2021 Flight Recorder Installation Survey on National-Registered Civil and Public Aircraft

Date: 2021/09/03

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 forms are sent to operators and government agencies. The goal of this survey is to find out 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, so as to enhance the readout efficiency during the occurrence investigations.

ICAO Annex 6 regulations on installation of flight recorders depend 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 the needs to install flight recorders and the specifications.

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, the aircraft may be exempted from requirements if the MTOW of the aircraft does not reach the weight threshold, the manufacturer does not provide any technical service for modification, or the operators can not obtain STCs issued by Taiwan CAA, FAA, EASA or civil aviation authority from the original design country for technical modifications. Free-air balloons are also exempted.

The adopted ICAO regulations by CAA Taiwan are as follows:

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

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

3.No.2: The Requirements of head-up display (HUD) or Enhanced Vision System (EVS) for Civil Air Transport and General Aviation Operations

4.No.3: Helicopter Performance and Operating Limitations

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, the newly acquired public helicopters (UH-60M) and second-generation fighters (F-16/M-2000/IDF) are equipped with military 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 installation 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 4th August, 2021. This survey included eighteen operators - China Airlines, EVA Airways, UNI Airways, Mandarin Airlines, Tigerair Taiwan, Starlux Airlines, Aerospace Industrial Development Corporation, Daily Air, Emerald Pacific Airlines, ROC Aviation Company, Winair 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.

According to the responses from all these agencies and except hot air balloons, there are a total of 280 aircraft, including 252 fixed-wings and 28 helicopters. Out of these, 256 are civil aircraft (251 fixed-wings and 5 helicopters) and 24 are public aircraft (1 fixed-wing and 23 helicopters).

The results are classified as findings from statistics related to civil operators, findings from statistics related to civil helicopters and balloons installed with portable GPS and LWR, findings from statistics related to public aircraft installed with flight recorder and portable GPS, and findings from FOQA statistics related to civil operators as follows.

Tigerair Taiwan has one new A320neo this year, and it is equipped with 25 hours CVR (L3 cockpit voice and flight data recorder, CVFDR).

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 with CVR and FDR installation are 95.3% and 94.5% respectively;
   - ◆ The numbers of the civil aircraft that has 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR installed are 1, 242 and 1, respectively.
2. Figure 2 shows the statistics of civil fixed-wing aircraft:
   - ◆ The proportion of the civil fixed-wing aircraft with CVR and FDR installation are 95.2% and 95.2% respectively;
   - ◆ The numbers of the civil aircraft that has 30-min solid-state CVR, 120-min solid-state CVR and 25 hours solid-state CVR installed are 1, 237 and 1, respectively.
3. The statistics of civil helicopters are as below:
   - ◆ There are 5 civil helicopters, 5 of which are equipped with CVR, and 3 of which are equipped with FDR.
   - ◆ The proportion of the civil helicopter installed with CVR and FDR are 100% and 60% respectively.
   - ◆ Two helicopters have neither LWR nor other data recording device installed.
4. The proportion of the civil fixed-wing aircraft with the FDR readout database in hard copies and electronic copies are 38.6% and 80.9% respectively.
5. The proportion of verified FDR readout database for civil fixed-wing aircraft is 98%.
6. By 4th Aug. 2021, the readout capability at TTSB LAB for the surveyed CVR and FDR has reached both 100%.

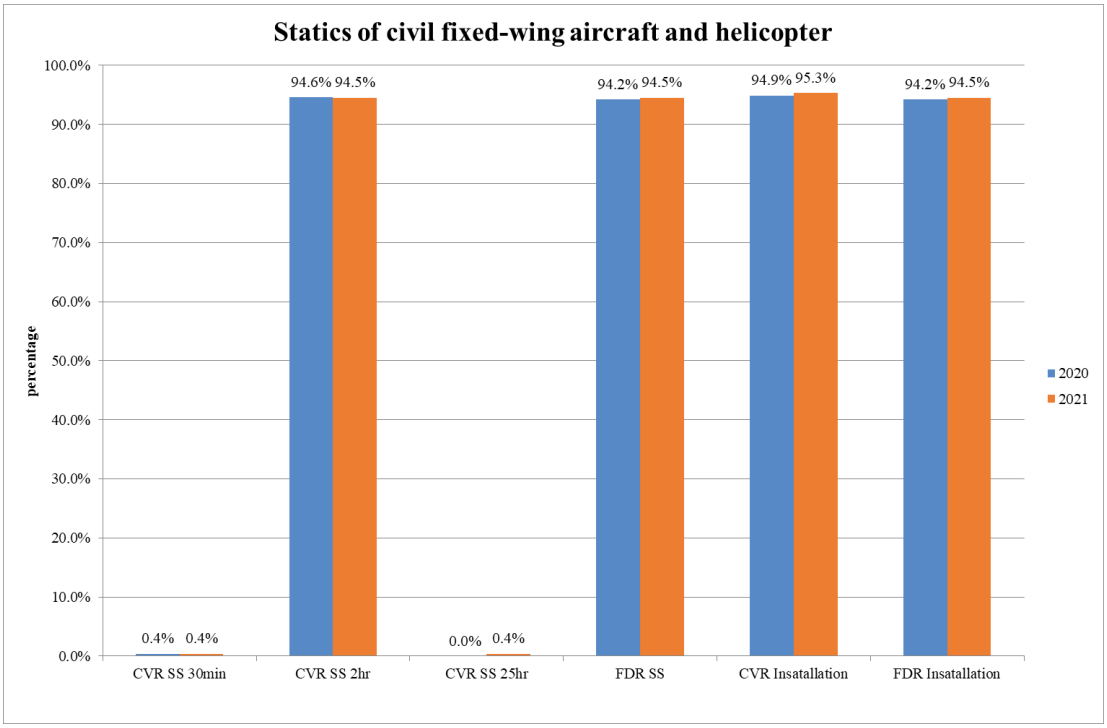

Figure 1 Statistics of civil fixed-wing aircraft and helicopter

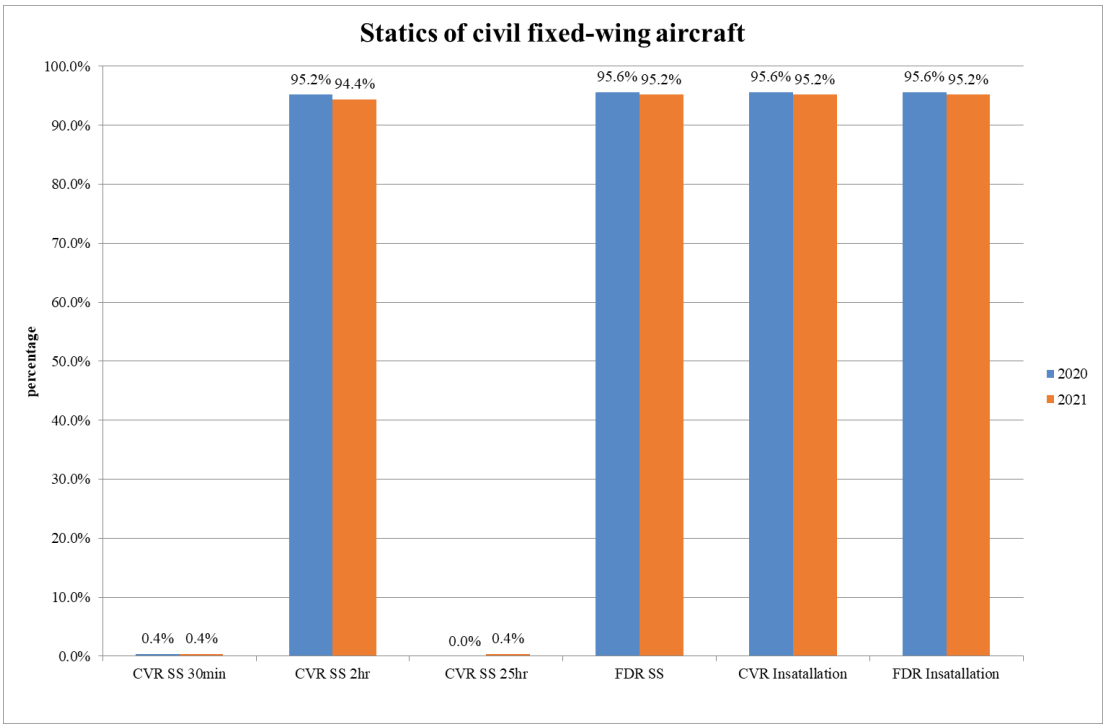

Figure 2 Statistics of civil fixed-wing aircraft

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%. Fifty-percent of the rest of

public aircraft fleet have portable GPS, equipped on the five AS-365 helicopters.

2. National Airborne Service Corps have 9 AS365 helicopters, 6 of them are equipped with LWR, the proportion of LWR installation is 66.6%.

3. By 4th Aug. 2021, the capabilities at TTSB LAB for the surveyed flight recorders installed on the public aircraft have reached 100%.

3.3 Findings from statistics related to hot-air balloons installed with portable GPS:

1. All 20 registered hot-air balloons in Taiwan have data recording devices installed. The Taitung County Government owns 11, Skyrainbow Airlines owns 6, Lu-Shi Management Consultant Co. Ltd. Owns 3.

2. Up to 4th Aug. 2021, 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 219 aircraft. Among those 187 aircraft are equipped with QAR.

Statistics of FOQA systems using by national-registered operators are listed as table 1.

Table 1 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. 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. (93.1% 2019, 95.2% 2020 and 95.2% 2021). 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. This year only Tigerair Taiwan has one new A320neo equipped with 25 hours CVR, the proportion of 25 hours CVR installation is 0.4%.

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 67.9%, in the meantime the proportion of FDR installation is gradually increased to 60.7% 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 elevate the flight safety.

By 4th Aug. 2021, 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%.

5. Future plans

1. Keep establishing readout capabilities for 25 hours CVR.

2. Keep establishing readout capability for damaged avionic devices and developing a dynamic database system to manage the aircraft flight parameters.

3. Improving readout and analysis capability for new generation flight recorders equipped on A321neo, A350 and B787 type aircraft.

4. Establish Asia-Pacific Region investigation technical meeting to keep build up the capacity of TTSB engineering analysis. Invite JTSB (Japan), TSIB (Singapore) and nearby countries together to hold the technical conference and practical training.

5. Attend international training programs to improve flight data mining, dynamic image analysis, and big data applications in aviation.