TRAFICOM
Finnish Transport and Communications Agency

Aviation safety investigation

Immola aviation accident, 8 August 2020

Investigation team appointed by Transport System Services/sector coordination

Traficom Publications

28/2021

Contents

1 Incident description

The pilot of the skydiving aircraft (Cessna U206A Super Skywagon, C206A, OH-CSU) took off on 8 August 2020 at 17:39 LT (14.39 UTC) at nearly the maximum take-off weight from runway 19 of Immola airfield. In addition to the pilot, there were five skydivers in the aircraft, which had been refuelled before the flight with 120 litres of AVGAS 100 LL fuel.

The weather was hot and there was almost no wind at Immola. At the nearest airport covered by the aviation meteorological service of the Finnish Meteorological Institute (Lappeenranta, at a distance of approximately 50 km), the valid METAR weather report was EFLP 081420Z AUTO 27006KT 230V310 9999 VCSH //////CB 26/16 Q1021=.

The aircraft took off, but in the pilot's opinion, it did not seem to accelerate well enough. The pilot decided to carry out an emergency landing on the grass on the right side of the runway, taking account of the approaching end of the runway and the obstacles behind it. The aircraft landed heavily on its main landing gear and bounced into the air, after which it hit the ground again, rolling over its nose landing gear, nose and left wingtip onto its roof with the nose facing in the direction where the aircraft took off. The skydivers in the aircraft managed to exit the aircraft and helped the pilot out, too. One person inside the aircraft was severely injured and five suffered minor injuries.

2 Investigation by the Safety Investigation Authority, Finland

On 27 August 2020, Safety Investigation Authority, Finland (SIA) published a report on the preliminary investigation into the aviation accident (*L2020-03 Laskuvarjohyppääjiä kuljettaneen lentokoneen epäonnistunut lentoonlähtö Immolassa 8.8.2020, in Finnish*). Based on the preliminary investigation, SIA decided that there was no need for an actual investigation.

https://turvallisuustutkinta.fi/material/collections/20200827150528/7Jv0yvucD/L2020-E3_Immola.pdf

In its preliminary investigation, SIA reached the following conclusions (including the causes of the accident or incident):

The aviation accident occurred because the take-off speed was too low.

Conclusion: The procedures mentioned in the aircraft's manual must be followed precisely. The procedures and performance characteristics in the aircraft manual have been confirmed with test flights.

The weather was warm and the wind had calmed down before the accident flight. The load differed from the other flights on the same day.

Conclusion: It is important to consider how the load and the weather affect the performance of the aircraft, especially in the training for parachuting activities.

The report offered the following suggestions for improvement (no recommendations were given).

In parachuting activities, the pilots must be aware of the impact of the load and the weather on the performance of the aircraft. The pilots of skydiving clubs must check the procedures applicable to the aircraft they use so that they correspond to the aircraft's documentation in different conditions.

In the training of new pilots for parachuting activities, attention should be paid on the impact of the load and the weather on the performance of the aircraft.

The knowledge of the pilots of the skydiving club about the engine used in the aircraft and the aircraft's performance characteristics was not clear. In parachuting activities in particular, the instructions of the aircraft must be unambiguous.

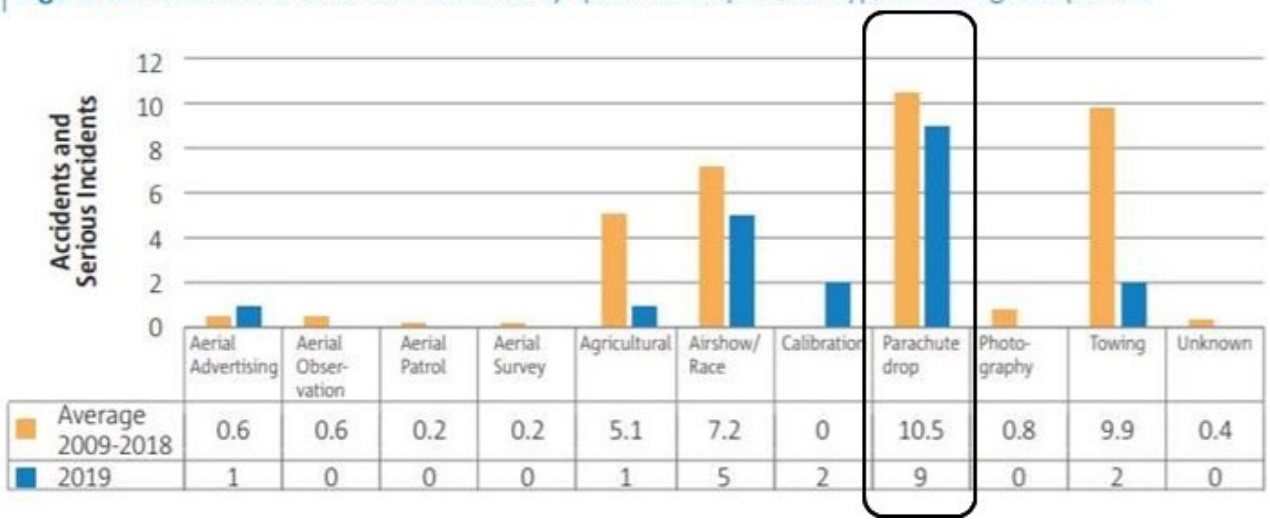
The free sector before the tall trees at the end of runway 19 at Immola airfield was small. When weather permits, take-offs should be carried out in direction 01, because there the front sector has a large cleared area available for an emergency landing, if necessary.

3 Safety investigation by Traficom

The Finnish Transport and Communications Agency (Traficom) deemed it necessary to investigate the causes and consequences of the aviation accident with regard to the organisation, legislation and flight training. The primary goal of the investigation was to promote and develop aviation safety.

The investigation proposal was submitted to the aviation sector coordination of Transport System Services, which made the decision to conduct a safety investigation and appointed an investigation team. One of the specific goals was to discover the reasons that led to the accident. There is a common European concern for the safety of parachuting activities. For its part, Traficom participates actively in promoting the safety of European parachuting activities.

Figure 26 Accidents and serious incidents by specialised operation type involving aeroplanes



	Aerial Advertising	Aerial Obser-vation	Aerial Patrol	Aerial Survey	Agricultural	Airshow/ Race	Calibration	Parachute drop	Photo-graphy	Towing	Unknown
Average 2009-2018	0.6	0.6	0.2	0.2	5.1	7.2	0	10.5	0.8	9.9	0.4
2019	1	0	0	0	1	5	2	9	0	2	0

Source: EASA Annual Safety Review 2020

The purpose of Traficom's safety investigation was to learn more about the following issues, among others:

- why had the operator given instructions to fly the aircraft that were in conflict with the flight manual?
- why did the operator not know which engine had actually been installed in the aircraft (285 or 300 hp)?
- what was the content of the flight training of the pilot, who had relatively little flight experience?

In addition, the goal of the investigation was to study the flight culture, operating procedures and level of operation of the skydiving club SkyDive Karjala ry that carried out parachuting activities and owned the aircraft involved in the accident, and potentially also other clubs and associations carrying out parachuting activities in a broader context.

3.1 Mapping the authority

Previous safety investigations of aviation accidents had been conducted by the Finnish Transport Safety Agency (Trafi), and therefore Traficom's authority to carry out a safety investigation had to be mapped before starting the investigation.

The boundary conditions of the investigation based on legislation were determined via a legal review carried out by Transport System Services. Only after this did the investigation team have the preconditions and authority to operate. During the process of determining the authority, a need to draw up separate instructions for Traficom's safety investigations was also discovered. The aim is to do this once the safety investigation has been completed.

Under section 120 of the Aviation Act (864/2014), Traficom has the authority to investigate incidents and occurrences in civil aviation, if such an investigation is necessary for the purpose of promoting aviation safety. It is also required that SIA is not investigating the matter in question. Therefore, Traficom's authority in this regard is secondary to that of SIA. In this case, SIA's decision not to conduct an actual aviation accident investigation made it possible for Traficom to conduct its own safety investigation in accordance with the Aviation Act. The Act on the Openness of Government Activities (621/1999) applies to the publication of the investigation report drawn up based on the investigation.

3.2 Investigation material

For the investigation, Traficom first contacted SIA to be able to use in its investigation the material obtained during the preliminary accident investigation by SIA. SIA took the view that the law does not allow the disclosure of the material. After this, the investigation team contacted the head pilot of SkyDive Karjala ry as well as the pilot of the aircraft involved in the accident, and with their cooperation, it received material essential for the investigation for its perusal. Among other things, this included the association's instructions for parachuting activities, the flight manual, the checklists as well as other materials. The details related to the maintenance of the aircraft were confirmed by Traficom from the party responsible for monitoring maintenance organisations. In addition, it was considered necessary to compare the material that had been obtained with the instructions of clubs and associations that use the same type of aircraft in their parachuting activities. The investigation team contacted two skydiving clubs and received the corresponding documents from them. SIA had also requested the same material from these clubs, and as a result, the material could be sent quickly in digital format.

3.3 Interviews

The primary aim of the safety investigation was to discover the reasons behind the aviation accident. Of special interest were the organisation organising parachuting activities, the details related to its flight and flight training operations, the association's operating culture and the national and EU legislation regulating parachuting flights.

During the interview planning phase, the interviewees were told that the aim of the investigation was not to hold the interested parties to any legal responsibility; instead, the aim was to develop aviation safety. The interviews were arranged as

remote meetings in accordance with Traficom's coronavirus instructions. The interviewees included the pilot of the aircraft involved in the accident as well as the head pilot of the association carrying out parachuting flights at Immola airfield, who participated in the interviews on a voluntary basis. In addition, background information was confirmed with the first pilot of the day of the accident and the company that maintained the aircraft.

4 Analysis

4.1 Flight operations

Based on the preliminary investigation by SIA as well as the interviews of the pilot of the aircraft involved in the accident and the parachuting pilot who acted as the trainer, the course of events appears to have been as follows.

The last take-off of the day started with an aircraft that was loaded full, close to the rear limit of the centre of gravity. The choice of runway fell on the less advantageous runway, considering the obstacles as well as a potential rejected take-off or emergency landing. The conditions were calm, but the temperature was unusually high, and it is likely that the temperature above the recently replaced asphalt was even higher than its surroundings.

The take-off was not carried out in accordance with the short field take-off procedure, even though there were obstacles in the take-off sector of the runway used that affected the available flight path.

During the take-off run, the aircraft left the ground prematurely while its speed was too low. This may have been influenced by the fact that the pilot had not been informed of the view of the trainer responsible for familiarisation training regarding the correct trim setting for take-offs with a full load. According to the trainer, the trim setting should be approximately 5 mm in front of the neutral mark, while the pilot had set it at the neutral mark.

On the day of the accident, the first pilot of the day had emphasised to the pilot of the aircraft involved in the accident that due to the weather, the take-off had to be carried out at the absolute minimum at the speed of 75 mph (indicated airspeed, IAS). The take-off speed mentioned in the association's checklist was 80 mph IAS.

When the aircraft took off prematurely, the pilot did not immediately reject the take-off; instead, the pilot attempted to continue the take-off. After realising that the aircraft was not climbing fast enough to go above the trees in the extension of the runway, the pilot decided to carry out an emergency landing on the grass next to the runway; however, the pilot lost control of the aircraft while attempting the emergency landing.

4.2 Parachuting operations

The skydivers were using the Skydive Karjala ry association's instructions for skydivers on parachuting flights (*Toimintaohje hyppylennoilla hyppääjille OH-CSU*) as well as the instructions on the standard operating procedures used on parachuting flights (*Hyppylento-ohje vakiotoimintamenetelmistä laskuvarjohyppylennoilla*). The instructions deal comprehensively with issues such as loading the aircraft, actions at different stages of the flight and cooperation with the pilot. According to the instructions, the skydivers are familiarised with the skydiving instructions before the activity. Independent skydivers complete the orientation as a self-study, while students receive familiarisation training by the trainer in charge of the students' training in accordance with the instructions of the Finnish Aeronautical Association (SIL).

Based on the pilot's interview, the skydivers followed the instructions during the accident flight. The interviews did not indicate that the pilot would have experienced any pressure from the skydivers, either. The accident flight was carried out close to the ending time of parachuting activities specified in the environmental permit (18:00 LT), but according to the pilot, this did not lead to any hurrying by the skydivers or the pilot. This view is also supported by the selected runway 19; taxiing there takes considerably longer than to runway 01.

The largest permitted number of people in OH-CSU is 7 persons (pilot and 6 skydivers). In the association's activities, so-called manifest software is used to calculate the total mass by entering the actual weights of the skydivers into the software. The total weight of all skydivers is shown to the pilot in the load list (list of skydivers and their weights) provided to the pilot before the flight, and the pilot-in-command is responsible for ensuring that the Maximum Take-Off Weight (MTOW) is not exceeded taking the amount of fuel into account.

However, the load list does not show the exact position of the centre of gravity. The centre of gravity is determined based on the standard load profile appended to the parachuting flight instructions. The determination is made with an Excel tool that can be used to review different seating arrangements. During the accident flight, both the total mass and the centre of gravity position were within the allowed limits. However, it must be noted that the centre of gravity position was nearly at the rear edge of the permitted area.

4.3 Airworthiness

The engine of the OH-CSU Cessna U206A Super Skywagon aircraft was Continental IO-520-A and its propeller was the three-bladed Hartzell PHC-C3YF-1RF/F8468A-8R. The engine power was 285 hp (213 kW), and it operated normally during the flight.

The aircraft had been maintained according to the approved maintenance programme, and it was airworthy at the time of the accident. The information of the propeller installed in the aircraft was missing from the flight manual of the aircraft delivered to Traficom, and the front page of the manual had incorrect information on the engine type. The other pages of the flight manual mentioned the IO-520-A engine and the performance characteristics in the manual were stated accordingly, but the indication of model F on the flyleaf had not been changed to model A. Based on the images received during the investigation, it is likely that model F had been stated on the type plate at the time of the accident, after which the F had been replaced with an A.

However, the owner of the aircraft and the pilots remained under the impression that the aircraft engine type was IO-520-F, which provides 15 hp more power for a limited period. It is nevertheless likely that this false impression did not have any effect on the incident.

According to the report of the maintenance company, the type of the engine on the aircraft at the time of the accident was IO-520-A, and it had been installed on the aircraft in 2017. The aim of the engine replacement made at the time was to convert the engine into one that corresponded to model F in connection with the engine assembly. During the work, it was discovered that an approved alteration work was not found for the engine, and it was assembled to correspond to model A. However, F had already been marked on the type plate, but in the company's understanding, the indication was not noticed or changed to correspond to the model A engine.

When the engine was brought to the maintenance company after the accident, a representative of the company asked the technicians to check if the indication of a model A engine had been engraved on the type plate. When asked about the

matter after the fact, the technician could not remember if the plate had an A at the time, or if the change in the marking was made after the accident.

According to the company, the flight manual of the accident aircraft (excluding the flyleaf) and the red line of the tachometer corresponded to the model A engine. The flight manual and engine have corresponded to model A since the 1990s, but the flyleaf of the manual erroneously mentions that the engine of Cessna U206A is IO-520-F. The engine model that does not belong to the type of aircraft in question had apparently been installed in the accident plane in the 1970s.

The change in the flight manual concerning the three-bladed Hartzell PHC-C3YF-1RF/F8468A-8R propeller installed as alteration work had been implemented in connection with the installation, but the supplement in question was missing from the aircraft flight manual delivered to Traficom.

4.4 Compliance with the requirements

The regulation of commercial and non-commercial parachuting flights has been EU-based starting from 21 April 2017, and it is based on the so-called EASA Basic Regulation (216/2008, later 2018/1139) and the Air Operations Regulation (965/2012). Before that, flight activities were regulated nationally together with the actual parachuting activities. Even today, the regulatory basis of parachuting activities is the national aviation regulation OPS M6-1. The key special provisions on non-commercial parachuting flights are presented in an appendix to this report.

As an immediate consequence of the disastrous parachuting flight accident in Jämijärvi that cost the lives of eight people, on 24 April 2014 the then Minister of Transport and Local Government gave Trafi the assignment (LVM/869/00/2014) to carry out an extensive survey of the risks of recreational aviation by 30 September 2014. Aviation operators, hobbyists and authorities were to be heard extensively in the preparatory work. Comparative data from key reference countries was also to be included in the survey. In the survey, the following measures were recommended with regard to parachuting activities:

Increasing awareness: contemplating ways in which information and training could be efficiently disseminated to all beginning licensed skydivers and experienced skydivers beginning or experimenting with a new sub-genre with an elevated risk of collision in free fall.

Issuing general training instructions to pilots flying parachuting planes. This may be based on suitable paragraphs from the Federal Aviation Administration's guideline AC 105-2E (8. Pilot responsibilities, Jump pilot training, sections 8 b – 8 f).

Issuing instructions for skydivers concerning risks in parachuting-related flight operations. The instructions will stress the seriousness of risks involved in aircraft loading and moving around on board, and the importance of coordination between the jumpers and the pilot.

Introducing clear markings and instructions on loading and movement on board in all aircraft used for parachuting.

These recommendations for measures were implemented together with operators. During this work, EASA also published its own instructions for parachuting flights (at AMC/GM level), such as NCO.SPEC.105. In connection with publishing the report, it was also decided to start a project with the aim of creating an operating model of safety work for the Finnish recreational aviation community that the

community could utilise and develop in the future, as well as a model that the authorities could use to support safety work in recreational aviation.

Trafi/Traficom implemented a risk assessment of parachuting flights in general aviation and monitored the implementation of EU regulations at clubs. From 2017 to 2019, it carried out inspections at skydiving clubs; they focused on the implementation of EU regulations, determining the technical condition and maintenance of parachuting aircraft, presenting and marketing the parachuting flight instructions of SIL's parachuting committee as well as recommendations for measures in the recreational aviation risk survey. The visit to the club that owned the accident plane took place in September 2017.

In connection with the present safety investigation, at the latest, it was determined that the EU requirements for pilots on parachuting flight (which cannot be considered to exist in the actual meaning of the word) do not guarantee a sufficient level of safety for parachuting flights. Another problem with the current EU law is also that its provisions apply to individual pilots instead of assigning responsibility to the actual organiser of parachuting flight operations. For this reason, the aim at international level should be to influence the development of the legal framework, and as a preliminary measure, instructions on training should be drawn up for Finnish operators, paying more extensive attention to issues such as abnormal situations (e.g. rejected take-off) and the risks of parachuting activities.

The association that owned the Immola accident plane had drawn up parachuting flight instructions compliant with the regulations for pilots of its parachuting flights and, commendably, it had also given instructions on how skydivers should act in the aircraft. In contrast, the training principles and training programme for new pilots were completely missing from the instructions.

Since the autumn of 2019, the parachuting flight instructions by SIL have also included appropriate training instructions, but only a few clubs have taken this into account. Instructions related to training are missing from the operating instructions of most clubs, or the instructions are very incomplete and unclear. In addition, most clubs have not updated their instructions after they were drawn up.

The risk assessments of parachuting flight operations should also be reviewed from time to time. The checklist for pilots of parachuting flights, as required by the Air Operations Regulation (the list is drawn up according to the instructions NCO.SPEC.105), has often been drawn up only as a copy of the aircraft's checklist and does not include all required elements. This deficiency could be corrected by copying SIL's model for parachuting flight instructions and taking the local conditions and the special characteristics of the aerodrome into account as needed.

The implementation of type rating training flights varies. Some of the skydiving clubs use flight instructors for type rating training flights, while others use an experienced parachuting pilot.

5 Conclusions

The conclusions include causes that contributed to the accident or incident. The causes refer to different types of factors behind the event and the direct and indirect aspects that influenced it.

5.1 Conclusion 1

The pilot’s familiarisation to parachuting flights was not based on a written training programme, and the familiarisation programme for parachuting flight training completed by the pilot had not been documented.

5.2 Conclusion 2

The pilot’s familiarisation training was provided by an experienced parachuting pilot. That parachuting pilot did not have an instructor's qualification in accordance with the Aircrew Regulation (1178/2011).

5.3 Conclusion 3

No take-offs in accordance with the short field take-off procedure had been carried out during the pilot’s familiarisation, and the person providing the familiarisation training had never used the procedure with the U206A aircraft type, either.

5.4 Conclusion 4

There was an understanding among parachuting pilots that the short field take-off procedure should not be used with this particular aircraft.

5.5 Conclusion 5

The understanding of parachuting pilots on certain flight procedures and the version of aircraft was based on tradition instead of up-to-date documentation.

5.6 Conclusion 6

No simulated rejected take-offs had been carried out with the U206A aircraft type during the pilot’s familiarisation on parachuting flight operations, and the intersection of runways used as a reference point acted as a place where one should consider rejecting the take-off instead of being the decision point to reject the take-off.

5.7 Conclusion 7

The pilot and the trainer providing the familiarisation training had different understanding of the trim setting to be used in the take-off of a fully loaded aircraft. According to the trainer, the trim setting should be approximately 5 mm in front of the neutral mark, while the pilot had set the trim at the neutral mark. This may have contributed to the aircraft taking off at underspeed.

5.8 Conclusion 8

The other pilots had previously given comments to the pilot about take-offs at an excessively low speed. However, this had not led to further training being provided.

5.9 Conclusion 9

The skydivers can be considered to have acted according to the instructions valid at the time of the event.

5.10 Conclusion 10

The total mass and the centre of gravity position of the aircraft were within the allowed limits, but the centre of gravity position was nearly at the rear edge of

the permitted area. The pilot knew that the centre of gravity on the flight in question was placed at the rear of the permitted area, but the load list provided to the pilot does not show the exact position of the centre of gravity to the pilot. Therefore, the pilot did not know the specific centre of gravity position. The lack of knowledge about the exact position may reduce the possibilities of controlling the aircraft safely.

5.11 Conclusion 11

The aircraft was technically airworthy, but the flight manual was not up to date or compliant with the type approval certificate.

5.12 Conclusion 12

Compliance with the requirements as required by the Air Operations Regulation was at a satisfactory level in the skydiving club. However, the instructions had not been updated after they had been drawn up, and the significant improvements made to the SIL's parachuting committee's model instructions had not been taken into account.

6 Recommendations

6.1 Recommendation 1

The training and familiarisation of parachuting pilots into skydiving flights should be based on a detailed, written training programme. This training and familiarisation should be documented.

6.2 Recommendation 2

EASA should amend the checklist in NCO.SPEC.105 for parachuting flights in the Air Operations Regulation (965/2012) from the GM to AMC level and specify its content.

6.3 Recommendation 3

The responsibility for parachuting flight operations should be assigned to the non-commercial organisation carrying out parachuting activities in one way or another. The responsibility could be assigned for example, by defining parachuting flights as a high-risk activity and drafting requirements proportional to the activity, based on the requirements on commercial Special Operations (SPO) but in a lighter format.

The exceptions to the commercial SPO requirements could include, for instance, not requiring a CPL (Commercial Pilot Licence) for the activity and accepting a "light" management system. An example of a system of this type and its requirements is the Balloon/DTO (Declared Training Organisation) management system. The competent authorities in this matter would be the European Commission / EASA.

6.4 Recommendation 4

The familiarisation training programme in the flight training of a parachuting pilot included in the parachuting flight instructions maintained by SIL's parachuting committee should be updated to include a more detailed training programme.

6.5 Recommendation 5

SIL's parachuting committee should pay attention to how the parachuting flight instructions of its member clubs are kept up to date and implemented.

6.6 Recommendation 6

A calculation program that calculates and shows the exact location of the centre of gravity of each flight should be used in parachuting activities to determine the centre of gravity. This information should be provided to the pilot with the load list before the flight.

6.7 Recommendation 7

It is likely that there are more extensive issues with how up-to-date the flight manuals of old aircraft are. Traficom should take appropriate measures to correct the situation.

Helsinki, 21 May 2021

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- Occurrence Regulation ((EU) No 376/2014)
- Safety Investigation Act (525/2011)
- Act on the Openness of Government Activities (621/1999)
- Administrative Procedure Act (434/2003)
- Other EU legislation
- EASA publications
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- Recreational aviation risk survey, Trafi, 2014
- Lentotoimintavaatimukset, yleisilmailu (Requirements on general aviation activities), Trafi, 2016 (in Finnish)
- Hyppylentotoiminnan riskiarvio (Parachuting flight risk assessment), Trafi, 2017 (in Finnish)
- Guideline for parachuting flight operations, SIL, SMLL, Traficom, 2019)
- OPS M6-1, Laskuvarjohyppytoiminta (OPS M6-1, parachuting activities), Traficom, 2020 (in Finnish)
- Interviews by telephone and via remote meetings
- Weather reports, the Finnish Meteorological Institute

Appendices

Appendix 1

Recreational aviation risk survey, Trafi, 2014

https://www.traficom.fi/sites/default/files/media/publication/Trafi-Recreational-aviation-risk-survey.pdf

Appendix 2

Lentotoimintavaatimukset, yleisilmailu (Air operations requirements, general aviation), Trafi, 2016 (in Finnish)

NCO.SPEC.100, NCO.SPEC.105, GM1 NCO.SPEC.105, NCO.SPEC.110 and NCO.SPEC.PAR.100 as well as other PAR requirements (parachuting activities), see pages 152-173

23604-NCO_SPEC.pdf

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ISBN 978-952-311-766-2
ISSN 2669-8757 (online publication)

TRAFICOM
Finnish Transport and Communications Agency