

# 2022 Flight Recorder Installation Survey on National-Registered Civil and Public Aircraft

Date: 2022/09/30

## 1. Background Introduction

Taiwan Transportation Safety Board (TTSB) carries out routine flight recorder installation survey on national-registered civil and public aircraft. Every year official document of flight recorder installation survey form is sent to operators and government organizations. This survey is to collect model and brand of the aircraft installation of cockpit voice recorders (CVR), flight data recorders (FDR), flight data acquisition units (FDAU), quick access recorders (QAR), and lightweight flight recorders (LWR) at various national-registered operators. The findings have been the reference to establish flight recorder readout capability in the Research and Engineering Division in order to enhance the readout efficiency during the occurrence investigations.

ICAO Annex 6 has regulated on installation standard and recommendation, that depends on aircraft category (fixed-wing or helicopter), operation type (commercial air transport or general aviation), date the type certificate was issued, maximum take-off weight (MTOW), and propulsion type to distinguish installation necessity and specification requirement.

In Chapter 2 (for civil aviation) and Chapter 3 (for general aviation) of Regulations Governing Aircraft Flight Operations both require the operators in Taiwan for flight recorders installation onboard their aircraft and minimum recording time and parameters stated in ICAO Annex 6 are adopted by CAA Taiwan in the national regulation. However, an aircraft may be exempted from this requirement, if the manufacturer does not provide any technical service for modification, the operators cannot obtain STCs issued by Taiwan CAA, FAA, EASA or civil aviation authority from the original design country for technical modifications or free balloons.

The adopted ICAO regulations by CAA Taiwan are as follows:

1.No.1-1C: The Requirements of Flight Recorders for Civil Air Transport Operations

2.No.1-2C: The Requirements of Flight Recorders for General Aviation and Supplemental Operations

Public and military aircrafts which are not governed by civil aviation regulations do not have relevant legal sources for the installation of flight recorders. However, public helicopters (UH-60M) and second-generation fighters (F-16/M-2000/IDF) are equipped with military flight recorders. In addition, AS365 helicopters (except N1 model) have equipped lightweight flight recorders.

## **2. The specific works accomplished are:**

1. Survey the models and the manufacturers of the flight recorders installed.
2. Survey the format of the flight data readout database.
3. Survey the models and the manufacturers of FDAU.
4. Survey the establishment of FOQA system.
5. Statistics of the installation of flight recorders in civil aviation aircraft.
6. Statistics of the installation of QAR in civil aviation aircraft.
7. Statistics of the installation of flight recorders in public aircraft.
8. Statistics of the installation of portable GPS devices and lightweight flight recorders in public aircraft and general aviation aircraft which are not installed flight recorders.
9. Analysis of laboratory readout capability of the flight recorders.

## **3. Findings**

TTSB accomplished the annual flight recorder installation survey on 4<sup>th</sup> August, 2022. This survey included twenty-one operators - China Airlines, EVA Airways, UNI Airways, Mandarin Airlines, Tigerair Taiwan, Starlux Airlines, Aerospace Industrial Development Corporation, Daily Air, Emerald Pacific Airlines, Win Air Business Jet, Executive Aviation Taiwan Corp., Strong Aviation, RealWorld Aviation, APEX Flight Academy, Skyrainbow Airlines and Lu-Shi Management Consultant Co. Ltd., Skyvision Aviation Corp., and four government agencies - National Airborne Service Corps., Civil Aeronautics Administration, Taitung County Government and Department of Information and Tourism, Taipei City Government.

According to the responses from all these agencies and except free balloons, there are a total of 310 aircraft, including 264 fixed-wings and 27 rotary wing (helicopters). Out of these, 267 are civil aircraft (263 fixed-wings and 4 helicopters) and 24 are public aircraft (1 fixed-wing and 23 helicopters). In addition, 19 legally certified free balloons by CAA. New flight recorder models introduced this year is shown in the table 1.

Table 1 List of newest flight recorder model in civil and public aircraft

Operator	Aircraft type	Recorder category	Manufacturer	Model
China Airlines	A321neo	CVDR	L3	SRVIVR25
EVA Airways	B777F	CVR	L3	
		FDR	L3	
Starlux Airlines	A321neo	CVDR	L3	
	A330neo	CVR	L3	
Tigerair Taiwan	A320neo	CVDR	L3	
APEX Flight Academy	P2012	CVFDR	Bendix/King	SENTRY
National Airborne Service Corps	AS365	lightweight flight recorders	Appareo	Vison 1000

The fixed-wing aircraft of China Airlines, Starlux Airlines and Tigerair Taiwan equipped with L3 CVDR recorder, that combined cockpit voice and data recorder and well exceeds 25-hours of voice recording over four audio channels. The results are classified as findings from statistics is shown in the following:

### 3.1 Findings from statistics related to civil operators

1. Figure 1 shows the statistics of civil fixed-wing aircraft and helicopters:

- ◆ The proportion of the civil aircraft is equipped CVR and FDR of 95.5% and 94.8% respectively;
- ◆ The numbers of the civil aircraft that has equipped with 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR, which is 1, 237 and 17, respectively.

2. Figure 2 shows the statistics of civil fixed-wing aircraft:

- ◆ The proportion of the civil fixed-wing aircraft is equipped CVR and FDR of 95.4% and 95.4% respectively;
- ◆ The numbers of the civil aircraft that has equipped with 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR, which is 1, 233 and 17, respectively.

3. The statistics of civil helicopters are as below:

- ◆ There are 4 civil helicopters, 4 of which are equipped with CVR, and 2 of which are equipped with FDR.
  - ◆ The proportion of the civil helicopter installed with CVR and FDR are 100% and 50% respectively.
  - ◆ Two helicopters have neither LWR nor other data recording device equipped.
4. The proportion of the civil fixed-wing aircraft with the FDR readout database in hard copies and electronic copies are 39.2% and 84% respectively.
  5. The proportion of verified FDR readout database for civil fixed-wing aircraft is 96.6%.
  6. APEX Flight Academy has newly aircraft (P2012) operated in 2021, Type Validation Certificate has issued by EASA, FAA and CAA in 2018, 2019 and 2021. TTSB does not possess the readout software of SENTRY flight recorder equipped in the newly aircraft (P2012), nonetheless auxiliary devices are available to download raw data. By 4<sup>th</sup> Aug. 2021, the readout capability at TTSB LAB for the surveyed CVR and FDR has reached both 99.6%.

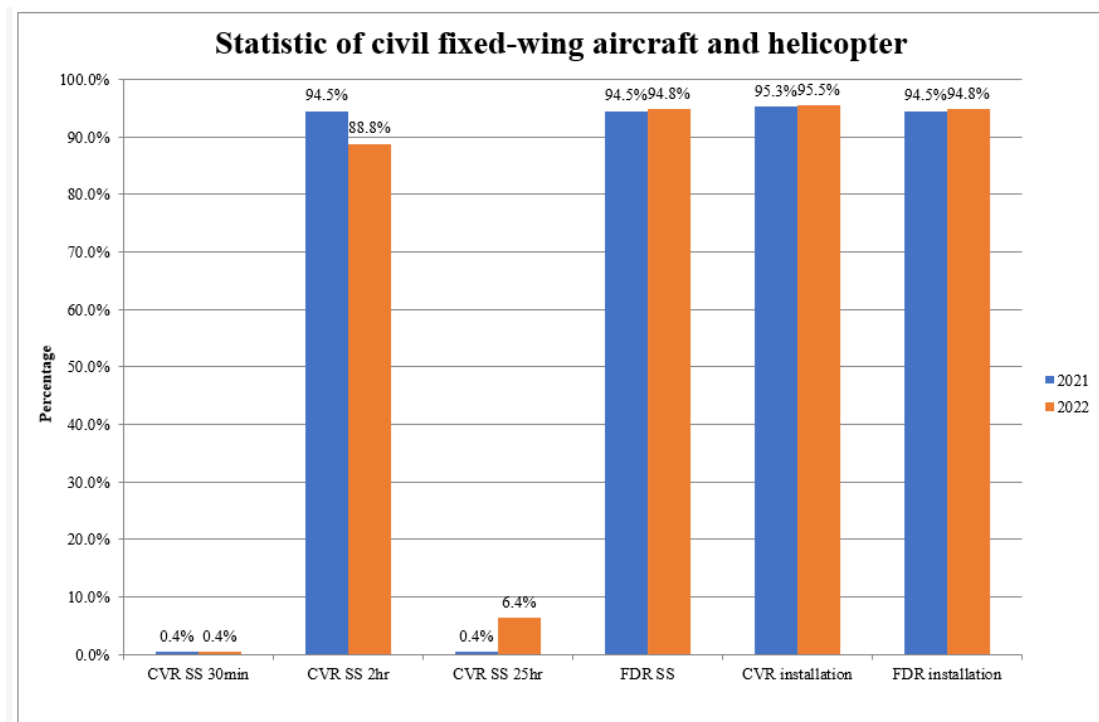


Figure 1 Statistic of civil fixed-wing aircraft and helicopter

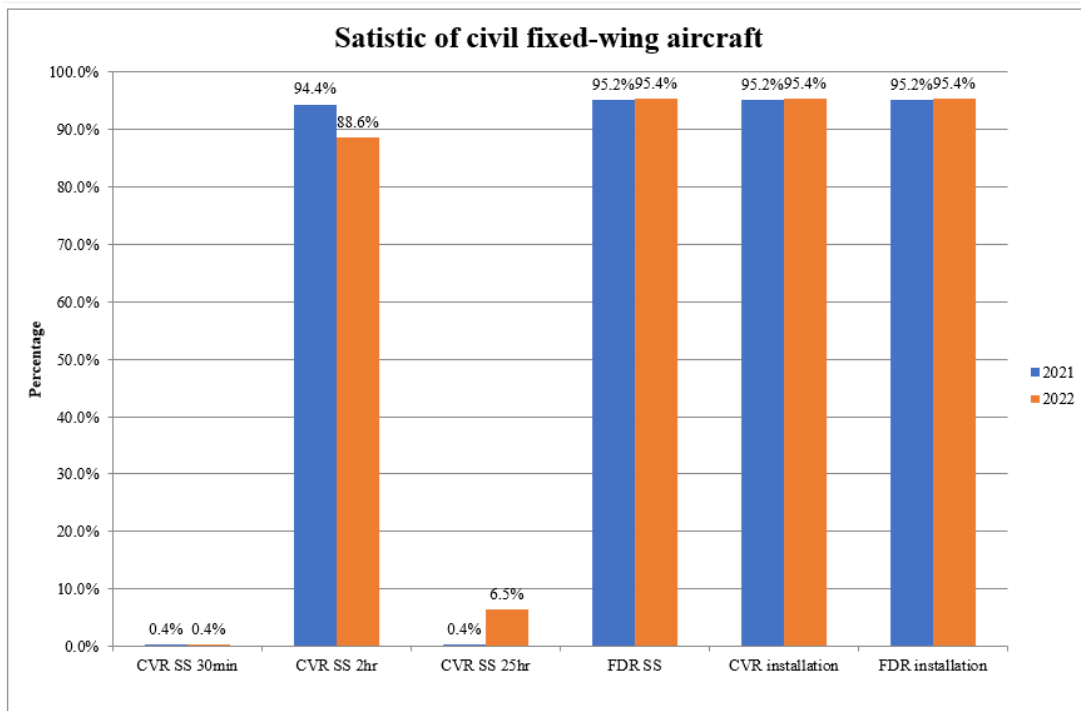


Figure 2 Statistic of civil fixed-wing aircraft

### 3.2 Findings from statistics related to public aircraft:

1. Of all 24 public aircraft (consisting of one fixed-wing BEECH-200, nine AS-365, and fourteen UH-60M), all UH-60M helicopters are equipped with mil-spec flight recorders, thus the proportion of flight recorder installation is 58.3%. Rest of public aircraft have portable GPS, which is 41.7% out of 100%. Nine of AS-365 helicopters, seven of its equipped lightweight recorders, which is 77.8% of installation. Due to the manufacturer does not provide any technical service for modification, two of AS-365N1 helicopters only equipped portable GPS.
2. By 4<sup>th</sup> Aug, 2022, the capabilities at TTSB LAB for the surveyed flight recorders equipped on the public aircraft have reached 100%.

### 3.3 Findings from statistics related to free balloons installed with portable GPS:

1. All 19 registered free balloons in Taiwan have data recording devices installed. The Taitung County Government owns 7, Skyrainbow Airlines owns 8, Lu-Shi Management Consultant Co. Ltd. owns 3, Department of Information and Tourism, Taipei City Government owns 1.
2. Until 4<sup>th</sup> Aug, 2022, the readout capability at TTSB LAB for the surveyed portable GPS is 100%.

### 3.4 Findings from FOQA statistics related to civil operators:

As per “Regulations Governing Aircraft Flight Operations - Article 9”, by Taiwan CAA:

*From 1 January 2009, an operator shall establish and implement a safety management system acceptable to the CAA which, as a minimum:*

- 1. Identifies safety hazards;*
- 2. Ensures that remedial action necessary to maintain an acceptable level of safety is implemented;*
- 3. Provides continuing monitoring (auditing) and regular assessment of the safety level achieved; and*
- 4. Aims to make continuous improvement to the overall level of safety.*

*The safety management system as set out in the preceding paragraph shall clearly define lines of safety accountability throughout the operator’s organization, including a direct accountability for safety on the management level, and comply with attachment 1.*

*An operator of an aircraft of a maximum certificated take-off mass in excess of 27,000 kg shall establish and maintain a flight data analysis programme as part of the safety management system in paragraph 1 above.*

*The flight data analysis programme as set out in the preceding paragraph shall be non-punitive and contain adequate safeguards to protect the source(s) of the data.*

Six national-registered operators have set up flight data monitoring programs for daily operation and total fleet size is 231 aircraft. Among those 186 aircraft are equipped with QAR. Statistics of FOQA systems using by national-registered operators are listed as table 2.

Table 2 Statistics of FOQA systems of domestic operators

<b>Operator</b>	<b>FOQA Maker</b>	<b>FOQA System</b>	<b>FDM</b>	<b>Animation</b>
China Airlines	Aerobytes	Aerobytes FDM	Y	Y
EVA Airways	Aerobytes	Aerobytes FDM	Y	Y
Mandarin Airlines	Aerobytes	Aerobytes FDM	Y	Y
UNI Airways	Aerobytes	Aerobytes FDM	Y	Y
Tigerair Taiwan	Teledyne	AirFASE	Y	Y
Starlux Airlines	Teledyne	AirFASE	Y	Y

#### **4. Conclusions**

One of the goals the TTSB Research and Engineering Division trying to pursue is to

reach 100% capability of flight recorder readout for national-registered civil and public aircraft. To accomplish this, the Division carries out national-registered aircraft flight recorder installation survey every year. In overall, tape-based CVR and FDR were completely phased out since 2015. With the recommendation regarding use of 120 minutes CVR issued to the CAA, there were positive responses in this survey. The proportion of 120 minutes CVR installation has achieved around 95% over the last 3 years. (95.6% 2020, 95.2% 2021 and 95.4% 2022). According to ICAO Annex 6 regulations, starting January 2022, all new-built aircraft whose maximum take-off weigh over 27,000 kg have to be equipped with 25 hours CVR.

As per “No.1-1C: The Requirements of Flight Recorders for Civil Air Transport Operations”, by Taiwan CAA:

*From 1 January 2022, an aircraft shall equip cockpit voice recorder that record at least 25 hours, thus stated in ICAO Annex 6 Part I 6.3.2.3.2. However, if operators may be exempted from this requirement shall provide explanation and submit relevant certified documentation approvable to the CAA, thus installation may be extended one year.*

This year, China Airlines, EVA Airways, Starlux Airlines and Tigerair Taiwan has seventeen aircrafts equipped with 25 hours CVR, the proportion of 25 hours CVR installation is 6.5%. TTSB Research and Engineering Division had coordinated with one of operator in Taiwan to successfully download 25 hours CVR testing data this year. Keep establishing readout capabilities for 25 hours CVR, discover new technique and efficient tool.

Due to old avionics and related regulation limitations, the helicopters maintained low recorder installation rate in the past. However, with the introduction of new aircraft into the fleet, the proportion of CVR installation is gradually increased to 66.7%, in the meantime the proportion of FDR installation is gradually increased to 59.3% as well. For those helicopters still not equipped with flight recorders, TTSB will keep encouraging operators and relevant organizations to evaluate LWR installation and flight data applications, so as to improve the flight safety. Due to the manufacturer does not provide any technical service for modification, two of AS-365 helicopters only equipped portable GPS, seven of its equipped lightweight recorders.

By 4<sup>th</sup> Aug. 2022, the readout capabilities at TTSB LAB for the surveyed CVR, FDR, portable GPS and LWR both in civil and public aircraft have all reached 100%. Due to newly aircraft (P2012) operated, readout capabilities of CVR and FDR has slightly decrease to 99.6%.

## **5. Future plans**

1. Keeping establishing readout capability for newly flight data recorder.

2. Keep establishing readout capabilities for 25 hours CVR, discover new technique and efficient tool of transcript.
3. Attend international training programs to improve flight data mining, dynamic image analysis, and big data applications in aviation.
4. Keep establishing readout capability for damaged avionic devices and developing a dynamic database system to manage the aircraft flight parameters.
5. Improving readout and analysis capability for new generation flight recorders equipped on A320neo, A321neo, A330neo, A350 and B787 type aircraft.
6. Establish Asia-Pacific Region investigation technical meeting to keep build up the capacity of TTSB engineering analysis. Invite JTSA (Japan), TSIB (Singapore) and nearby countries together to hold the technical conference and practical training.