

Let's make  
aviation safer!

# Lightweight flight data & cockpit recording

**FE 320 cockpit camera  
for crash-protected  
ED-155 solutions**



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*ED-155:  
What changes?  
What are the solutions?  
Who has to take action  
now?  
How can lightweight  
aviation benefit?*

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*“Not learning from the past is a brutally expensive and dangerous way to run a flight operation. Through the analysis of past flights, flight data monitoring can catch errors before they have a chance to lead to accidents.”*

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NTSB vice chairman  
**Bruce Landsberg**

as cited on <https://www.ainonline.com/aviation-news/business-aviation/2021-07-01/let-flyer-beware>

## How lightweight crash-protected ED-155 recorders can boost safety in light aircraft aviation

A quick overview of the current situation

Safety is one of the most important topics in aviation. The regulations are very tight in this segment because a small error could trigger a big catastrophe and the risk of human injury is way higher than in other type of transports. Even if there is no human harm, every incident damages the whole industry. For a long time, the Light Aircraft industry was somehow under the radar and far less strict rules applied in this area. This is now changing, and it's changing fast.

**A hard deadline:  
the installation of a lightweight flight data and cockpit recorder according to ED-155 is mandatory as from 5th September of 2022!**

For years, the NTSB (National Transportation Safety Board) and EUROCAE (European Organization for Civil Aviation Equipment) have required professional crash-proof image and data recorders for light aircraft and helicopters. The new update of EU regulation 2019/1387, forces the issue of the installation of lightweight crash-protected recorders according to ED-155 for newly built A/C and aircraft operated under CAT (commercial air transport) rules. With this deadline there is now an urgent need for action for lightweight aircraft OEM's and operators in commercial air transport.

**What we can learn from the tragical Kobe Bryant Accident (and from far too many others!)**

Following a fatal accident with no survivors or witnesses, an investigation may never be able to determine the exact causes and contributing factors unless the aircraft is equipped with an on-board recording device. The news about the tragic helicopter accident that happened to Kobe Bryant spread all over the world. Since a helicopter is a lightweight vehicle, it normally flies in Visual Flight Rules (VFR) conditions and it doesn't have a black box. As a consequence, the circumstances behind the Kobe Bryant accident remain unexplained. This is a sad example of why the ED-155 regulation is necessary.

But what if Bryant's helicopter had been equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR)? In this case, comprehensive data on the course of events of the accident would have been available, the causes could have been investigated. With such knowledge the industry can take measures to prevent similar accidents. Step by step, light aircraft aviation can thus become even safer and safer.

*“The more information we have, the better we can understand not only the circumstances of a crash, but what can be done to prevent future accidents. We are asking that currently available recording technology be put to use in a way that will improve aviation safety.”*

Dana Schulze,  
Director of the NTSB Office  
of Aviation Safety

as cited in <https://www.ntsb.gov/news/press-releases/Pages/NR20200602.aspx> (6/2/20)

**ED-155: The public opinion is already one step ahead.  
Light aircraft operators have to act now.**

In common passenger aircrafts, Flight Data Recorders and Cockpit Voice Recorders have been mandatory for a long time. People generally think all aircrafts, no matter which type, have installed a black box, with which all the information about a journey is collected and can be investigated after incidents. It is rarely known that this does not yet apply to light aircraft and light helicopters.

**Why is there still reluctance among some operators and pilots?**

The technology is still assumed to be costly and hard to install. Also, pilots partly perceive flight data and cockpit recorders as a kind of “big brother” technology. State-of-the-art solutions take that into account and prove better, e.g., with a data deletion option after uneventful flights. They are specifically adapted to the requirements of the light aircraft scene.

**Thinking ahead: State of the art solutions for lightweight  
crash-protected ED-155 recorders**

With the aim of making aviation safer, sensor and camera experts in the aerospace sector bring together their expertise to present light & smart crash-protected recording solutions fitting optimally into light aeroplanes, light helicopters and VTOLs with a simple installation. In this paper we give an overview of the regulations and requirements in the area of ED-155 and outline the potential and the benefits of crash-protected ED-155 recording solutions including certified cameras for a wide range of users in the field.



**Who is affected?**

ED-155 requires the installation of a lightweight flight data recorder for:

- Light aircraft used for commercial operations (CAT or SPO)
- Turbine engine aeroplanes with an MCTOM of 2.250 kg or more
- Aeroplanes with a MOPSC of more than 9
- Turbine engine helicopters with an MCTOM of 2.250 kg or more

## Why cameras are so important for crash-protected ED-155 recording solutions

Fully compliant all-in-one solutions

A partnership of proven sensor/recorder experts and camera experts with specific aerospace know-how can be the perfect basis for high performance all-in-one ED-155 recording solutions.

What is the flight data and cockpit recorder recording? Flight-data is stored together with high quality cockpit voice and video data in a crash-protected memory (CPM). Flight Data Recorders (FDR) record information such as altitude, airspeed, heading, and other aircraft parameters, many times per second. Cockpit Voice Recorders (CVR) record radio transmissions and ambient cockpit sounds, such as pilot voices, alarms, and to a certain extend also engine noises.

As a fallback, the camera provides partly redundant information from the cockpit instruments and additional visual information from the cockpit (such as pilot actions, external view, etc.). In principle, the camera is also a bridging technology for flight data recorders in analog-based cockpits by streaming analog cockpit instruments. The camera is hence an extremely versatile and important tool within ED-155 recording solutions.

### Kappa "Flight Eye Cockpit" for ED-155 recorders

As an OEM component for ED-155 recording solutions, Kappa relies on the proven „Flight Eye Cockpit“ camera (FE 320). The camera provides Full HD 1080p (with configurable bandwidth down to 200 Kbit, Ethernet IP and H.264 compression). Thoroughly matched to the crash-protected recorder, it meets all ED-155 requirements: HDR video quality under extreme light conditions, frame rate adjustments, distortion-free images at wide field of view, and uninterrupted, digitally stabilized video streaming even under heavy aircraft vibrations. The camera comes in a modular SWAP-C design, either in compact design or with separated sensor and electronic unit (up to 10 m). The camera also provides a dual streaming function to feed two independent recorders.

Already successfully implemented: HENSOLDT and Kappa offer the SferiRec LCR with the camera FE 320 LCR as a high-performance joint ED-155 recording solution. All ED-155 requirements are safely met with the currently lightest device on the market.

**Find more information on our website!**



LCR 100



FE 320



FE 320



Anti-Reflection FE 320

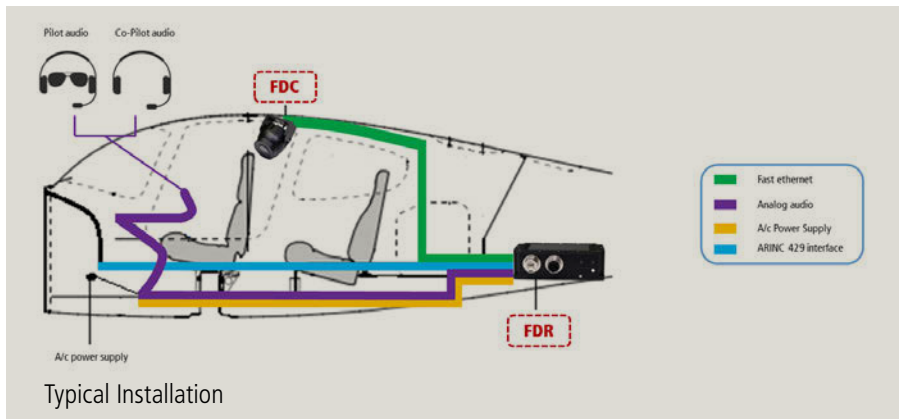
**Versatile use: interesting use cases beyond ED-155**

Crash-protected recording solutions not only fulfill the ED-155 and ETSO-2C197 requirements, but can also bring additional practical benefits for numerous actors in the area of light aircraft aviation. Flight schools can use the solution to intensify their training. Due to the installed sensors, it can deliver instructive data for training purposes. Realtime information and vision give the chance to perform tests and in that way being safer and more confident while flying. Tests, results, and training can be checked and evaluated after the flight. Flight schools and MROs are provided with additional information about exceedances and incidents not observed or reported by the pilot. Moreover, aircraft insurances might also be interested in detailed asset protection information.

To be able to use high-quality video streams for these purposes, it is recommended to work with cockpit cameras that deliver higher frame-rates and better resolutions than specified by ED-155. It’s also possible to use cameras with dual streaming (e.g., the FE 320 camera from Kappa optronics) to feed two independent recorders with different set-ups on image quality and bandwidth, one specifically for ED-155 crash-protected recording, and one for the described other use cases.

**Strong positive feedback from the industry**

Numerous OEMs show great interest in SWaP-C solutions meeting ED-155. Thanks to these new systems, not only big aircraft and companies can boost the safety issue for their aircraft, but finally also medium and small size platforms have access to a safe, easy-to-install and affordable solution specifically adapted to their purposes.



**Who can benefit?**

- All Lightweight Aircraft Actors: fulfill ED-155 requirements. Note: for CS-23 aeroplanes (not being complex motor-powered aircraft or rotorcraft and ELA2 A/C) no STC is required for the installation. For these aeroplanes CS-STAN is sufficient. LCR: CS-SC104a / Camera: CS-SC403a
- MROs: objective data for efficient maintenance
- Flight Schools: next-level training with instructive flight data for analysis and student coaching
- Aircraft Insurances: comprehensive data for asset protection

*“(...) since 86 percent of the 185 turbine-powered helicopter accidents it investigated between 2005 and 2017 had no recording equipment installed, the FAA actions were ineffective.”*

**National Transportation Safety Board (NTSB)**

as cited in <https://www.ntsb.gov/news/press-releases/Pages/NR20200602.aspx> (6/2/20)

## ED-155 Crash-protected Recording for lightweight aircraft

What is in the Regulation?

The latest high profile accidents involving aircraft which are currently not required to carry cockpit voice or data recorders are bolstering accident investigators desires to have standardized recorders on that class of aircraft. ICAO recently submitted a proposal, the mentioned EU Regulation 2019/1387, to require ED-155 recorders to be fitted. EUROCAE ED-155 is part of working group 77 consisting of Accident Investigators, Regulatory Agencies, OEM’s, System Manufacturers, Industry Groups. ED-155 regulation responds to a need for improved recording of vital information on small aircraft for aviation safety investigations. It defines the minimum operational performance specification for recording

functions for aircraft data as cockpit audio, airborne images and data-link messages in a robust recording medium primarily for the purposes of the investigation of an occurrence, e.g., an accident or incident. It is applicable to robust on-board recording systems, ancillary equipment and their installation in aircraft. This regulation can also be used to give guidance to manufacturers intending to develop or install lightweight flight recording systems which may be used for other purposes such as flight training or flight data monitoring. It is not the intent of this Minimum Operational Performance Specification (MOPS) to provide replacement or acceptable alternatives for the ED-112 specification.

For more characteristics about the regulation and deeper information go to the ED-155 document itself.

### Comparison ED-112A & ED-155 Crash Survival Requirements

Survivability Requirement	ED-112A Crash Survival	ED-155 Crash Survival
Impact Shock	3.400 g	1.000 g
Shear and Tensile Test	→ ULB	N/A
Penetration Resistance	penetration force produced by a 227 kg weight	N/A
Static Crush	22.25 kN	4.54 kN
High Temperature Fire	60 Min. 1.100°C	15 Min. 1.100°C
Low Temperature Fire	10 hours 260°C	N/A
Deep Sea Pressure	water at a pressure of 60 Mpa / equivalent to a depth of 6.000 m	N/A
Sea Water Immersion	3 m water depth for 30 days*	N/A
Fluid Immersion	for a period of at least 8 hours	N/A
New ETSOs (European Technical Standard Order)	increase duration to 90 days	N/A

New ETSOs:  
 ETSO-2C123c: Cockpit Voice Recorder Systems  
 ETSO-2C124c: Flight Data Recorder Systems

#### In Short:

#### ED-155 Key Points

- ED-155 has reduced crash protection as compared to ED-112 for reduced cost and weight goals, since ED-155 is destined to lightweight aircraft.
- Both Fixed and Deployable Recorders are addressed, the regulation gives the chance to have either.
- No ULB is required.
- ETSO-2C197 and TSO have a minimum size of Crash Protected Memory (CPM) or Robust Memory defined. However, there is no limitation of size and weight, the device just has to fit into the small aircraft.
- Specification of main functions:

Cockpit Audio Recording System (CARS)  
 for at least 2 hours

Aircraft Data Recording System (ADRS)  
 for at least 25 hours

Airborne Image Recording System (AIRS)  
 for at least 2 hours

## History and regulations

Dive in deeper into the topic?

FDRs, ADR for accident data recorder, are electronic devices employed to record and collect data of any system on an aircraft. The documented data by this device is used for accident and incident investigation. FDR together with CVR, help accident investigators to determine the reasons and sources of the event and moreover, give the chance to authorities to understand what really happened and to help mitigate future incidents and risks. The results of the findings might lead to a recommendation by the regulator or in some cases also to an AD (Airworthiness Directive). The findings of the investigation can contribute to avoid similar accidents or incidents in the future. FDRs are subject to different regulations to ensure their proper functioning. Since the first uses of these devices, they are continuously evolving with new technologies in order to achieve a better recoverability after an event.

### Regulations

Regulations arise from the need to understand why an incident occurs so that future similar scenarios can be avoided. International standards and recommended practices are established by International Civil Aviation Organization (ICAO) for the international commercial air transport. However, a national air agency could decide not to enforce a regulation from ICAO, but this may have an impact on the national fleet's ability to operate internationally. It's important to note that ICAO is not a standards organization, instead it is more focused on producing performance-based requirements.

#### European Regulation

The European Aviation Safety Agency (EASA) is the responsible regulator for Europe. In the case of ICAO, all the requirements are accomplished in Annex 6 "Operation of Aircraft".

EASA has an initiative for changing EU Regulation Nr. 965/2012: Obligation for installation of a crash recorder in aircrafts where currently no recorder is required. Aircrafts which operate commercially (Commercial Air Transport (CAT) and Specialized Operations (SPO)) as well as small category VTOL aircraft are affected.

SC-VTOL regulation requires already an ED-155 recorder for all VTOL platforms. Within this notice of purpose amendment, a harmonization with new ICAO Annex 6 rules shall be achieved. Furthermore, identification of safety issues affecting light aircraft by means of data recorded in flight shall be established. Turbine engine helicopters with an MCTOM of 2.250 kg or more are affected. The flight recorder shall record, by means of flight data or images, information that is sufficient to determine the flight path and aircraft speed.

## History

**First device appears in 1939 based on photographs and during World War II recorders using metal wire and foil arise, first generation FDR.**

**In 1953 a device that could record aside from instruments reading and cockpit audio was created, known as "Black box".**

**In the 1960s all carriers had to be equipped with a flight recorder and follow some regulations becoming a mandatory equipment.**

**Second generation FDRs were introduced in 1980 based on solid state. The use of solid-state memory expanded the recording capacity, enhanced crash/fire survivability, and improved recorder reliability.**





**US Regulation**

Federal Aviation Agency (FAA) is responsible for the US regulation. The National Transportation Safety Board has asked helicopter manufacturers to require visual and audio data recorders on commercial turbine-powered helicopters.

NTSB declare three urgent recommendations and led the FAA to issue an emergency airworthiness directive affecting an entire fleet of helicopters. H. R. 7274 regulation. The NTSB formally recommended in 2004 that passenger helicopters be equipped with a Terrain Awareness and Warning System (TAWS) and two years later they also recommended that helicopters be equipped with a flight data recorder (FDR) and cockpit voice recorder (CVR). Unfortunately, the FAA refused to act on these safety recommendations. After the abovementioned helicopter accident, it seems that finally they are going to implement these safety requirements and the installation of the devices is going to be mandatory.

When FDR and CVR are combined as a single unit they are called “combined recorders” or also CVFDR. The two flight recorders are required to be capable of surviving the conditions likely to be encountered in a severe aircraft accident. Reports from investigations of accidents have indicated that in some instances, a continuous recording after an interruption of the main electrical generating system could have provided useful information. Therefore, to mitigate any possible interruption of the main electrical generating system, an alternate power supply should be required. It is very important the preservation, production, protection and use of the recordings and there are specific rules for that.

SferiRec® FE 320 LCR with camera was developed and certified in order to fulfil new urgent European Operational Regulations (EU Regulation 2019/1387, SC VTOL 01). This regulation has to be fulfilled for aircraft first issued with an individual CofA on or after 5 September 2022.

**Canadian regulation**

In Canada, FDR and CVR regulations are specified in section 605.33 of the Canadian Aviation Regulations (CARs). Given the design characteristics and configurations, many aircraft flown by private operators are not required by regulation to be equipped with either an FDR or a CVR. In 2013, following its investigation into a fatal inflight breakup occurrence Transportation Safety Board (TSB) concluded that there was a compelling case for implementing lightweight FDR systems for all commercial operators. Due to other ministerial commitments, Transport Canada (TC) has not initiated its work for any of these undertakings. From now on, TC plans to introduce requirements at minimum, fully aligned with ICAO standard ED155, A18-01 (September 2020) regulation, to all new aircrafts and recommend to retrofit aircraft already in service.

**NTSB most wanted safety list 2021 - 2022**

Aviation: “install crash resistant recorders and establish flight data monitoring programs”

**The installation of a lightweight Crash Recorder according to ED-155 is required for:**

- Light aircraft used for commercial operations (CAT or SPO)
- Turbine engine aeroplanes with an MCTOM of 2.250 kg or more
- Aeroplanes with a MOPSC of more than 9
- Turbine engine helicopters with an MCTOM of 2.250 kg or more

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**Further questions?  
I look forward to engaging further with you on this topic!  
Don't hesitate to get in touch!**

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