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HOW TO SECURE BASIC EVIDENCE AFTER AN AVIATION ACCIDENT

Summary. This article attempts to provide a synthesis of basic directions indispensable to accurately collecting evidence after an aviation accident. The proper collection procedure ensures the avoidance of the loss of evidence critical for an investigation carried out by law enforcement agencies and/or the criminal justice system, which includes the participation of aviation expert investigators. Proper and complete evidence is also used to define the cause of the accident in the proceedings conducted by Państwowa Komisja Badania Wypadków Lotniczych (State Committee for Aviation Incidents Investigation, The State Committee for Aviation Incidents Investigation, hereafter referred to as the PKBWL). The methodology of securing evidence refers to the evidence collected at the scene of an accident right after its occurrence, and also to the evidence collected at other sites. It also includes, within its scope, additional materials that are essential to furthering the investigation process, although their collection does not require any urgent action. Furthermore, the article explains the meaning of particular pieces of evidence and their possible relevance to the investigation process.

Keywords: aviation accident, evidence, inspection of the accident scene, personal data records, equipment maintenance and operation records, flight data recorder

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1. INTRODUCTION

The collection of basic evidence is the key procedural element related to the occurrence of an aviation accident. Most often, it is performed by representatives of the police or the prosecutor's office arriving at the accident scene immediately after the rescue teams. The collected evidence material, which is used to carry out the proceedings related to the event, will also be made available to the experts of the PKBWL in order to determine the turn of events and the cause of the accident. Hence, the collection of appropriate basic evidence, both in terms of quantity and quality, seems to be the key element influencing the quality of proceedings and their effects.

The first and most important task of all investigation authorities is to properly assess safety. The following activities should be considered as the most important:

- priority activities related to saving people's lives and property in such a manner as to limit the destruction and loss of basic evidence
- protecting outsiders against the influence of aviation accident effects
- preventing tampering with basic evidence (wreckage or its fragments and items that were previously on board the aircraft), including the protection of somebody else's property
- limiting access to the accident scene to persons who are taking part in appropriate activities at the scene

2. ACCIDENT SCENE INSPECTION

The topic of accident scene inspection is complex and could alone be the subject of a separate publication. The issue of inspection must be considered with regard to four areas:

- inside the aircraft
- external inspection of the aircraft
- location of individual elements of the aircraft
- inspection of the accident area, locating any trace evidence

Fig. 1. Overview of an accident scene recorded by aircraft

Accident scene inspection should include not only the description, but also photos and videos. Taking photos and videos can be initiated as early as during the rescue action phase. Later, this could allow for the determination of the scope of rescuers' intervention after the event. Recording unstable evidence, such as tracks on a sandy or snowy ground and leakage of working fluids, is of special significance. It is also important to realize weather conditions (snow, rain, wind) may result in degradation of basic evidence. Moreover, it is necessary to prepare a site plan with the location of all identified elements and traces. If possible, during the inspection, videos from available aircraft or drones may be used.

During the inspection of the aircraft interior, all internal spaces should be examined, including cockpit, passenger cabin(s), halls, toilets, equipment cabins, hatches, compartments and boots. Of course, the cockpit is the most important space, whose inspection should include all its elements, with special consideration paid to:

- indicator visualization
- positions of all control elements
- positions of all switches, valves etc.
- position of the seats, hatches, door, safety belts, all items regardless of their purpose etc.

In the other cabins, important elements include:

- condition of the cabins and the damages that occurred
- position of all indicators, switches, devices and equipment etc.
- location and condition of all items present inside

Fig. 2. View of a helicopter instrument board with recorded positions of indicators and switches

As for the elements of the aircraft, both the appearance of the elements and their spatial location in the area should be examined. When there are doubts about the name of a given element, its function and completeness, members of the PKBWL (if present at the aviation accident scene) may be asked for help, or the identified element may remain without a name, but with its appearance recorded.

The final important element of inspection covers all traces left at the accident scene, which relate to the accident, such as:

- evidence of the aircraft (or its elements) hitting the ground
- damage to infrastructure (buildings, trees, etc.) in the area
- evidence of fuel, oil or any other working fluid leakage
- injuries to non-passengers.

Another important element of the inspection includes penetration of the area neighbouring the accident scene in order to look for possible evidence of the aircraft's interaction or aircraft elements that were left at a site before the aircraft hit the ground or terrain obstacles. In particular, this refers to the area located at the flight direction, as identified in witness statements. As such, the view at the flight direction and from the flight direction should be recorded.

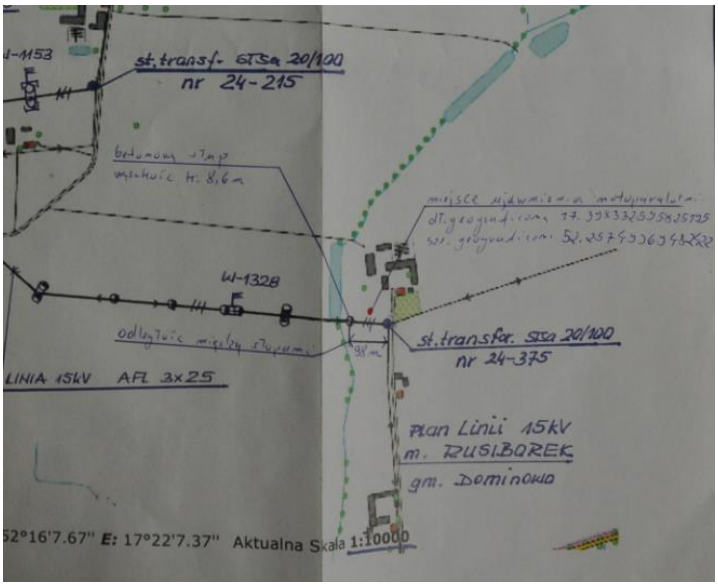

Fig. 3. A fragment of a site plan marking the place where the aircraft fell down and the air energy lines (the fall site is described accurately using GPS position)

3. PROTECTION OF THE ACCIDENT SCENE

The aircraft wreck should be left untouched until the inspection. This refers to the aircraft and the detached elements.

Different destructive factors may occur, depending on the course of the event, its scope and its size. These factors influence people and are the main cause of different injuries. In particular, they include the activity of:

- thermal factors
- mechanical factors
- pressure factors
- chemical factors
- electric current or discharge of electric charge (electrostatic discharge)
- electromagnetic radiation
- radioactive factors

Upon securing the accident scene, one must take the following main hazards into consideration:

- dislocation of aircraft elements and autonomic activity of mechanic elements
- occurrence of fire
- activity of fuel and working fluids
- electric shock
- activity of electromagnetic radiation sources
- unsealing of the pressure containers
- release of radioactive material
- explosion of pyrotechnic agents and armaments
- activity of dangerous materials transported on board the aircraft
- activity of the infrastructure damaged during the accident

It must be emphasized that only the appropriate identification of hazards and the expertise of the inspectors allow for the safe performance of all necessary activities in a manner that is not dangerous to the health and life of those who perform them.

4. RECORDING EQUIPMENT

The majority of aircrafts are equipped with a flight data recorder and/or a voice/radio correspondence recorder in the cockpit. This especially applies to major communication aircraft (airplanes) and military aircraft. Recorders, which are usually located in the posterior part of the aircraft, are mostly rectangular in shape, orange and with an unequivocal description in English (FLIGHT DATA RECORDER or COCKPIT VOICE RECORDER). Further actions taken with respect to the recorders should be carried out by experts. Until submitted to the experts, the recorders cannot be opened and dried or removed from the environment in which they were found (e.g., marine water). Examples of recorders are presented in Figure 4.

Other devices that are not typical recorders, such as GPS devices, handheld video cameras, mobile phones, laptops, industrial video cameras and photo cameras, can also provide information about the flight course.

Fig. 4. Overview of different flight data recorders

5. DOCUMENTATION OF THE AIRCRAFT AND THE CREW

For a complete evaluation of all the circumstances related to the aviation event, it is necessary to secure documentation relating to the crew and the aircraft, as well as documents located on board the aircraft.

Depending on the aircraft type, the pilot should have a valid pilot's licence. With respect to some aircraft, legal provisions exclude the necessity to have a licence, as they require an appropriate certificate confirming a pilot's qualifications instead. This is true for hang gliders, ultralight trikes, paragliders, parachutes, unmanned aerial vehicles and ultralight airplanes. In the case of flights performed in an airport area, a member of the flight crew is not obliged to have the documents with them. Such a requirement exists, however, when the flight covers landing outside the airport. In the majority of cases, it is necessary that the pilot (or another member of flight crew) has confirmation of their pilot medical examinations in the form of appropriate documentation. This also concerns pilots who are flying, based on qualification certificates, in the case of training flights or flights involving passengers. Otherwise, there is no obligation to have a certificate of pilot medical examinations. A radio operator's licence is an additional form of authorization for pilots related to radio communication. In the case when these documents are not available from the pilot or their flight organization, the information about current authorizations of flight crew members and the validity of pilot medical examinations can be obtained from the respective civil aviation regulatory authority. In the case of foreign authorizations, their validity in Poland must be verified.

The size of aircraft documentation depends on the aircraft's complexity. It always covers two types of documentation: instructions for use of the given aircraft type and the documentation of the particular aircraft, confirming its functionality and airworthiness. As for the first group, such documents include:

- aircraft flight manual
- aircraft technical manual
- engine technical manual
- rotor technical manual (if the aircraft has a rotor)
- aircraft repair manual
- any other detailed manuals of the aircraft or its aggregates

Despite a certain degree of universality, the documentation should be strictly related to the particular aircraft, especially with respect to its completeness. Apart from the first mentioned manual, which should be on board the aircraft, the other manuals should be stored at the registered office of the aircraft user.

The second group of documents is documentation directly related to the exploitation of the particular aircraft, which should contain:

- aircraft logbook
- engine log book
- rotor logbook (if appropriate)
- transmission gear logbook (for helicopters)
- technical service programme
- certificate of airworthiness (valid on the day of the event)
- civil liability insurance policy
- aggregate specification
- bulletins
- other valid complementary documentation depending on the aircraft type

As for the already mentioned aircraft that are partially excluded from the Act of Aviation Law, they do not require such detailed documentation. Only training aircraft and aircraft used for passenger flights must have inspection cards (e.g., hang glider or paraglide) that valid on the day of the event.

Another group of evidence that should be secured at the accident scene includes all documents located on board the aircraft, such as maps, airport schemes (instrument approach procedure charts), and any notes and pieces of handwriting.

6. APPLICABLE AVIATION ORGANIZATION REGULATIONS

To assess the correct functioning of an aviation organization, it is necessary to secure all documentation concerning the organization and the flight training performed. These particularly include:

- operational instructions of an aviation organization
- airport use instructions
- training instructions
- training programmes

With respect to aviation organizations that need certification from the state aviation authority, it is legitimate to obtain a certificate. Such certificates define the scope certified by the supervision authority.

7. WITNESS INTERVIEW

All direct and indirect witnesses to the event must be immediately identified. This also concerns all persons who could have any knowledge about the aircraft's departure site and its service, air traffic, etc. During these activities, the following witness data must be determined: full name, address and telephone number, education and profession, and where the person was located at the time of the accident.

A witness interview should feature the following characteristics:

- it should allow for the free statement of the witness
- the witness's observation site and locations of the observed phenomena should be indicated on a map (diagram)
- the witness should be asked for information related to the position of the aircraft, such as flight track, descending/dropping, velocity, height, bank, pitch and deviation
- the witness should be asked for information about the engine function (sounds, fire, smoke, leakage etc.)
- the witness should be asked for information about the condition of the aircraft, such as angle of control surfaces, landing gear condition, open hatches, doors, fairings, and detachment of aircraft elements
- the witness should be asked about actions and behaviour of event participants or other witnesses
- it should refer to other unusual phenomena
- it should determine the applicable weather conditions in terms of temperature, clouds, visibility, wind direction and velocity, falls

8. ACTIVITIES RELATED TO AIRCRAFT CREW AND PASSENGERS

All persons who could be responsible for performing flight-related activities should be immediately identified. At the same time, the persons should be tested for consumption of alcohol or other agents that could influence their mode of action. As in the case of the witnesses, basic information should be collected, as indicated above. Moreover, for members of the aircraft crew, their function should be determined and documents confirming they have the qualifications necessary to perform their functions should be requested, if possible.

In the case of fatalities, among both the crew and the passengers, it is necessary to perform necropsies in order to determine the cause of death and any possible influence on their state of health at the time of the event. The determination of the location and positions of the bodies is the key element here.

9. OTHER BASIC EVIDENCE

At the accident site, samples of fuel should be immediately collected (at least a few litres). The samples should be poured into at least two completely clean and dry containers. Fuel samples located in the storage of fuel tanked before the last flight must also be collected. A laboratory certificate confirming the applicable fuel and any other working fluids (e.g., oils, hydraulic fluids) should also be secured.

In cases when aviation communication with the aircraft took place, such communication records should be also secured. These can be obtained from on-board or ground recorders located in the offices of air traffic control authorities or airport control centres (e.g., aero club office). Moreover, recordings from radar devices should be secured if the flight took place in the area supervised by the radar station. Such recordings may be obtained at the Polska Agencja Żeglugi Powietrznej (Polish Air Navigation Service Agency).

Obtaining information about the weather at the date and location of the accident is also important. Such data can be obtained from the Instytut Meteorologii i Gospodarki Wodnej (Institute of Meteorology and Water Management), after submitting an official request. The following basic information must be provided: date, time and place of the accident, including the height of flight at the moment of the accident. The weather parameters of interest must also be defined: temperature pressure, strength and direction of wind, cloudiness type and amount, height of the cloud base, visibility, type and intensity of precipitation, presence of storms and other phenomena. Data obtained directly from airports, aero clubs, road regions etc. can also be helpful, as they are useful when determining any local phenomena, especially in locations where Instytut Meteorologii i Gospodarki Wodnej (Institute of Meteorology and Water Management) observation points are not too densely located.

Another significant basic piece of evidence to be obtained during the later stages of proceedings is an expert opinion, which can cover various topics, including legal, psychological, psychiatric, medical, pilot, technical, metallographic, meteorological, fuel, phonetic and other issues. For simple cases where such narrow specialized expert opinions are not necessary, the opinion of an aviation expert may be sufficient.

10. SUMMARY

The main areas, as stated above, in respect of securing evidence after an aviation accident are not exhaustive for this broad issue. However, they indicate the main directions of activity, as well as highlight their nature and complexity. In short, this review points to the sources and methods of basic evidence collection. The activities of the investigation authorities should also involve initiative and thoroughness, which require at least a basic knowledge about the subject matter in order to minimize of evidence loss. Collected and properly secured evidence is an important basis for starting an investigation. One must remember, however, that, in many cases, further assessment should be performed by specialists or experts, since the obtained evidence is often highly specialized, while incorrect interpretation may result in erroneous conclusions.

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