WP10

Web-based cost-sharing flights

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Web-based cost-sharing flights

Background Information

(1) On 12th September 2016 DGAC-F notified the Agency, the Commission and the Member States of its decision to issue restrictions on cost shared flights advertised via online platforms or other means of publicity, under the BR Art. 14.1 provisions (immediate reaction to a safety problem).

(2) Under Art. 14.2, the Agency has one month from the official notification to notify its position on the Art. 14.1 to DGAC-F, the Commission and the Member States.

(3) On 22nd September 2016 a meeting was held between EASA staff members and a DGAC-F delegation, in order to review the substantiation for the notified measures.

(4) From the material presented at the meeting, it became clear that justifications for the safety issue and the proposed mitigating measures, were lacking.

(5) The Agency sent an official request for further information to DGAC-F (through the French permanent representation in Brussels) by letter dated 12th October 2016.

(6) In parallel, the Agency decided to set up a group of experts from national authorities, general aviation stakeholders and cost-shared flights platforms. This group was launched on 7 October and was asked to deliver its conclusions during Q1/2017.

(7) The group was composed of NAA representatives (France, UK, Germany, Finland, the Netherlands and Sweden), Europe Air Sport, Web-based platforms (Skyüber, Wingly, Coavmi and FlyT), European Commission DG-MOVE and EASA Staff.

(8) Four meetings of the group took place, on 7 October, 3 November and 20 December 2016 and 16 January 2017. **The group's conclusions are presented in this paper**.

Topics Discussed

Discussion on Flying Experience

(9) Available data and studies do not evidence a direct correlation between the number of flying hours of a GA pilot and this pilot's safety level. All agreed that the number of flying hours of a GA pilot is not the only factor contributing to his/her safety level.

Discussion on Recency

(10) All agreed that pilots should have a minimum of flying recency before taking passengers on board. The requirement to have at least performed 3 take-offs and landings in the past three months is already included in the AirCrew Regulation. The majority of Group members (except France) agreed that there is no reason to add additional recency requirement for those flights.

Discussion on available data

(11) There is currently no specific safety data available on cost sharing flights via web-based platforms. The majority view (with the exception of France) was that in the absence of specific identified risks, any restriction imposed to those flights would have no justification.

Discussion on the magnitude of the activity

(12) The current number of flights conducted under existing platforms account for less than 1% of the total flights conducted in the EU in General Aviation (leisure flights). This is clearly a niche activity. Having in mind the lack of data to substantiate specific identified risks, the majority view (with the exception of France) is that there is no urgency to develop specific requirements for this activity.

Discussions on Opportunities vs Risks

(13) The group discussed opportunities and risks of cost-shared flights. The majority of the group (with the exception of France) did not identify any specific risks of cost-shared flights. The group agreed that the opportunities that the web-based platforms could offer to improve GA safety, should be explored.

Conclusions and Actions.

(14) Specific risks in terms of safety related to the fact that passengers are contacted through a web platform, as opposed to the aeroclub, family and friends, or in a local pub do not appear to exist for the majority view (except France).

(15) In the absence of such evidence, the majority view (except for France) is that no additional requirements should be imposed to this activity.

(16) In relation to the opportunities that the Web-based platforms could offer to improve GA safety, a Charter, to be signed by all platforms, was develop. This Charter includes the commitments to:

a. Use the platform as a means to convey Safety Promotion Information to both pilots and passengers. This information should be targeted towards specific safety-related issues, include best practices and an on-line training with training modules on passenger handling.

b. Include a code of conduct for both pilots and passengers

c. Include information to passengers on the actual safety level of GA flights as compared to CAT flights and other means of transportation

d. Include a tool box with e.g. check lists for the pilots on how to deal with passengers prior to and during the flights. This should include safety related instructions.

e. Include a forum/Chat room for the pilots in order to share experience. This forum should identify specific safety-related discussion items.

f. Gather data related to e.g. flights, number of hours, aircraft, pilots profile and agree to share this data with EASA and NAA's upon request

g. Organise an annual evaluation meeting with EASA and NAAs to evaluate implementation of the Charter.

(17) The draft Charter was presented to the MAB on 14 February 2017 and received positive feedback

(18) The Charter was signed by 3 platforms during Aero Friedrichshafen on April 5th (Wingly, Coavmi and Flyt)

(19) On April 7th the Agency issued a recommendation that DGAC-F should withdraw its Article 14.1 derogation

Platform Logo	EASA Logo

Preamble

This Charter has been developed in cooperation with the European Aviation Safety Agency (hereafter "EASA") in order to promote the safety of non-commercial General Aviation flights with light aircraft. By signing this Charter ***[name of platform]*** makes the commitment to adhere to the principles, responsibilities and values stated below. Specifically, ***[name of platform]*** commits to:

Article 1

Inform the passengers of the different safety levels concerning non-commercial General Aviation flights with light aircraft as compared to commercial air transport operations.

Article 2

Actively promote a safety oriented code of conduct for both pilots and passengers.

Article 3

Provide pilots with check-lists, guidance and tutorials on safety best-practices.

Article 4

Provide passengers with accurate and meaningful information on the type of aircraft flown and the pilot's current experience and qualification.

Article 5

Provide an online forum in order to promote the sharing of safety best practices within the GA pilot community.

Article 6

Collect data related to flights, aircraft and pilot profiles, and to share this data with EASA and national competent authorities.

Article 7

Meet annually with EASA and national competent authorities with a view to review the implementation of this Charter.

Article 8

Implement the detailed elements provided in the Annex to this Charter

Article 9

Publish this Charter on the platform's website.

Date

Signed

Annex to the Safety Charter

In relation to Article 1:

The following information shall be made available to the passengers:

"You are about to book a cost-shared flight on a light aircraft. You should be aware of the fact that safety rules for cost-shared flights are not as strict as they are for commercial air transport flights. This means that, there is more risk involved in taking a cost-shared flight than buying a ticket from a commercial airline operator, where much stricter safety rules apply and where the aircraft, pilots and the operator are subject to continuous checks and strict oversight rules from the authority.

As opposed to commercial airline passenger flights, the risk levels involved in General Aviation flights can be compared with risk levels found in road transportation"

In relation to Article 2:

A code of conduct for pilots shall be published and include the following elements:

(1) The pilot is the only one who has the authority to make decisions concerning the flight and the aircraft. The presence of other people on board should never make the pilot feel pressured to conduct the flight in a certain way because he is the only one who knows how to safely pilot the aircraft. The passenger will have been informed about the possibility of the cancellation of the flight at any time for any reasons.

(2) Bad weather conditions are a primary reason for accidents in non-commercial General Aviation flights with light aircraft. Weather conditions can change quickly, as a result the pilot may cancel the flight. Therefore, the day before the actual flight, the pilot should inform the passenger of the weather forecast regarding the feasibility of the flight. The presence of the passenger on the day of the flight and their expectations that it will take place, shall not make the pilot reluctant to cancel a flight.

(3) The pilot can refuse to board a passenger at any time, for any reason (safety or operational) and without any justification.

(4) EU safety regulations only permit cost-shared flights by private individuals, if the direct cost (i.e. cost directly incurred in relation to the flight, e.g. fuel, airfield charges, rental fee for an aircraft) are shared between all parties, including the pilot. Cost-shared flights shall not have an element of profit. If a flight is not a cost-shared flight in accordance with EU safety regulations, the flight will be qualified as a commercial flight and commercial air operation rules will apply.

(5) Prior to the flight, the pilot shall always indicate the type of aircraft used for the cost-shared flight. Whenever, the aircraft type and model of the aircraft changes, the pilot must inform the passenger of such a change.

(6) The cost-shared flight will be conducted under the sole responsibility of the pilot under the applicable regulation for non-commercial flights with light aircraft by private pilots. It is also the pilot's responsibility to ensure the flight is insured for flights with passengers.

(7) The pilot should inform the passenger that toilets are not available on board.

The code of conduct shall be acknowledged by the pilot

A code of conduct for passengers shall be published and include the following elements:

(1) Respect the pilot's instructions

It is important to understand that the pilot is the only decision maker on the aircraft as he/she is the pilot in command. Before departure, the pilot can decide at any time to cancel the flight. During the flight passengers must abstain from making any comments on the decisions of the pilot, to avoid distracting the pilot from safely piloting the aircraft.

(2) Respect the pilot decision regarding weather hazards

As part of their pilot licence, private pilots have received training on weather conditions and the consequences of deteriorating weather conditions. Most pilots will only be allowed to fly in visual weather conditions as part of their VFR (Visual Flight Rules) training. Some pilots might have an IFR (Instrument Flight Rules) qualification and are permitted to fly under non-visual weather conditions. At all times, both VFR and IFR pilot's decision on flying, diversion during flight or not flying shall be respected. A passenger should never try to persuade a pilot to fly if the pilot has decided otherwise, at the risk of putting the passenger and the pilot in danger.

(3) Respect the maximum luggage weight

The light aircraft in which you will be flying is very sensitive to weight variations. The pilot takes into consideration the weight that passengers have declared for themselves and their luggage to check the plane's gravity centre. Therefore it is mandatory that passengers respect the maximum weight authorised by the pilot on this aircraft and not move their luggage during the flight. It's for all those reasons that passengers shall indicate the weight precisely before departure and inform the pilot if it were to change.

(4) It is forbidden to carry illegal or risky goods

Passengers should never take illegal or risky goods with them. If the passenger has doubts about the dangerous nature of carried goods, the passengers shall inform the pilot and check with the pilot if transportation is possible. The pilot can check your bags at any time and refuse to take you. If the pilot sees that you are carrying dangerous goods and the pilot has not been informed, the pilot shall refuse to take you on board.

(5) Always be on time

When planning the flight, the pilot takes into account the planned time of departure and arrival and the expected weather conditions at those times. Thus it is important that the pilot is able to take-off at the planned time. In case of uncertainty on the timely arrival, passengers shall inform the pilot.

(6) Cancellation by the passenger before the flight

The passenger may cancel a flight at any time before departure.

(6) Safety rules

Passengers shall obey the following basic safety principles:

i. Refrain from smoking during the flight when the pilot tells you

ii. Passengers are never allowed to touch the instruments as this it could lead to an accident.

iii. Passengers shall not speak when the pilot is using the radio and during take-off and landing.
iv. Passengers shall never touch the door lock if the pilot has not instructed them to do so.
v. Passengers should refrain from using psychoactive substances, including alcohol before or during flying.
vi. Toilets?

The code of conduct shall be acknowledged by the passenger

In relation to Article 3:

Pilots shall be encouraged to use a checklist, including at least the following elements, before commencing any flight:

Pilot check list

Have you ensured that a list of the emergency and survival equipment carried on board (see NCO.GEN.130 of Regulation EU No. 965/2012) is available for immediate communication to rescue and co-ordination centres?

(1) Have you checked that the relevant documentation for the aircraft is current?
(2) Did you provide a passenger briefing prior to the flight?
(3) Did you complete a weight and balance/performance calculation?
(4) Is your first aid kit accessible and up to date?

Detailed guidance on passenger handling shall be provided to the pilot. Below is an example

1-Just after the passenger booking:

- ✓ Contact the passenger by phone/chat to acquaint each other
- ✓ Explain to the passengers the risks of cancellation of the flight due to the weather or any other cancellation reason.
- ✓ Give some advice to the passenger in terms of logistics (sunglasses, transportation to the airfield, weight of passengers, maximum luggage, etc…)

2-The Day before the flight:

- ✓ Make a weather briefing with the passengers / cancellation if needed
- ✓ Make sure the passenger will be on time to the airfield
- ✓ Repeat advice to the passenger in terms of logistics (sunglasses, transportation to the airfield, weight of passengers, maximum luggage, etc…)

3-Before Engine start:

- ✓ Take time to explain on the map the route you are planning to do
- ✓ Explain to the passenger what he should or not do (below an example of
- ✓ passenger briefing)

4- Passenger Briefing: inside the aircraft

- ✓ **I**nstallation, seat belt, seat position, locking and unlocking of the doors

- ✓ Ruder, Yoke are unobstructed (Explain to the passenger that he shouldn't touch it and he should make sure it is always unobstructed)
- ✓ Explain to the passengers that he should not speak when you are using the radio
- ✓ Explain how to proceed in an emergency landing
- ✓ How to proceed in case of stress or sickness, that he should not hesitate to tell it to the pilot (Pilot should handover an air sickness bag).
- ✓ Instruct the passenger on how to participate in the safety of the flight (you can tell passengers how they can help you)

By 30th June 2018, all pilots registered in the Platform shall have undergone a dedicated on-line training.

Pilot training

This training will be developed by EASA and made available by 31st March 2018. The training will include the following four modules:

MODULE 1. Risk and threat awareness

MODULE 2. Passenger briefing and communication

MODULE 3. Pre-flight and inflight management

MODULE 4. Threat and Error Management (TEM) and Single pilot crew Resource Management (SRM)

In relation to Article 4:

The platform shall check, record and/or publish the following information:

- ✓ Check the validity and record of the licence of the pilot and the medical certificate
- ✓ Publish the pilot's total and recent (past 12 months) experience on his/her public profile:
- ✓ Publish the pilot qualification (licence and ratings) on his/her public profile
- ✓ Publish the aircraft used for the flight and the number of hours on the aircraft
- ✓ Record non-public comments of users and make them available to the concerned pilot

In relation to Article 5:

TBD

In relation to Article 6:

The following information shall be recorded and made available to EASA and national competent authorities

1. Number of flights done on the platform
2. Duration of flights
3. Number of pilots
4. Number of passengers

5. Number of A-A local flights and A-B long distance navigation flights (absolute and percentage)
6. Repartition of the pilots in terms of experience (absolute and percentage)
7. Repartition of pilots in terms of licence and qualification (absolute and percentage)
8. Number of cancelled flights: due to bad weather, due to plane unavailability.

A voluntary programme of flight monitoring shall be implemented.

Pilots shall be encouraged to participate in this programme and those participating in the programme shall be identified on the platform. Under this programme, flight logs[1] shall be collected by the platform and ultimately made available to EASA and national competent authorities.

[1] AirNav Pro and Sky Demon are typical systems that provide flight log recording, but there might be others

In relation to Article 7:

EASA will organise an annual meeting with all platforms signatory of this charter and national competent authorities.

During the annual meeting,
The platforms will:

- ✓ Share statistical data
- ✓ Report on significant safety events known to them
- ✓ Report on the implementation of the Charter

EASA will:

- ✓ Share safety relevant information with Platforms and national competent authorities.
- ✓ Update Platforms on the publication of relevant safety promotion material.

EASA, the national competent authorities and the Platforms will:

- ✓ Discuss the continuous improvement of the Charter

TRAINING MODULES FOR PILOTS PERFORMING COST-SHARED FLIGHTS

I. BACKGROUND

Flight sharing platforms enable private pilots to offer passengers to share the cost of a flight. The pilot may feel compelled to perform the flight despite adverse flying conditions. This new activity may potentially enhance risks associated with human factors such as the Get-Home-Itis. Indeed, General Aviation is prone to this phenomenon where external (such as the passenger's desire to reach the destination) and internal (the pilot) pressures push the pilot to pursue the flight despite unfavorable conditions (such as weather, fatigue and mechanical issues etc). Moreover, it seems necessary for pilots to be fully comfortable when preparing and executing a navigation that requires sound and robust human skills that go beyond the sole flying abilities.

In light of these specific risks, the private pilot should acquire specific knowledge and skills via an online training module, self-study training or group training.

This program could be implemented by platforms advertising cost-shared flights through a specific agreement. This agreement would enable the platforms to enforce this program, thus increasing the safety of the flights.

II. TRAINING MODULES

MODULE 1. Risk and threat awareness

In order to make sound and safe decisions, the pilot should be fully aware of threats and errors associated to flying with passengers on board.

1. Awareness of risks

1.1. Get-home-itis:

The pilot should be aware of the Get-Home-Itis phenomenon according to which the pilot feels the pressure to perform the flight despite unfavorable conditions. The emphasis will be put on the pilot's capability of correctly identifying this pressure as well as responding to it in the best manner.

The emphasis will be put on the pilot's ability to refuse to perform a flight when the flying conditions are not entirely satisfactory. It is obvious that in adverse conditions pilots won't perform a flight. The difficulty arises when the flying conditions are mildly unsatisfactory but could possibly worsen en-route: in this case, the pilot may more easily yield to the Get-Home-Itis phenomenon.

This phenomenon is well documented in cases where a pilot flies with his family to a weekend destination. At the end of the weekend the pilot will more easily feel the pressure to perform the flight despite current, or foreseen, unsatisfactory weather conditions. The family members and the pilot himself may have professional or personal obligations the following day pushing him to perform the flight.

The Get-home-Itis phenomenon is not limited to a pre-flight decision to take-off. It is even more prevalent during the flight itself. Indeed, once airborne, the pilot will feel more pressure to pursue the flight despite

unfavorable conditions. The pilot will be reminded that he/she has the ability to abort the navigation and decide to either divert to an alternate airfield or go back to his departure airfield. Thus, the emphasis will also be put on the pilot's ability to decide to divert or U-turn a flight when the flying conditions are deteriorating or are expected to deteriorate.

1.2. Human error:

Human errors are one of GA's main accident causes: thus, it is paramount for the pilot to be fully aware of his abilities and limitations. This item will require the pilot to be aware of human error as a contributor to accidents. It will also require him to identify the different sources of human error as well as the appropriate mitigating measures (*such as the Threat Error Management[2] tools of Module 4*).

It is also necessary for the pilot to understand the process of human factors which focus on the limitation of the human's capabilities and performance.

2. Awareness of specific risks related to cost-shared flights

Flying with passengers that are unknown to the pilot, i.e. via cost shared flights offered through a platform, carry specific risks that should to be known to the pilot.

2.1. Security issues related to unknown passengers

Even if security issues are not in the scope of EASA, the current situation in Europe requires the pilot to be fully aware of risks related to illicit activities such as terrorism. In the case of flight sharing, the pilot carries passengers that he/she/she does not necessarily know personally. Such an activity raises security issues that the pilot should be fully aware of. Mitigating measures should also be known (*cf 1.1 of Module 2*).

2.2. Safety issues related to the passenger's unforeseen reactions

As mentioned above, the pilot offering a flight through a cost sharing platform does not necessarily know the passenger boarding his aircraft. Thus, he/she will have more difficulty in anticipating the passenger's reaction which could become a safety issue. It would therefore be necessary for the pilot to be aware of the potential safety hazards related to the unforeseen reaction of a passenger. He/she would also need to know a few practical tools that could help him handle such a situation (*cf. 1.2 of Module 2*).

MODULE 2. Passenger briefing and communication

In order to alleviate certain passenger related risks the pilot should pay careful attention to the communication and information process.

[2] Also known under its acronym : TEM

1. Passenger information

1.1 Passenger contact and assessment

It seems important for the pilot to contact the passengers to get some basic information on their:

- Weight/body type (for weight and balance issues),
- Luggage if applicable,
- As well as their intentions/motivations for the flight (for security reasons). The pilot should assess the passenger's intention both:
    - Before meeting at the airfield by verbally speaking to him
    - When meeting at the airfield by assessing his behaviour

1.2 Passenger briefing

An adequate and clear passenger briefing is essential in helping reduce risks related to the passenger's unforeseen reaction:

- It could first be necessary for the pilot to explain to the passenger the basic flight principals: this practice will help reduce the potential stress and anxiety among the passengers.
- It is also important to remind the pilot of the necessity of briefing the passenger on the flight conditions that are expected (such as turbulence).
- It is also important to remind the pilot of the necessity of briefing the passenger on the procedures found in normal and abnormal situations: such a preparation will help anticipate the passenger's reaction when faced with such situations.
- If there are several passengers, it could also be important for the pilot to carefully choose the individual that seems more comfortable flying in the seat next to the pilot. Such a choice is important since the two front seats generally have dual controls.

Passenger communication is paramount in reducing human behaviors risks.

2. Passenger implication

The pilot should remind the passenger on how to communicate during the flight and/or react when an abnormal situation occurs. Such passenger education and information seems essential to perform a flight in the safest conditions possible.

MODULE 3. Pre-flight and inflight management

The safe performance of a flight implies a sound and effective preparation and execution process.

1. Effectively and safely preparing a flight (specifically a navigation)

1.1. Weather preparation:

In this item, the pilot will be reminded of basic fundamental principles and practicalities of weather planning and preparation. Most notably, due to the increased flight range and duration, the emphasis will be put on planning the flight that require more anticipation and precision in reading and interpreting weather charts.

1.2. Flight planning:

In this item, basic fundamental principles and best practices of flight planning will be emphasized. Due to the increased flight range and duration, planning the flight require more anticipation and precision when determining the flight route and eventual alternate airfields. Consideration should also be given to the specificities of the passengers (such as their weight, possible anxiousness, etc).

The pilot should be able to prepare for different inflight situations that could arise given the parameters that he/she possesses before the flight.

He/she should also be reminded of the necessity of being flexible on the flights' path when the weather conditions aren't entirely satisfactory. If the flight was initially expected to go towards one direction, but the weather conditions aren't good, the pilot should allow himself to change his heading. Moreover, the passengers should be reminded that even if they agreed to cost-share a specific journey, the pilot may change the flight's path for operational or weather related reasons.

1.3. Navigational procedures

This item will enable to check if the pilot effectively possesses the knowledge and skills related to navigational procedures and rules.

2. Effectively and safely performing a flight

2.1 Inflight monitoring

This item concerns the pilot's ability to effectively monitor and assess the flight's progress as well the flight parameters.

2.2 Inflight anticipation

This item concerns the pilot's ability to effectively anticipate normal and abnormal flight situations. More specifically, the emphasis will be put on the pilot's ability to anticipate weather changes and prepare for the best action courses.

For example, even if the pilot does not expect significant weather changes that could jeopardize a safe continuation of the flight or arrival at his destination, he/she should mentally prepare the best course of action if such a situation occurred.

Anticipation is the key to a safe and successful flight.

2.3 Pilot's (corrective) actions

The emphasis will also be put on the pilot's ability to manage unusual or abnormal situations that require good resource management. Specifically, unusual situations cause more stress among pilots and increase their workload. The pilot should be fully aware of his possible limitations when confronted with an abnormal situation. His decision making abilities may be challenged during an abnormal/unfamiliar situation.

Thus, he/she should adopt resource management tools such as Single pilot crew Resource Management (*or SRM as described in module 4)*.

The pilot not holding an IFR rating should possess some minimum knowledge and skills about IMC situations. By being comfortable when inadvertently encountering such IMC situations, the pilot can make the right decisions: such as an IMC U-turn or being able to recover from unexpected IMC situations.

The pilot should also be reminded that sensory perception is likely to be impaired during an IMC situation.

MODULE 4. Threat and Error Management (TEM) and Single pilot crew Resource Management (SRM)

Risks and threats associated with GA flights can be mitigated applying the TEM and SRM tools.

1. TEM: a risk management tool

1.1 Identifying threats

Threat Error Management (or TEM) is a safety concept that covers both air operations and human performances. Initially applied to commercial aviation, this concept is more and more used in GA operations. It is based on the pilot's ability to identify threats, possible human error and the undesirable aircraft situations.

1.2 Adopting appropriate counter measures

This item will emphasize the possible measures to counter these threats, errors and undesirable aircraft situations, both before and during the flight.

These could include:

- Appropriate planning counter measures:
    - Briefing
    - Communication
    - Threat anticipation
- Appropriate execution counter measures:
    - Task management
    - Automation management

2. SRM: a resource management tool

Single Pilot Crew Resource Management (or SRM), is the "*art and science of managing all the resources (both onboard the aircraft and from outside sources) available to a single pilot (prior to and during the flight) to ensure that the successful outcome of the flight is never in doubt*"[3].

It is a specifically useful tool during emergency situations that are highly stressful for the GA pilot especially when he/she is flying the plane without the help of a copilot. Such tools enable to mitigate human error risks associated to the surprise effect of an abnormal situation (also known as the "*startle effect*"). SRM is loosely the GA or private pilot equivalent of Crew Resource Management (CRM) required for commercial pilots.

2.1 skills

This SRM tool highlights resources that the pilot should master in order to correctly react to normal, and more specifically abnormal situations, and therefore mitigate human error:

- ***Aeronautical decision making:*** It is the mental approach that allows the pilot to determine the best possible actions when confronted to normal and abnormal situations.
- ***Risk management:*** It is the decision making process of identifying and assessing potential or actual risks as well as finding the associated mitigating actions.
- ***Task management:*** It is the process according to which pilots confronted with many tasks assess and prioritize the sequence and order of potential and actual tasks that are to be performed.
- ***Controlled flight into terrain awareness (CFIT).***
- ***Situational awareness:*** It is the pilot's ability to perceive and understand the potential and actual situational risks (such as those associated to the pilot, aircraft, environment, external pressures etc.).

[3] FAA Topic note : https://www.faa.gov/news/safety_briefing/2015/media/SE_Topic_15_03.pdf