated with a usage monitoring system for a non-complex aircraft are around 10 000 €. |
| 9 | Main cost drivers | Indicate what specifications are, in your opinion, driving the total cost of recording equipment:<br>– flight parameters to record,<br>– crashworthiness specifications,<br>– start and termination logic,<br>– testing,<br>– certification,<br>– necessary airframe modifications prior to this installation,<br>– aircraft down-time,<br>– etc. | Aircraft manufacturers: for ED-155 like recording equipment: main drivers are certification (if item required to have a TSO/ETSO authorisation), testing (ground and flight test), and flight parameters (if dedicated sensors need to be installed). For ED-112 crash-protected flight recorder, in addition to the above, development of a data frame layout for the FDR recording.<br><br>Equipment manufacturers: STC cost, installation of dedicated sensors (in particular for analogue cockpits), crashworthiness, economies of scale are too small.<br><br>Flight school: STC cost, airframe modification (wirings), crashworthiness. |
| 10 | Total weight of equipage, including the recording equipment and its dedicated wires, connectors, sensors + the weight of the installation kit and of voltage/current transformers (if applicable) | If applicable, indicate:<br>– the weight of an installation that is recording flight parameters only;<br>– the weight of an installation that is recording audio only;<br>– and the weight when all functions are included. | Aircraft manufacturers: weight above 5 kg and up to 10 kg for ED-112 compliant crash-protected flight recorders (without dedicated connectors, sensors, acquisition unit etc.). Between 1 kg and 4 kg total weight for ED-155 like recording equipment.<br><br>Equipment manufacturers: less than 5 kg total weight for ED-155 like recording equipment.<br><br>Flight school: 4 kg total weight for ED-155 like recording equipment. |

| Number | Question | Comment | Reply |
|---|---|---|---|
| 11 | Total power consumption of the recording equipment, including dedicated sensors | If applicable, indicate power consumption:<br>– for the flight parameter recording function only;<br>– for the audio recording function only; and<br>– with all functions included. | Aircraft manufacturers: between 4 and 10 W for ED-155 like recording equipment. From 6 to 40 W for ED-112 compliant crash-protected recorder.<br><br>Flight school: 10W max.<br><br>Equipment manufacturers: 10 to 30W for the total power consumption |
| 12a | Retrofit: aircraft down time | If the aircraft down time varies significantly from one aircraft model to the next (or from one individual aircraft to the next), please explain and provide a range of aircraft down times. | Aircraft manufacturers: 1 to 2 days for ED-155 like recording equipment (several aircraft manufacturers indicate they do not perform retrofit).<br><br>Flight school: around 3 days.<br><br>Equipment manufacturers: 1 day in the best case, more often 2 to 6 days. |
| 12b | Retrofit: number of man-hours needed | – number of man hours for mechanical and electrical part of installation;<br>– including functional test after installation;<br>– If the number of man-hours varies significantly from one aircraft model to the next (or from one individual aircraft to the next), please explain and provide a range of man-hours;<br>– Note: labour cost may vary depending on the country where the installation is performed. | Equipment manufacturers: between 1 and 3 days for 2 mechanics (16 to 48 man hours).<br><br>Flight school: about 50 man-hours. |
| 12c | Retrofit: main drivers for down-time and man-hours | Please indicate which are the main drivers of the down-time and man-hours needed for installing recording equipment:<br>– sensors installation,<br>– ground testing,<br>– flight testing,<br>– etc. | Aircraft manufacturers: for ED-155-like recording equipment, the main drivers are installation of sensors (flight parameter sensors and camera in the cockpit) and wirings, and ground testing.<br><br>Equipment manufacturer: installation of wiring, accessibility to sensors and cables. |

| Number | Question | Comment | Reply |
|---|---|---|---|
| | | | Flight school: mechanical and wiring installation. |
| 13 | Download and replay equipment | – Specify if downloading the data requires dedicated hardware / software (connecting cables, special junction boxes, operating system, etc.);<br>– Specify if converting the data files into ready-to-analyse data requires dedicated software (i.e. flight parameters expressed in engineering units, audio files in a common audio format), or if the data files cannot be converted from a proprietary format. In this case, please give the unit price of the download and replay equipment;<br>– Indicate if data can only be analysed by an external service provider. | Aircraft manufacturers: dedicated hardware is not always necessary; however, dedicated readout software is needed in any case for ED-155 like recording equipment as for crash-protected ED-112 compliant crash-protected flight recorders. The data can be analysed without assistance of an external service provider.<br><br>Equipment manufacturers: dedicated software needed for configuring the unit and reading it out; however, using standard connexion or standard memory media. The data can be analysed without assistance of an external service provider.<br><br>Flight school: proprietary readout software provided with the recording equipment. |
| 14 | Maintenance scheduled tasks: time intervals and cost | – List all scheduled tasks, with their periodicity and LLP´s (Life limited parts)<br>– This should; include the recording equipment and its dedicated sensors;<br>– Take into account the usage made of the recorder (e.g. used for FDM) which may have an impact on the maintenance cost (wear and tear). | Aircraft manufacturers: scheduled maintenance tasks not always defined. For ED-155 like recording equipment, typically one recording inspection per year and operational check (control of LED status) before the 1st flight of the day.<br><br>Equipment manufacturers: no limited life part, except for one (change of battery every 10 years). One manufacturer indicated having defined a functional test to be run during scheduled maintenance of the aircraft.<br><br>Flight school: no limited life part. No preventive maintenance prescribed. |
| 15 | Any other issue not captured by the questions above | Any issue related to cost, weight, volume, effect on aircraft performance, restrictions to installation, impact on aircraft operation, aircraft maintenance, etc. | Aircraft manufacturers: authorities should not impose retrospective requirements on voluntary installations of recording equipment. Acceptance of aircraft operators and pilots. If for some aircraft models crash-protected ED-112 |

| Number | Question | Comment | Reply |
|---|---|---|---|
| | | | recorder was considered necessary, do not impose more than Type II FDR and allow one single flight data and cockpit voice combination recorder, to limit cost, weight, consumption (the use of Type IA FDR (78 parameters, according to ICAO Annex 6) in this kind of aeroplanes increases more than 8 kg in weight (sensors, wiring, etc.) and cost is around 50 000 Euros). Big internal effort to have the ED-155 like recording equipment certified on the A/C.<br><br>Equipment manufacturers: making the recording equipment a MEL item may create operational restrictions. Lack of a regulatory framework that is commensurate to the case of light aircraft.<br><br>Flight school: problem of design and/or installation with dedicated sensors, unreliable software on the recording unit, data transfer is too long.<br><br>EHA: recording equipment should not be included in the MMEL of the helicopter with a rectification interval of level A or B or C, as it does not need to be serviceable at the start of every flight. |
| 16 | Savings generated by the equipment once installed | – Savings could be lower insurance premiums, better aircraft condition or usage monitoring, better company image, more accurate billing information, etc.;<br>– Please provide concrete examples and an assessment of the saved amount. | Aircraft manufacturers: there could be a possibility in the future to influence the insurance rate for the product liability as the data may help to decrease the cost in a legal case. Avoidance of unnecessary maintenance. (e.g. MGB expertise in case of<br>over limit). Good safety image of the company. Possibility to adapt the billing according to the usage of the helicopter<br><br>Equipment manufacturers: avoid costly and invasive engine inspections. Reduced fuel consumptions by eliminating impractical procedures. Annual insurance premium |

| Number | Question | Comment | Reply |
|---|---|---|---|
| | | | increases can be curtailed by providing proof of operating a FOQA program. Companies operating under an Air Taxi AOC can qualify for more sales due to compliance with customer FDM requirements and have more trust from their customers thanks to the capability to better analyse their incidents. Those who are reimbursed by Distance Flown can show and justify course deviations in their billing data. Disprove claims of flight over forbidden areas, thus saving the associated penalty.<br><br>Flight school: Increase of operating cost, due to the unexpected cost to correct installation problems. Installed system remains mechanically fragile. |
| 17a | Safety benefits other than for ICAO Annex 13 investigations | Please provide concrete examples of safety benefits, specifying the organisation and evidence that the recorded information was used to improve or to better monitor the safety level (e.g. support for training courses). | Aircraft manufacturers: ensuring SOPs are followed across the fleet. For instance, some helicopter offshore operators limit the aircraft speed below certain altitude when flying close to the shore to minimize risk of bird strike. Proactively identify and reduce the risk. 3D replay for training or for other analysis. However one aircraft manufacturer thinks that the protection of recorded data could limit the potential use of data. The recorded data are not typically used for maintenance or a full-fledge FDM programme.<br><br>Equipment manufacturers: enhanced training using real-word examples, standard of practice analysis to improve safety procedures. The pilots know that they are monitored and therefore take less risk. Better understand accidents and take effective corrective actions. Detect unsafe situations before an accident occurs (e.g. at one operator, it was detected that torque was exceeded almost daily at take-off. The take-off procedure was amended) |

| Number | Question | Comment | Reply |
|---|---|---|---|
| | | | Flight school: better understand incidents (one case where it was helpful). However restrictive policy to download the data could be a hindrance for using them for maintenance purposes. |
| 17b | Benefits other than safety-related (e.g. legal cases: was the recording already used in court cases and approved as a piece of evidence by judicial authorities?) | Please provide concrete examples | Two aircraft manufacturers believe that these data may support legal cases (provide better evidence against plaintiff's theories). One aircraft manufacturers thinks they could be used to collect data related to warranty claims against the aircraft.<br>Equipment manufacturers:<br>– Insurance benefits; some companies offer reduced rates for FDM installation<br>– Liability; operators, owners alike can use the data to mitigate or support findings. |

## 7.5 Appendix H: General principles of the safety risk assessment

### 7.5.1 Common methodology used for the safety risk assessment

Safety risk assessment is the assessment of the consequences of a hazard assuming the worst foreseeable situation expressed in terms of predicted probability and severity.

*What is risk?*

Risk is the assessment of the consequences of a hazard assuming the worst foreseeable situation expressed in terms of predicted probability and severity.
Key elements of risk assessment:

— probability of the event,
— severity,
— risk matrix.

This information is based on the available information at the Pre-RIA stage.

In order to define the elements 'probability' and 'severity', the following tables were developed based on the ICAO framework.

**Table H.1: Probability of occurrence**

| Definition | Description |
|---|---|
| Frequent | Likely to occur many times (has occurred frequently) |
| Occasional | Likely to occur sometimes (has occurred infrequently) |
| Remote | Unlikely, but possible to occur (has occurred rarely) |
| Improbable | Very unlikely to occur |
| Extremely improbable | Almost inconceivable that the event will occur |

**Table H.2: Severity of occurrence**

| Definition | Description |
|---|---|
| Catastrophic | Multiple deaths and equipment destroyed (hull loss) |
| Hazardous | A large reduction of safety margins<br>Maximum two fatalities<br>Serious injury<br>Major equipment damage |

| Definition | Description |
|---|---|
| Major | A significant reduction of safety margins<br>Serious incident<br>Injury of persons |
| Minor | Nuisance<br>Operating limitations<br>Use of emergency procedures<br>Minor incident |
| Negligible | Little consequences |

A scale for the 'severity' and 'probability' parameters is used to measure the risk (severity × probability).

This results in a safety risk level: High/Medium/Low.

The outcome is presented in the following matrix.

**Table H.3: Risk index matrix**

| Probability of occurrence | | Severity of occurrence | | | | |
|---|---|---|---|---|---|---|
| | | Negligible | Minor | Major | Hazardous | Catastrophic |
| | | | | | | |
| Extremely improbable | | | | | | |
| Improbable | | | | | | |
| Remote | | | | | | |
| Occasional | | | | | | |
| Frequent | | | | | | |

**Table H.4: Description of the different risk levels**

| Risk level | | Description |
|---|---|---|
| | | |
| | High significance | Unacceptable under the existing regulatory circumstances. Rulemaking action required. |
| | | |
| | Medium/high significance | Based on feedback from stakeholders, this combination of probability and severity may be considered to be of a high or a medium risk depending on the issue.<br>Reasoning to be provided in Section 2.2 of the Pre-RIA. |

| | | |
|---|---|---|
| | | |
| | Medium significance | Tolerable based on risk mitigation by the stakeholders and/or rulemaking action. |
| | | |
| | Low significance | Acceptable, but monitoring or non-rulemaking action required. Under certain circumstances, rulemaking may be required. Reasoning to be provided in Section 2.2. of the Pre-RIA |

### 7.5.2 Special considerations related to general aviation

The following extract from Section 2 of the document 'European General Aviation Safety Strategy – discussion paper', dated 30 August 2012, gives the rationale for a different safety assessment between general aviation and commercial operations:

'It is important to recognise the differences between commercial and non-commercial environments from a safety management perspective.

1.Control of Risk

End-use stakeholders in non-CAT aviation generally have much more ability to assess and control the risk of the operation. In many cases, with the exception of very limited risk to third parties, the operators are the only stakeholders exposed to risk. Even when passengers (or more often and precisely 'participants') are carried, they are usually much closer to the process by which risk is assessed and managed, and their participation is discretionary, not an intrinsic part of their day-to-day business. Operational control is particularly important in determining appropriate target levels of safety. This is, and has been traditionally, a good justification for offering a high level of autonomy to the pilot.

[…]

2.Level Playing Field

In the competitive CAT market, a level playing field between actors is necessary to ensure that safety does not enter a vicious spiral. If the level of safety expenditure, or the value of safety compared to operational success, is left to the discretion of individual operators, a competitive advantage often arises for the operator who takes more risk. In essence, provided nothing catastrophic occurs, the braver airline succeeds at the expense of the more cautious. Thus without explicit standards set by the regulator, safety would be eroded. There is no corresponding effect for non-CAT aviation. Risk management in a non-commercial operation will typically be carried out by the pilot

who is able to take account of his own aversion to risk in making operational decisions. If the pilot chooses a more cautious approach, the operator does not suffer business failure.'

## 7.6 Appendix I: Requirements related to indications of instruments on board aeroplanes and helicopters

This Appendix summarises the flight parameters required to be displayed on board aeroplanes and helicopters operated under Part-CAT or Part-SPO. It was prepared in order to get a picture of what flight parameters are likely to be already available in the aircraft, which then could be recorded either as flight data or by means of recording images of the flight instruments.

### 7.6.1 Aeroplanes

The requirements related to flight and navigational instruments can be found in CAT.IDE.A.125 and CAT.IDE.A.130 of Part-CAT, and in SPO.IDE.A.120 and SPO.IDE.A.125 of Part-SPO.

Table I.1 presents the indications required to be presented on the flight instruments of aeroplanes operated under Part-CAT. Table I.2 presents the indications required to be presented on the flight instruments of aeroplanes operated under Part-SPO.

**Table I.1: Indications to be presented on the flight instruments of an aeroplane (Part-CAT)**

| Presented information | Description | Eligible aeroplane types | Eligible operating conditions |
|---|---|---|---|
| Magnetic heading | | All | VFR by day; VFR at night; IFR |
| Time | Time in hours, minutes and seconds. | All | VFR by day; VFR at night; IFR |
| Pressure altitude | | All | VFR by day; VFR at night; IFR |
| Indicated airspeed | | All | VFR by day; VFR at night; IFR |
| Vertical speed | | All | VFR by day; VFR at night; IFR |
| Turn and slip | Sensing the rate of turn, but not the rate of bank. | All except single-engined aeroplanes first issued with an individual CofA before 22 May 1995 | VFR by day; VFR at night; IFR |

| Presented information | Description | Eligible aeroplane types | Eligible operating conditions |
|---|---|---|---|
| | | if the compliance would require retrofitting under VFR by day. | |
| Attitude | | All except single-engined aeroplanes first issued with an individual CofA before 22 May 1995 if the compliance would require retrofitting under VFR by day. | VFR by day; VFR at night; IFR |
| Heading | | All except single-engined aeroplanes first issued with an individual CofA before 22 May 1995 if the compliance would require retrofitting under VFR by day. | VFR by day |
| Outside air temperature | | All except single-engined aeroplanes first issued with an individual CofA before 22 May 1995 if the compliance would require retrofitting under VFR by day. | VFR by day; VFR at night; IFR |
| Mach number | | Aeroplanes for which speed limitations are expressed in terms of Mach number. | VFR by day; VFR by night; IFR |
| Stabilised heading | | All | VFR at night; IFR |

### 7.6.2 Helicopters

The requirements related to flight and navigational instruments can be found in CAT.IDE.H.125 and CAT.IDE.H.130 of Part-CAT, and in SPO.IDE.H.120 and SPO.IDE.H.125 of Part-SPO.

Table I.3 presents the indications required to be presented on the flight instruments of helicopters operated under Part-CAT.

Table I.4 presents the indications required to be presented on the flight instruments of helicopters operated under Part-SPO.

**Table I.3: Indications to be presented on the flight instruments of a helicopter (Part-CAT)**

| Presented information | Description | Eligible helicopter types | Eligible operating conditions |
|---|---|---|---|
| Magnetic heading | | All | VFR by day; VFR by day for helicopters with an MCTOM of more than 3 175 kg, or any helicopter operating over water when out of sight of land, or when the visibility is less than 1 500 m; VFR at night; IFR |
| Time | Time in hours, minutes and seconds. | All | VFR by day; VFR at night; IFR |
| Pressure altitude | | All | VFR by day |
| Indicated airspeed | | All | VFR by day; VFR at night; IFR |
| Vertical speed | | All | VFR by day; VFR at night; IFR |
| Attitude | | All | VFR by day for helicopters with an MCTOM of more than 3 175 kg, or any helicopter operating over water when out of sight of land, or when the visibility |

| Presented information | Description | Eligible helicopter types | Eligible operating conditions |
|---|---|---|---|
| | | | is less than 1 500 m; VFR at night; IFR |
| Outside air temperature | | All | VFR by day; VFR at night; IFR |
| Stabilised heading | | All | VFR at night; IFR |

## 7.7 Appendix J: Examples of in-flight recording systems

Table J.1 contains examples of models of in-flight recording systems which can be installed on light aircraft and are known to EASA.

This table is purely illustrative, non-exhaustive, and it should not be understood in any manner as EASA recommendations. This table is only intended to provide concrete examples of in-flight recording systems for the purpose of better understanding the analysis made in the impact assessment.

The systems are presented by equipment manufacturer name in alphabetical order.

**Table J.1: Examples of in-flight recording systems**

| Name of equipment manufacturer | Equipment brand name |
|---|---|
| Appareo | GAU 3000 |
| Appareo | Vision 1000 |
| ETEP | Sentinel |
| Flight Data Vision | MDU 379 |
| Free Flight Systems | Memory Management System |
| Iaero | Apibox |
| ISEI | Safetyplane |
| KAPI Electronics | Kapi Air |
| L3Com | Lightweight Data Recorder |
| North Flight Data System | CV2R |
| North Flight Data System | OVVR |
| NSE | Brite Saver |
| Outerlink | IRIS |