

2023 Flight Recorder Installation Survey on National-Registered Civil and Public Aircraft

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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), issue date of the aircraft type certificates, 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 upon CAA Taiwan authorization, when its manufacturer does not provide any technical service for modification, and the operator cannot obtain STC issued by Taiwan CAA, FAA, EASA or civil aviation authority from the original design country for technical modifications, or certified 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 tasks 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 2nd August, 2023. This survey included twenty 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 three government agencies - National Airborne Service Corps., Civil Aeronautics Administration, Taitung County Government and Department of Information and Tourism.

According to the responses from all these agencies and except free balloons, there are a total of 323 aircraft, including 271 fixed-wing and 28 rotary-wing (helicopters). Out of these, 275 are civil aircrafts (270 fixed-wing and 5 helicopters) and 24 are public aircrafts (1 fixed-wing and 23 helicopters). In addition, 24 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/Serial number
EVA Airways	B787-10	CVDR	Rockwell Collins	EAFR/ 886-0084-201
Starlux Airlines	A350-900	CVDR	L3	SRVIVR25/7100-1900-31

The fixed-wing aircraft of Starlux Airlines equipped with L3 CVDR recorder, that combined cockpit voice and flight data recorder and well exceeds 25 hours of voice recording over four audio channels. The new delivered B787-10 fixed-wing aircraft operated by EVA Airways which equipped with new serial number of EAFR flight recorder, that record 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 helicopter:

- ◆ The proportion of the civil aircraft is equipped CVR and FDR of 95.3% and 94.5% 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, 226 and 35, 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 95.6% and 95.6% 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, 222 and 35, respectively.

3. The statistics of civil helicopter listed as below:

- ◆ There are 5 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 80% and 40% respectively.
- ◆ Three helicopters have neither FDR, 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 37.8% and 84.1% respectively.
- 5. The proportion of verified FDR readout database for civil fixed-wing aircraft is 100%.
- 6. By 2nd Aug., 2023, the readout capability at TTSB LAB for the surveyed CVR and FDR has reached both 100%.

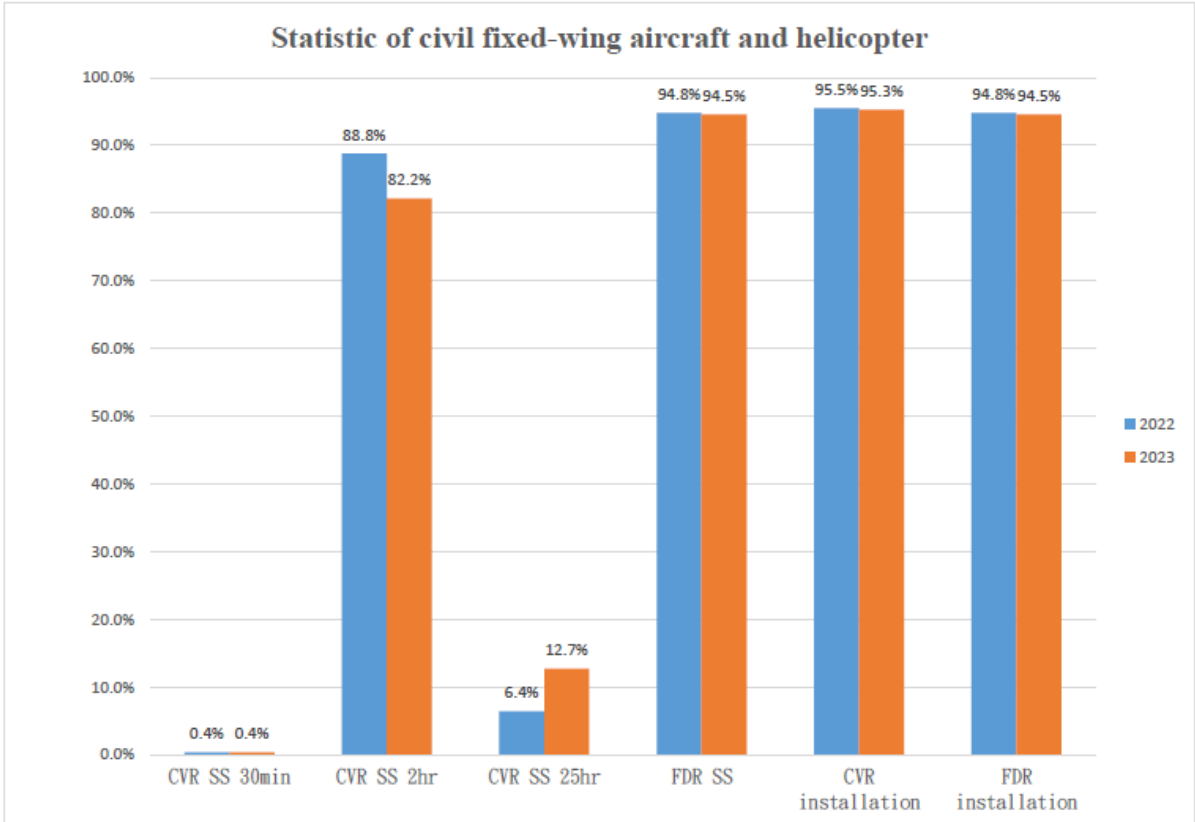


Figure 1 Statistic of civil fixed-wing aircraft and helicopter

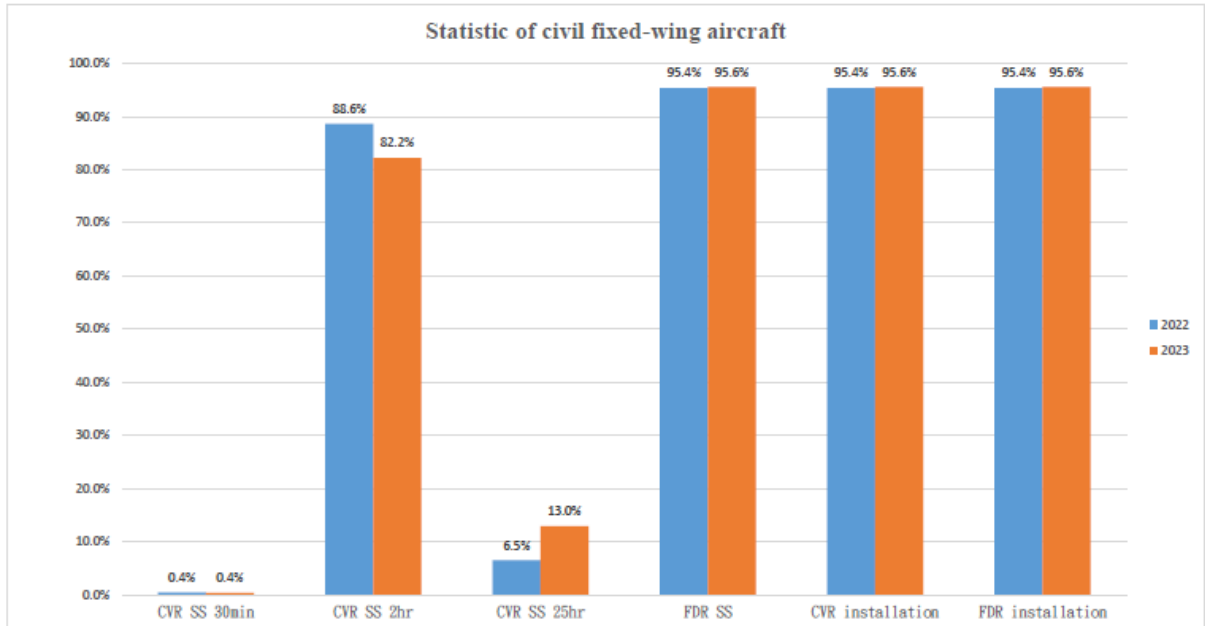


Figure 2 Statistic of civil fixed-wing aircraft

3.2 Findings from statistics related to public aircraft:

1. Of all 24 public aircrafts (consisting of one fixed-wing BEECH-200, nine AS-365, and fourteen UH-60M), all UH-60M helicopters are equipped with mil-spec flight recorder, thus the proportion of flight recorder installation is 58.3%. Rest of public aircrafts 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 2nd Aug., 2023, 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 balloon installed with portable GPS:

1. All 24 registered free balloons in Taiwan have data recording devices installed. The Taitung County Government owns 13, Skyrainbow Airlines owns 8, Lu-Shi Management Consultant Co. Ltd. owns 3.
2. By 2nd Aug., 2023, 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 establish flight data monitoring programs for daily operation and total fleet size is 239 aircraft. Among those 182 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

Operator	FOQA Maker	FOQA System	FDM	Animation
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. The proportion of exceedance 120 minutes CVR installation has increased accordingly, and has achieved around 95% over the past 3 years. (95.2% in 2021, 95.1% in 2022 and 95.2% in 2023). According to ICAO Annex 6 regulations, starting January 2022, all new-built fix-wing commercial aircraft whose Maximum Take-Off Weight over 27,000 kg shall 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 have thirty-five aircrafts equipped with 25 hours CVR, the proportion of 25 hours CVR installation is 13%. TTSB Research and Engineering Division had exchange opinions with others accident investigation organization to discuss possibility of intelligence CVR recording technique or tool that can be transferred the 25 hours voice recording record into transcript, in order to enhance efficiently of transcription.

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 57.1%, in the meantime the proportion of FDR installation is gradually increased to 64.3% 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 helicopters are only equipped with portable GPS and seven are equipped with lightweight recorders.

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%. Newly aircraft (P2012) operated in 2022, TTSB Research and Engineering Division had coordinated with operator to conduct CVR and FDR download tests, and obtained data successfully this year.

5. Future plans

1. Continuously exchange or discuss with others accident investigation organization, to obtain up-to-date technique and efficient tool of transcript and built up own capability for 25 hours CVR readout.
2. Attend international training programs to improve flight data mining, dynamic image analysis, and big data applications in aviation.

3. Keep establishing readout capability for damaged avionic devices and developing a dynamic database system to manage the aircraft flight parameters.
4. Improving readout and analysis capability for new generation flight recorders equipped on A320neo, A321neo, A330neo, A350 and B787 type of aircraft.
5. Establish Asia-Pacific Region investigation technical meeting to keep build up the capacity of TTSB engineering analysis. Invite JTSA (Japan), TSIB (Singapore), ARAIB (Korea) and nearby countries together to hold the technical conference and practical training.