

2024 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 accomplished tasks

This survey included twenty-three 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, Ginger Aviation , APEX Flight Academy, Heli Service Taiwan Co., Ltd., MetaStar-Airlines, 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.

The list of accomplished tasks that collected by operators which are:

1. The models and the manufacturers of the flight recorders installed.
2. The formats of the flight data readout database.
3. The models and the manufacturers of FDAU.
4. The establishment of FOQA system.

3. Findings

Based on the responses from all these agencies, TTSB can analyze the laboratory readout capability of the flight recorders which installed in civil aviation and public aircraft, and also portable GPS devices and lightweight flight recorders in public aircraft and general aviation aircraft. In addition of statistic of installation of QAR in civil aviation aircraft.

There are a total of 323 aircraft, including 267 fixed-wing and 32 rotary-wing (helicopters) and 24 legally certified free balloons. Out of these, 240 are civil aircrafts (238 fixed-wing and 2 helicopters) and 24 are public aircrafts (1 fixed-wing and 23 helicopters). In addition, 16 aircraft (15 fixed-wing and 1 helicopter) are newly operated this year and their flight recorder models introduced are 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
China Airlines	B777F	CVDR	L3	SRVIVR25/ 7100-1000-70
	A321-271N	CVDR	L3	SRVIVR25/7100-0200-00
	A350-900	CVR FDR	L3	CVR/ 2100-1227-02 FDR/ 2100-4245-00
EVA Airways	B787-10	CVDR	Rockwell Collins	EAFR/ 886-0084-201
	B777F	CVDR	L3	SRVIVR25/7100-1000-70
Starlux Airlines	A350-900	CVDR	L3	SRVIVR25/7100-1900-31
Tigerair Taiwan	A320-271N	CVDR	L3	SRVIVR25/7100-0200-00
Mandarin Airlines	ATR72-213A	CVR/FDR	L3	FA2100-1225-61
APEX Flight Academy	P2012	CVDR	Bendix/King	SENTRY
Skyvision Aviation	BD-700-1A10	CVR	L3	FA2100/2100-1025-24
Heli Service Taiwan	AW169	CVDR	Curtiss-Wright	EAFR/D51701-001
MetaStar-Airlines	M2-525	CVR	L3	FA2100/S3100-622

The fixed-wing aircraft of Starlux Airlines, EVA Airways are equipped with L3 CVDR recorders, and B787-10 of EVA Airways aircraft are equipped with Rockwell Collins EAFR flight recorders that both combined cockpit voice and flight data recording functions and well exceed 25 hours of voice recording length on their four audio channels. The 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 equipped CVR and FDR is 94.9% and 93.5%

respectively;

- ◆ The numbers of the civil aircraft equipped with 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR are 1, 215 and 45, respectively.

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

- ◆ The proportion of the civil fixed-wing aircraft equipped with CVR and FDR is 95.9% and 95.5% respectively;
- ◆ The numbers of the civil aircraft equipped with 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR are 1, 211 and 44, respectively.

3. The statistics of civil helicopter listed as below:

- ◆ There are 8 civil helicopters, 5 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 62.5% and 25% 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 41.5% and 93.6% respectively.

5. The proportion of verified FDR readout database for civil fixed-wing aircraft is 100%.

6. Heli Service Taiwan Co. has newly helicopter (AW169) equipped with 25 hours EAFR system flight recorder (Fortress recorder). TTSB does not possess the download and the readout software of such flight recorder. By 30th of Aug. 2024, the readout capability at TTSB LAB for the surveyed CVR and FDR has reached both 99.6%.

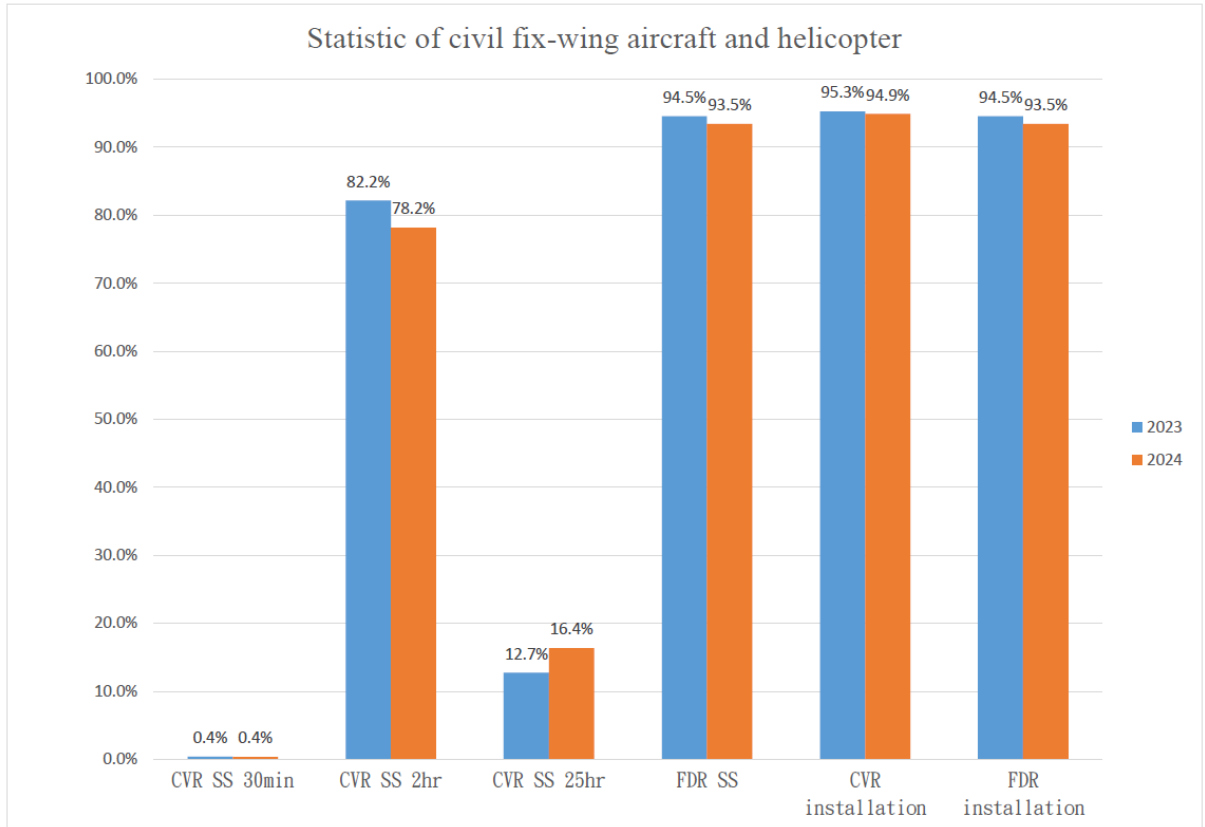


Figure 1 Statistic of civil fixed-wing aircraft and helicopter

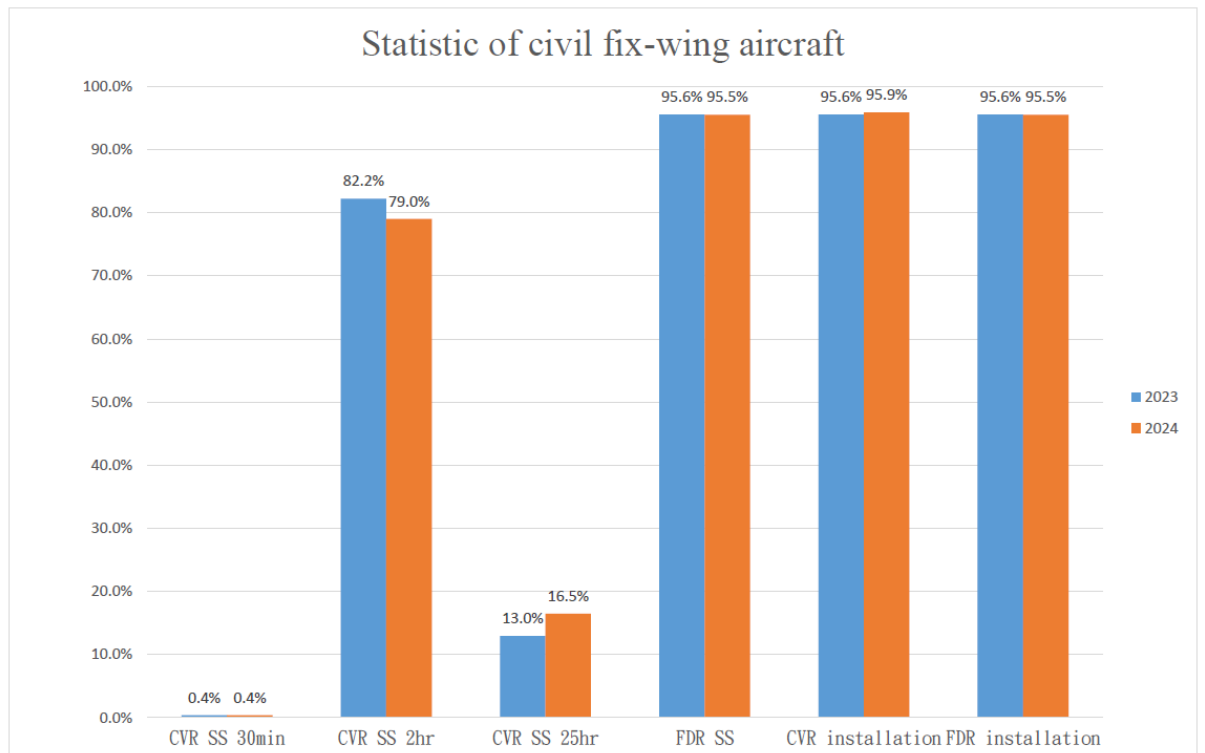


Figure 2 Statistic of civil fixed-wing aircraft

3.2 Findings from statistics related to public aircraft:

1. Of all 24 public 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%. Out of nine AS-365 helicopters, seven of them are equipped with lightweight recorders, equal to 77.8% of installation. Due to the manufacturer does not provide any technical service for modification, two of AS-365N1 helicopters are only equipped portable GPS.
2. 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. 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 established flight data monitoring programs for daily operation and total fleet size is 234 aircraft. Among those 169 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. (95.1% in 2022, 95.2% in 2023 and 95.5% in 2024). According to ICAO Annex 6 regulations, starting January 2022, all new-built fix-wing commercial aircraft whose Maximum Take-Off Weigh 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 forty-four aircrafts equipped with 25 hours CVR, the proportion of 25 hours CVR installation is 18.8%.

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%. Due to newly helicopter (AW169) operated, total readout capabilities of CVR and FDR has slightly decreased to 99.6%.

5. Conclusion and suggestions

Based on the statistic result of this year, the readout capabilities at the TTSB lab for the surveyed CVR, FDR, portable GPS and LWR in civil and public aircraft have all reached 100%. Due to newly helicopter (AW169) operated, overall readout capabilities of CVR and FDR has slightly decreased to 99.6%. To conclude, the following suggestion is made:

1. Keeping establishing readout capability for newly flight data recorder.
2. With the recent FAA Reauthorization Act addressing 25-Hours Cockpit Voice Recorder (CVR) requirements that cover aircraft operated by air carriers under Part 121 (commercial) and type-certificated with a passenger seating capacity of 30 or more, or an all-cargo or combi derivative of such an aircraft, will be proposed equipped with 25- Hours Cockpit Voice Recorder within 6 years of enactment (of the Act.) TTSB will be coordinated with Taiwan CAA, to promote modification of civil aircraft to be equipped with such recorder, in order to enhance safety management.
3. Attend international training programs to improve flight data mining, dynamic image analysis, and big data applications in aviation, and 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. Convene Asia-Pacific Region investigation technical meeting to keep building up the capacity of TTSB engineering analysis. Invite JTSA (Japan), TSIB (Singapore), ARAIB (Korea) and nearby countries together to hold the technical seminar and practical training.