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Risk Analysis of the Proposed Privileges for the Private Pilot Licence Alternative Medical Standard

A report prepared for the New Zealand Aviation Federation

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Glossary

AMSL	Above mean sea level
ATSB	Australian Transport Safety Bureau
CAA	Civil Aviation Authority
DL9P	NZTA Commercial Driver Licence with passenger endorsement
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organisation
NPRM	Notice of Proposed Rule Making
NZTA	New Zealand Transport Agency
ME	Medical Examiner
PPL	Private Pilot Licence
RIS	Regulatory Impact Statement
RPL	Recreational Pilot Licence

1 Summary

The Civil Aviation Authority (CAA) is currently in the process of reviewing the medical standards associated with the Private Pilot Licence (PPL). Under the present regime, all PPL pilots must hold a class 2 medical certificate in order to fly on this licence. However, considering the risks associated with medical events are relatively low in the PPL sector, the standard of medical fitness and costs associated with obtaining and maintaining the class 2 medical certificate is considered by the CAA to be disproportionate.

The CAA proposes in its Notice of Proposed Rule Making (NPRM)[1] to create an alternative PPL medical standard, which would require PPL pilots to hold the standard "NZTA commercial driver with passenger endorsement" (DL9P) medical certificate. Under the proposed regime, PPL pilots with either the class 2 or DL9P medical standard will be able to fly, however those on the DL9P will face some additional restrictions as a means of mitigating the perceived increased risk which may be associated with this medical standard. Table 1 below presents the proposed regime, with the privileges and limitations associated with the class 2 medical alongside the proposed privileges and restrictions associated with the new DL9P medical standard.

Table 1: Privileges and restrictions under the Class 2 and proposed DL9P medical standard

	PPL w/ class 2 medical	PPL w/ DL9P medical (proposed)
Privileges: The pilot may:	• act as pilot-in-command of an aircraft of the category for which the pilot licence is granted and for which the pilot holds an aircraft type rating, and may carry passengers in the aircraft; and • act as a co-pilot of an aircraft of the category for which the pilot licence is granted and for which the pilot holds an aircraft type rating, and which is required to be operated with a co-pilot.	• carry up to five passengers, unless performing an aerobatic maneuvre (in which case no passengers are allowed); • fly aircraft with a maximum certified weight of up to 2,730 kg; • fly in the vicinity of controlled aerodromes provided they are in radio contact with the appropriate ATS unit; and • obtain glider tow and parachute drop ratings
Restrictions: The pilot must not act as pilot-in-command or as co-pilot of an aircraft:	• for remuneration; • if the aircraft is being operated for hire or reward; • if the aircraft is: - being operated at night; - being operated on a cross country flight; - a helicopter carrying a sling load unless a qualified flight instructor has certified that the holder has satisfactorily completed the flight training required to perform that activity.	• flying outside of New Zealand; • flying for remuneration; • flying for hire or reward; • flying multi-engine aircraft; • flying pressurised aircraft; • exercising the privileges of an aerobatic rating; • undertaking agricultural aircraft operations; • towing banners and drogues; • flying at night; • flying under IFR; • carrying a passenger if performing an aerobatic maneuvre; or • performing a parachute drop operation exceeding 10,000 feet ASML.

[1] Notice of Proposed Rulemaking (NPRM) - Private Pilot Licence Medical Review, released by the CAA in December 2019.

Table 1 presents the range of privileges that the CAA proposes be restricted on the DL9P medical standard. The proposed restrictions include restricting pilots with the DL9P medical standard from flying multi-engine or pressurised aircraft, flying under IFR and night flying (amongst other things).

TDB Advisory Ltd (TDB) has been commissioned by the NZ Aviation Federation to provide an independent risk analysis of the privileges and restrictions proposed by the CAA in its NPRM.

Regulation that is based on risk is a key component of good regulatory practice and is one of the best practice regulatory principles in the Ministry of Transport's 2012 'Transport Regulatory Policy Statement'. It can therefore be expected that a rigorous and comprehensive risk assessment and empirical enquiry would form a major component of the CAA's review of the medical standards. While some aspects of the NPRM appear to be based on rigorous risk assessment, upon review of the CAA's NPRM we found:

- inconsistencies in the way different privileges have been assessed;
- points which appear to be unsubstantiated/potentially inaccurate, and
- an overall lack of clarity in the CAA's framework and methodology for assessing risk.

While lack of historical data and the fact there been very few accidents involving medical events in the PPL sector in New Zealand makes a systematic and rigorous assessment of risks relating to different privileges challenging, it is not impossible. In this report we employ a standard risk-assessment framework to analyse the risks related to a number of privileges that face restrictions on the proposed DL9P standard. We compare the medical-related risks relating to each privilege with a base-case scenario involving a PPL pilot flying on the DL9P medical standard. Our risk analysis finds:

- no additional medical-related risks associated with multi-engine aircraft, pressurised aircraft, parachute operations or IFR;
- a lack of a causal link in general between private agriculture operations; towing/sling load operations; and night flying and the occurrence of a medical event. [2] However, these activities were found to involve marginally higher risk than the base case due to higher severity of consequences if a medical event were to occur; and
- aerobatics was found to involve marginally higher risk than the base case due to the potential for gravitational effects to increase the probability of some medical events.

For the privileges where we find no additional risk in need of mitigation, we consider there to be no benefit from excluding this privilege under the DL9P medical standard. In the case of multi-engine, pressurised aircraft and IFR, our analysis indicates that this privilege may well reduce risk, in which case permitting rather than restricting these privileges would benefit overall safety in the sector. For some privileges (eg, aerobatics and towing and sling loads) we found marginally higher risk than the base case. However, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate those risks more than the DL9P.

[2] In the case of night flying, the only exception to this was vestibular effects/disorientation, where we find a possible causal link between night flying and these medical events.

2 Background

Introduction

The Civil Aviation Authority (CAA) is currently in the process of reviewing the medical standards associated with the Private Pilot Licence (PPL)[3]. At present, New Zealand pilots operating on a PPL must hold a class 2 medical certificate issued under Section 27 of the Civil Aviation Act, 1990.[4] This is aligned with the International Civil Aviation Organisation (ICAO) standard, giving PPL holders the ability to fly overseas on this licence.

Medical standards are in place to mitigate the risk of medical related accidents in aviation. David J. Rainford, in Ernsting's Aviation Medicine 4th edition, describes the purpose of medical examinations for pilots as:

> *"to identify and exclude those who have an unacceptably increased risk of incapacitation during the relevant period of certification subsequent to the examination."* [5]

Incidents and accidents relating to medical incapacitation tend to be relatively uncommon in aviation. A study on pilot incapacitation by the Australian Transport Safety Bureau (ATSB) run between 1975 and 2006 in Australia found that of all 160,338 accidents and incidents that occurred in aviation, only 98 were related to medical events. With a far higher proportion of events relating to factors such as pilot error, mechanical defects and weather issues, events related to medical causes accounted for less than 1% of total occurrences.[6]

A similar US study by the Federal Aviation Administration (FAA) between 2001 and 2016 found the following top 10 leading causes of fatal accidents in general aviation:

1. loss of control inflight;
2. controlled flight into terrain;
3. system component failure (power related);
4. fuel related;
5. unknown or undetermined;
6. system component failure (non power related);
7. unintended flight in instrument meteorological conditions (IMC);
8. mid-air collisions;

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[3] The PPL is one of four licence types for pilots in New Zealand. It is made for private flying that is not for hire or reward. The other three licence categories are Recreational Pilot Licence, Commercial Pilot Licence and Airline Transport Pilot Licence.

[4] Civil Aviation Act, 1990, section 27.

[5] David J. Rainford, Ernsting's Aviation Medicine: 4th Edition, p 552.

[6] Australian Transport Safety Bureau, Pilot Incapacitation: Analysis of Medical Conditions Affecting Pilots Involved in Accidents and Incidents, 2007.

9. low-altitude operations; and
10. other.[7]

Some medical related occurrences may have fallen within the 'unknown or undetermined' or 'other' categories. However, with no specific mention on this list, it is clear that medical events are far less common than other causes of fatal accidents in general aviation.

In the PPL sector in particular, risks associated with medical incapacitation are considered to be relatively low. When the standard of medical fitness associated with obtaining and maintaining a class 2 medical is balanced against the risks for PPL pilots, this medical standard could be considered disproportionate. As a result, some overseas states including the UK, US and Australia have developed or are developing an alternative medical standard that reflects this lower risk. By the same accord, the CAA is currently reviewing the medical standards for the PPL in New Zealand.

The CAA review

In 2016, the CAA began its review surrounding whether an alternate medical certification standard for the PPL could be adopted without inappropriately reducing levels of safety.

The CAA's review first considered the following options:

- retaining the status quo;
- introducing an alternative aviation medical certificate;
- an alternate medical standard for PPL pilots which requires a commercial driver medical certificate with passenger endorsement;
- an alternate medical standard for PPL pilots which requires a private driver licence medical certificate with passenger endorsement; and
- introducing a self-declaration system.

After industry consultation and consideration of the costs and benefits of each option, the CAA has recommended the fourth option – an alternate medical standard for PPL pilots which requires a commercial driver medical certificate with passenger endorsement (DL9P). It is important to note that the introduction of the DL9P medical standard would not replace the class 2, rather it would operate as an alternative. In other words - one PPL licence, two medical standards.

As opposed to PPL pilots on the class 2, PPL pilots flying on this alternate medical standard would face some limitations and restrictions, as a means of mitigating any increased level of risk which may be associated with this medical standard.

As part of the CAA's proposed changes, the Recreational Pilot Licence (RPL) will be revoked. The CAA proposes current RPL pilots (who hold a DL9P medical) will be issued a PPL under the proposed new medical standard.

[7] Federal Aviation Administration, Fact Sheet – General Aviation Safety, July 30th 2018, page 7.

Privileges associated with the new medical standard

In December 2019, the CAA released the Notice of Proposed Rulemaking (NPRM) - Private Pilot Licence Medical Review. The first section of this document states that:

1.1 *The purpose of this rule-making proposal is to adopt a standard of medical certification for New Zealand private pilots that:*

- *requires a standard of medical fitness that is commensurate to the risk posed by private pilots; and*
- *is associated with costs that are commensurate to the risk posed by the sector.*

The CAA considers the DL9P medical certificate to require a standard of medical fitness commensurate to the risk posed by private pilots and associated with costs commensurate to the risk posed by the sector, subject to some important restrictions and limitations. Table 1 below presents the privileges and restrictions for PPL holders on the class 2 alongside those on the proposed DL9P medical standard.[8]

Table 1: Privileges and restrictions under the Class 2 and proposed DL9P medical standard

	PPL w/ Class 2 medical	PPL w/ DL9P medical (proposed)
Privileges: The pilot may:	• act as pilot-in-command of an aircraft of the category for which the pilot licence is granted and for which the pilot holds an aircraft type rating, and may carry passengers in the aircraft; and • act as a co-pilot of an aircraft of the category for which the pilot licence is granted and for which the pilot holds an aircraft type rating, and which is required to be operated with a co-pilot.	• carry up to five passengers, unless performing an aerobatic maneuvre (in which case no passengers are allowed); • fly aircraft with a maximum weight of up to 2,730 kg; • fly in the vicinity of controlled aerodromes provided they are in radio contact with the appropriate ATS unit; and • obtain glider tow and parachute drop ratings
Restrictions: The pilot must not act as pilot-in-command or as co-pilot of an aircraft:	• for remuneration; • if the aircraft is being operated for hire or reward; • if the aircraft is: - being operated at night; - being operated on a cross country flight; - a helicopter carrying a sling load unless a qualified flight instructor has certified that the holder has satisfactorily completed the flight training required to perform that activity.	• flying outside of New Zealand; • flying for remuneration; • flying for hire or reward; • flying multi-engine aircraft; • flying pressurised aircraft; • exercising the privileges of an aerobatic rating; • undertaking agricultural aircraft operations; • towing banners and drogues; • flying at night; • flying under IFR; • carrying a passenger if performing an aerobatic maneuvre; or • performing a parachute drop operation exceeding 10,000 feet ASML.

Congruent with the licence being for "private" flying, under neither the current or proposed regime are PPL pilots allowed to fly for remuneration, hire or reward. Aside from this, PPL pilots on the class

[8] The privileges and limitations associated with the Recreational Pilot Licence (RPL) are also presented in Appendix 1 for reference.

2 medical standard are able to fly any aircraft for which they carry a rating (are trained in) and exercise any privilege they have the rating for.

Pilots on the proposed DL9P medical standard may also fly an aircraft they have a rating for, subject to a number of limitations. Firstly, pilots on this standard will not be able to fly outside of New Zealand, as doing so would violate ICAO standards (which require a class 2 medical certificate to fly internationally).

Other restrictions include:

1. a passenger limit;
2. maximum aircraft weight;
3. flying multi-engine aircraft;
4. flying pressurised aircraft;
5. limitations on aerobatics;
6. aviation for private agricultural operations;
7. towing banners and drogues;
8. flying at night or on instrument flight rules (IFR); and
9. some limitations regarding parachute drops and airspace.

These restrictions appear to have been set on the basis of the CAA's assessment of risk. However, the CAA's methodology for assessing risk related to each restriction is not made entirely clear. The NPRM states:

> *2.1.6 The CAA has identified a range of privileges that could be reasonably associated with the commercial driver licence with passenger endorsement medical standard."*
>
> *"The risk posed by operators under these privileges and proposed medical standard is considered to be mitigated in part by the types of activities typically undertaken by PPL holders. The proposed privileges reflect these mitigating factors and ensure any changes to the types of activity undertaken by the sector are managed effectively.*

The restrictions associated with the DL9P medical standard seem to have been assessed by the CAA as involving risk that is not sufficiently mitigated by the proposed new medical standard.

3 Risk-based regulation

Risk-based regulation is a key component of good regulatory practice. One of the Ministry of Transport's 'Best practice regulatory principles' states:

> *"**Transport regulatory activities are risk-based** – risk assessment and empirical enquiry precedes and informs all aspects of regulatory development, design and implementation."* [9]

In accordance with this principle, it can be expected that risk assessment and empirical enquiry are a major component of the CAA's review of the new medical standard and its limitations. In regard to risk assessment and empirical enquiry, upon review of the CAA's NPRM, we have found:

- inconsistencies in the way different privileges have been assessed;
- points which appear to be unsubstantiated/potentially inaccurate; and
- an overall lack of clarity on the CAA's framework and methodology for assessing risk.

These issues are not across every privilege or limitation. In particular, the CAA's assessment of passenger numbers and aircraft size both appear to involve significant consideration of industry views, private and third-party risk, analysis of privately flown aircraft in New Zealand and importantly, reference to international practice.

However, we find the CAA's assessment of a number of limitations on the proposed new medical standard incomplete, unclear and at times inconsistent. These include restrictions on:

- multi-engine aircraft;
- pressurised aircraft;
- parachute operations;
- aerobatics;
- banner, drogue towing;
- agricultural operations;
- night flying; and
- IFR;

as well as inconsistencies surrounding the treatment of glider towing and sling-load operations.

The low record of medical-related incidents in aviation, particularly in the New Zealand PPL sector make it challenging to undertake risk assessments. In the Regulatory Impact Statement (RIS), the CAA discusses the 18 reported occurrences in New Zealand involving private pilots and medical issues between 1995 and 2015 (with no occurrences in relation to RPL holders). While less than one incident per year over twenty years is already a small sample to form a basis for risk assessment, a number of the occurrences do not appear comparable to the proposed new medical standard.

[9] Ministry of Transport, Transport Regulatory Policy Statement, 2012, page 7.

Among the 18 occurrences discussed by the CAA:

- 4 involved pilots who did not hold current medicals and therefore should not have been flying;
- 5 involved pilots who held medical certificates based on standards incongruent with the class 2 or DL9P; and
- 3 were ambiguous as to whether or not they resulted from a medical reason.

This effectively limits us to 6 medical-related occurrences over 20 years that we can confidently refer to in this discussion – an insufficient number for robust empirical analysis, alongside leading to the clear conclusion that the probability of a medical-related occurrence is very low.

While this illustrates the difficulties of risk analysis surrounding this issue, it does not make this task impossible. Other approaches could include analysis of the cases overseas or creating and applying a risk-assessment matrix - a framework which analyses risk based on probability and consequences of an event.

In the case of analysing the risk associated with different privileges under the proposed new medical standard, where there is little historical data to go off, we consider a risk-assessment matrix an appropriate framework for risk assessment. In this report, we use the risk-assessment matrix framework to assess the risks relating to the privileges that have been restricted on the proposed new medical standard. In doing so, we aim to provide visibility on:

- the type of medical-related risk involved in each activity;
- the composition of this risk; and
- the magnitude of risk.

This analysis provides a systematic and rigorous framework to assess the medical risk related to each restriction in the proposed DL9P medical standard.

The following section presents and discusses the risk-assessment matrix and how it will be applied in this report. Section 5 to 12 continue by applying this framework to each restriction.

4 A framework for assessing risk

Risk-assessment matrix

The risk-assessment matrix is a mechanism to provide visibility on risk and assist rigorous decision making. This matrix is used by a number of organisations in a range of industries, including aviation. ICAO discusses the use of risk-assessment matrices in its Safety Management Manual,[10] which we have used as reference when developing the framework in this report.

In a risk-assessment matrix, risk is modelled as:

Risk = Probability (of event occurring) **x Severity** (of the possible consequences)

where probability can be defined as:

the likelihood that a consequence or outcome might occur;

and severity as:

the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard.

Figure 1 below presents the matrix visually.

Figure 1: Risk-assessment matrix

		Severity of Consequences				
		Catastrophic 5	Hazardous 4	Major 3	Minor 2	Minimal 1
Probability of Occurance	Frequent 5	25	20	15	10	5
	Occasional 4	20	16	12	8	4
	Remote 3	15	12	9	6	3
	Extremely remote 2	10	8	6	4	2
	Extremely improbable 1	5	4	3	2	1

Risk-assessment matrices can be anywhere from 3x3 upwards, with more rows and columns providing more refined results. We have set up the 5x5 matrix above based on the risk matrix ICAO presents in its Safety Management Manual.

[10] International Civil Aviation Organization, Safety Management Manual, page 2.11 to 2.16

This matrix ranks severity of consequences from catastrophic to minimal, assigning a number to each level. Probability of occurrence is ranked in the same way, from frequent (5) to extremely improbable (1).

Multiplying the assigned number for probability by the number for severity of consequences provides an indication of the overall risk. This method not only indicates the possible magnitude of the risk, but also makes it easy to make comparisons of risk.[11]

In this risk matrix, ratings of 1 to 4.99 are considered low risk (green), 5 to 14.99 are medium risk (yellow) and 15 to 25 high risk (red).

In order to assign likelihood and severity of consequences to each possible event, we use ICAO's aviation specific risk probability and risk severity tables as presented below.

Table 2: Risk probability table

Liklihood	*Meaning*	*Value*
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Extremely remote	Very unlikely to occur (not known to have occurred)	2
Extremely improbable	Almost inconceivable that the event will occur	1

Table 3: Risk severity table

Severity	*Meaning*	*Value*
Catastrophic	• Aircraft / equipment destroyed • Multiple deaths	5
Hazardous	• A large reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage	4
Major	• A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency • Serious incident • Injury to persons	3
Minor	• Nuisance • Operating limitations • Use of emergency procedures • Minor incident	2
Minimal	• Few consequences	1

When applying these measures in our case, we bear in mind that the New Zealand context is smaller in scale than the ICAO's model may be designed for. We also note that given the lack of empirical examples of different medical events and different privileges, logic forms an important basis for our

[11] Some risk-assessment matrices (such as that used in the ICAO Safety Management Manual) involve the numbers 1 – 5 on one axis, and letters A to E on the other. This results in risk ratings taking the format number/letter, such as 4A or 2C. We use numbers on both axes so that relative risk levels are easily assessed. Rather than comparing a risk of 3C with a risk of 2B, this variation allows us to compare a risk rating of 6 with a risk rating of 8 for example.

application of this framework. Some level of subjectivity is therefore inevitable in applying this framework.

Application of the model

In this report, we use the risk matrix described above to analyse the medical risk for each of the restrictions the CAA proposes for pilots under the DL9P medical standard.

The base case

In order to do so, we first establish a 'base case' and asses the risks associated with this case. We define the base case as a PPL pilot:

- on the proposed DL9P medical standard;
- undertaking a one-hour daytime VFR flight, in a single engine, non-pressurised aircraft; and
- flying for approximately one hour, from Nelson to Fielding, generally at 7,500 ft.

This base case provides the basis for comparison when we are assessing the risks related to each restriction. By comparing the medical risks related to each case with the base case, we will be able to see whether the privilege involves any additional risk by using the alternative medical and what the risk may look like.

The medical events

Our assessment will look at the risk related to the following six kinds of medical events: [12]

1. Gastrointestinal illness
2. Cardiovascular event
3. Headache
4. Hypoxia
5. Renal calculi
6. Vestibular illusion/disorientation

Assessing the base case

We are now ready to assess the base case. With reference to the ICAO's definitions of each level of probability and severity, each medical event has been assigned a probability and severity of consequences, which produces an overall risk rating (from 1 to 25): see Table 4 below.

Table 4: The assessed risk of a medical event in the base case

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3	Hazardous	4	Medium risk	12
Headache	Occasional	4	Minimal	1	Low risk	4
Hypoxia	Remote	3	Major	3	Medium risk	9
Renal calculi	Remote	3	Major	3	Medium risk	9
Vestibular effects/disorientation	Remote	3	Major	3	Medium risk	9

[12] While there are a wide range of medical events that could take place mid-air, from common gastrointestinal pains to obscure issues, we consider the list captures a sufficiently broad range of possible medical events. In a more extensive study, these categories would be divided, and the range extended.

We recognise that under each category of medical event there are a range of possible events with a range of probabilities and severity of consequences. For example, a pilot may have a cardiovascular event like a heart attack so minor that they are barely aware it is happening, or a major stroke that leaves him unconscious. Vestibular effects/disorientation for may be as minor as a few seconds of confusion, or as major as full loss of visual acuity. Taking this range into account, the values we assign under each category are based on the average of the range. While a serious gastrointestinal illness for example may have significant consequences, on average consequences will be minimal.

Having assessed the medical events in the base case, the next step involves using the same framework to assess the risk of medical events for each of the proposed restrictions on the DL9P medical standard. This will take place in the following chapters. However, to explain the process, we present the risk-assessment for one of the proposed restrictions – towing banners and drogues – below.

Table 5: If towing banners and drogues was allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1.5	Medium risk	6
Cardiovascular event	Remote	3	Hazardous	4.5	Medium risk	13.5
Headache	Occasional	4	Minimal	1.5	Medium risk	6
Hypoxia	Remote	3	Major	3.5	Medium risk	10.5
Renal calculi	Remote	3	Major	3.5	Medium risk	10.5
Vestibular effects/disorientation	Remote	3	Major	3.5	Medium risk	10.5

This table assesses the risk related to the same six medical events as the base case, however in this case it is for a pilot with on a DL9P medical certificate towing a banner or drogue.[13]

Comparison with the base case

The table below presents the medical risk ratings for the proposed restriction, side by side with the base case. This shows us whether the activity restricted on the proposed new medical standard is associated with higher or lower risk than the base case.

Table 6: How do the medical risks associated with towing banners and drogues compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1.5	1	0.5	6	4	**2**
Cardiovascular event	3	3	0	4.5	4	0.5	13.5	12	**1.5**
Headache	4	4	0	1.5	1	0.5	6	4	**2**
Hypoxia	3	3	0	3.5	3	0.5	10.5	9	**1.5**
Renal calculi	3	3	0	3.5	3	0.5	10.5	9	**1.5**
Vestibular effects/disorientation	3	3	0	3.5	3	0.5	10.5	9	**1.5**

The columns shaded in blue are the important part of this table. These columns highlight the difference between this case and the base case. In this instance, we found no difference in probability of these medical events between this case and the base case, however, did find severity of consequences to be 0.5 higher for each medical event. This has resulted in a marginally higher risk rating than the base case, which is visible in the final 'marginal risk' column.

Assessing the probability of occurrence, severity of consequences and finding an overall risk rating for each medical event sheds light on the following:

[13] A full discussion of how and why these were assigned follows in chapter 9.

1) Does this privilege actually involve marginal medical risk that makes it inappropriate for the proposed DL9P medical standard?

2) If it does:

    a. what does the risk relate to?

    b. is it higher risk because of higher probability or higher severity of consequences?

    c. what is the relative size of the risk?

Understanding the nature of the risk associated with each privilege is important for informed decision making, and in order to ensure the right tools are being used for risk-mitigation.

5 Multi-engine aircraft

Introduction

The CAA proposes to prohibit PPL pilots on the DL9P medical standard from flying multi-engine aircraft. Sections 3.15 to 3.20 of the NPRM provide discussion of this decision, with reasons for restriction including the following:

3.15 Complexity and speed associated with a multi-engine aircraft have an adverse impact on the ability of a pilot to recover control in the case of a medical event.

Higher workload associated with multi-engine aircraft.

Aircraft traveling at higher speeds are likely to have increased kinetic energy and impact in the event of a crash.

The NPRM also mentions some arguments against restricting multi-engine aircraft use on the DL9P medical standard, including:

3.18 Risks associated with multi-engine aircraft are related to training.

Multi-engine aircraft are lower risk due to the ability to fly on one engine should the other fail.

No causal link between multi-engine aircraft and medical incapacitation.

Some single engine aircraft are more complex and high speed than some multi-engine aircraft.

Risk assessment

Table 7: If flying multi-engine aircraft was allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3	Hazardous	4	Medium risk	12
Headache	Occasional	4	Minimal	1	Low risk	4
Hypoxia	Remote	3	Major	3	Medium risk	9
Renal calculi	Remote	3	Major	3	Medium risk	9
Vestibular effects/disorientation	Remote	3	Major	3	Medium risk	9

Table 8: How do the medical risks associated with flying multi-engine aircraft compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1	1	0	4	4	**0**
Cardiovascular event	3	3	0	4	4	0	12	12	**0**
Headache	4	4	0	1	1	0	4	4	**0**
Hypoxia	3	3	0	3	3	0	9	9	**0**
Renal calculi	3	3	0	3	3	0	9	9	**0**
Vestibular effects/disorientation	3	3	0	3	3	0	9	9	**0**

Discussion

Flying multi-engine aircraft does not change the probability of a medical event occurring. This is acknowledged in point 3.19 of the NPRM, which states that “there is no causal link between medical incapacitation and flying multi-engine aircraft”. As such, the probability of each of the listed medical events occurring is the same as in the base case.

As for severity of consequences of each possible medical event, we do not consider flying a multi-engine aircraft to increase or decrease these. This is contrary to the NPRM, which asserts that factors including complexity, handling characteristics and speed associated with multi-engine aircraft will have adverse impact on the pilot’s ability to recover if a medical event occurred (ie. increased severity of consequences).

We do not find the CAA’s statement regarding complexity of multi-engine aircraft having an adverse effect on the pilot’s ability to recover to be substantiated. A pilot in a multi-engine aircraft holds a rating in that aircraft and through training, minimum flight-time requirements and the biennial flight review, has proven competency in that aircraft. We therefore do not consider that in a medical event, a pilot flying a multi-engine aircraft that they are trained to fly will find it more complex than a pilot flying a single engine aircraft they are trained to fly.

We do not find increased complexity or different handling characteristics to be a relevant issue in this discussion. In order to fly a multi-engine aircraft, a pilot must pass their licence tests and required flight time, proving competency and familiarity in that aircraft. Whether single or multi-engine, different aircraft will have different intricacies and characteristics, and the risk associated with these should be mitigated by training, minimum flight time requirements and the biennial flight review required to fly the aircraft.

In section 3.41 of the NPRM, which discusses sling-load operations, the CAA state that the demonstration of competency is of most relevance to the ability of a pilot to perform this operation. It then states that there are no elements of medical certification that are likely to affect the ability of pilots to carry out these operations. We agree with this logic and find this logic to apply equally to the case for flying multi-engine aircraft.

As for speed of the aircraft, we do not consider the assumption that those in multi-engine aircraft travel at greater speeds to be substantiated. Table 9 on the following page presents details on twelve common aircraft in New Zealand, including two multi-engine aircraft, the Piper Seneca and Diamond DA42 and two pressurised aircraft, the Piper Malibu and Cessna P210 (to be discussed in the following section of this report).

Table 9: Common aircraft in New Zealand

Aircraft	Engines	Seats	MTOW (kg)	Max speed (knots)	Service ceiling	Pressurisation
Cirrus SR 22 G6	1	5	1,610	200	25,000	✗
Piper Malibu	1	6	1,950	190	25,000	✓
Piper Matrix	1	6	1,950	190	25,000	✗
Piper Seneca	2	6	2,120	188	25,000	✗
Cirrus SR 22	1	5	1,520	180	17,500	✗
Cessna P210	1	6	1,750	179	27,000	✓
Diamond DA42	2	4	2,000	176	18,000	✗
Cessna 210	1	6	1,700	170	27,000	✗
RV10	1	4	1,205	170	20,000	✗
Cessna 182	1	4	1,385	145	20,000	✗
Piper Warrior	1	4	1,040	125	14,000	✗
Cessna 172	1	4	1,000	124	13,000	✗

As the table shows, while both multi-engine aircraft are marginally heavier than other aircraft in the group,[14] when it comes to maximum speed, three common single-engine aircraft are faster than the Piper Seneca, and five common single-engine aircraft are faster than the Diamond DA42. We recognise this list does not include every single or multi-engine aircraft in the skies, however it illustrates the lack of correlation between multi-engine aircraft and higher speed.

While unrelated to medical incapacitation, the risk related to crashing due to engine failure is an important consideration associated with multi-engine aircraft. The ability to fly on a second engine improves the safety of a pilot in the event of engine failure.

Our analysis finds no marginal risk associated with flying multi-engine aircraft on a DL9P medical certificate. Taking into account the positive implications on safety associated with engine failure, the overall level of safety for both the pilot and third parties is found to be higher than in the base case.

Having found no additional risk to mitigate, we consider there to be no benefit from excluding multi-engine aircraft from the DL9P medical standard. If anything, we find multi-engine aircraft to be a lower risk choice for private pilots. To require the more expensive class 2 medical certificate to fly a multi-engine aircraft is both inefficient and likely to result in the unintended consequence of discouraging pilots from choosing this potentially safer aircraft.

[14] Whilst remaining well under the max weight of 2,730 kg on the proposed new medical standard.

6 Flying pressurised aircraft

Introduction

Pressurised aircraft have the ability to pump air into the cabin, allowing the aircraft to fly at mid to high altitude whilst maintaining a lower effective cabin altitude. Of the common aircraft in NZ listed in Table 9 in the previous section, the Piper Malibu and Cessna P210 are good examples of pressurised planes flown in the PPL sector. Explaining why flying pressurised aircraft should not be allowed on the DL9P medical standard, the NPRM states:

3.24 Pressurisation adds another level of complexity, increasing the workload of the pilot.

Pressurisation is associated with greater medical risk due to the consequences of rapid or slow decompression such as hypoxia/barotrauma.

Currently RPL pilots may not fly pressurised aircraft.

Point 3.22 of the NPRM also mentions some advantages of flying at higher altitudes, including;

3.22. Private aircraft flying at high altitudes are interacting with large commercial aircraft as they are more likely to be in controlled airspace with separation distances applied, reducing likelihood of mid-air collision.

The greater space available (lateral and horizontal) provides pilots with more room to recover from a medical event.

Risk assessment

Table 10: If flying pressurised aircraft was allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3	Major	3	Medium risk	9
Headache	Occasional	4	Minimal	1	Low risk	4
Hypoxia	Very remote	2	Major	3	Medium risk	6
Renal calculi	Remote	3	Minor	2	Medium risk	6
Vestibular effects/disorientation	Remote	3	Minor	2	Medium risk	6

Table 11: How do the medical risks associated with pressurised aircraft compare to the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1	1	0	4	4	**0**
Cardiovascular event	3	3	0	3	4	-1	9	12	**-3**
Headache	4	4	0	1	1	0	4	4	**0**
Hypoxia	2	3	-1	3	3	0	6	9	**-3**
Renal calculi	3	3	0	2	3	-1	6	9	**-3**
Vestibular effects/disorientation	3	3	0	2	3	-1	6	9	**-3**

Discussion

We assess the probability and severity of consequences relating to gastrointestinal illness and headache as equal to that of the base case, with overall risk rated as low.

Similarly, we do not find flying a pressurised aircraft to change the probability of cardiovascular event, renal calculi or vestibular illusion/disorientation. However, the severity of consequences of each of these events is considered lower than in the base case. This is related to point 3.22 of the NPRM, which discusses the greater lateral and horizontal space available when flying a pressurised aircraft at medium/high altitude. If one of these medical events were to occur, the pilot has more time to recover and descend safely, and less aircraft/immediate obstacles of concern in their airspace. As a result, the likelihood of severe consequences is lower than in the base case. As point 3.22 also mentions (whether a medical incident is involved or not), communication with air traffic controllers and separation distances required in controlled airspace also result in a significant reduction in the likelihood of mid-air collision.

Contrary to the NPRM, the probability of hypoxia is found to be lower in a pressurised aircraft than in the base case. In a pressurised aircraft, a pilot may choose to fly at mid to high altitude and use pressurisation to reduce their cabin altitude to 3,000 ft for example. Provided that the aircraft does not suffer mechanical fault or an impact breaking a pressurised vessel, there is no reason for the plane to suffer uncontrolled decompression. Should the pressure in the aircraft rise above 10,000 ft, an alarm will sound, and the pilot knows to reduce altitude, before hypoxia or other pressure-related illnesses can kick in.

In comparison, the pilot on our base case is flying an unpressurised plane. For most of the journey the pilot may fly at 7,500 ft. However, we consider a scenario where the pilot comes upon some cloud where it makes sense to fly over rather than descend under. The pilot flies up to 11,000 ft in order to avoid flying with no visibility.

At this altitude, the pilot is at risk of developing hypoxia. The pilot may:

a) recognise the risk they are taking and use an oxygen mask to self-regulate oxygen;

b) recognise the risk they are taking and use an oxygen mask to self-regulate oxygen, without realising that their oxygen cylinder is not sufficiently topped up, thus leading to an increased risk of developing hypoxia;

c) recognise the risk they are taking and use an oxygen mask to self-regulate oxygen, without realising that their oxygen is not being properly administered, thus leading to an increased risk of developing hypoxia;

d) not have an oxygen mask or decide that they do not need one at this altitude, thus increasing the risk of developing hypoxia.

Considering these situations, we find it much more likely that a pilot who flies high in a non-pressurised plane has issues with their oxygen supply than a pilot of a pressurised plane faces uncontrolled decompression.

Overall, our analysis finds the medical risks associated with flying pressurised aircraft to be lower than in the base case. More time to recover and safely descend from higher altitude reduces the severity of consequences of events such as cardiovascular issues, renal calculi and vestibular effects

/disorientation. Risks associated with hypoxia are found to be higher with use of an oxygen mask in an unpressurised aircraft than pressurisation. We therefore do not consider any benefits would arise from excluding the ability to fly pressurised aircraft from the DL9P medical standard. If anything, considering medical related risk is lower than the base case, we see reason to encourage pressurised aircraft in the PPL sector in New Zealand.

7 Parachute operations

Introduction

Private parachute operations are first discussed in 3.23 of the NPRM alongside pressurised aircraft. The NPRM states:

3.23 An altitude restriction is proposed for PPL pilots on the DL9P medical standard. That is, the PPL pilots must not exceed 10,000 ft above mean sea level (AMSL) when performing parachute drop operations.

The justification for this restriction is later described in section 3.51-3.55 alongside discussion of glider towing. The NPRM states:

3.51 Parachute operation (as well as glider towing) require additional ratings.

3.54 There are similar levels of complexity and risk associated with parachute operations as glider tow.

Private parachute operations may not exceed 10,000 ft AMSL. Private parachute operations above this height are considered technically complex (involving the use of oxygen, rapid climb and descent for example).

In combination with an alternative standard of medical certificate, parachute operations above 10,000 ft present an unacceptable level of risk and therefore are not allowed on the DL9P medical.

Risk assessment

Table 12: If parachute operations above 10,000 ft were allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3	Hazardous	4	Medium risk	12
Headache	Occasional	4	Minimal	1	Low risk	4
Hypoxia	Remote	3	Major	3	Medium risk	9
Renal calculi	Remote	3	Major	3	Medium risk	9
Vestibular effects/disorientation	Remote	3	Major	3	Medium risk	9

Table 13: How do the medical risks associated with parachute operations above 10,000 ft. compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1	1	0	4	4	**0**
Cardiovascular event	3	3	0	4	4	0	12	12	**0**
Headache	4	4	0	1	1	0	4	4	**0**
Hypoxia	3	3	0	3	3	0	9	9	**0**
Renal calculi	3	3	0	3	3	0	9	9	**0**
Vestibular effects/disorientation	3	3	0	3	3	0	9	9	**0**

Discussion

We do not find private parachute operations above 10,000 ft to involve greater risk of a medical event than the base case.

As stated in 3.45 of the NPRM, any additional risk that could be associated with parachute operations above this altitude would be associated with oxygen, rapid climb and descent. We noted in the previous section of this report that the use of oxygen at altitude in unpressurised aircraft does involve risk, whether it be from improper use of equipment, equipment fault or insufficient oxygen on board. That being said, there seems little difference in risk between a private pilot with four passengers who increases altitude above 10,000 ft to avoid clouds, and a private pilot with four passengers who flies above 10,000 ft for a parachute operation. Both must take into consideration and manage the oxygen supply of themselves and their passengers and abide by the Civil Aviation Rules regarding oxygen. These state that pilots can only fly between 10,000 and 13,000 ft without oxygen for up to 30 minutes, and must use oxygen at any altitude above 13,000 ft.

As opposed to the base case pilot, fully aware of the altitude they intend to reach before take-off, it is quite possible that the pilot undertaking private parachute operations has checked and ensured there are no issues with their oxygen supply prior to take-off. As a trained pilot with a parachute rating, aware they are taking people to higher altitudes, this kind of risk management and mitigation can be expected. Taking these factors into consideration, while improper oxygen management above 10,000 ft may increase the likelihood of hypoxia, this does not appear any more of a problem, or any more probable, than in the base case.

The probability and severity of other hazardous medical events such as cardiovascular events, renal calculi and vestibular effects/disorientation are not connected to parachute operations. Ultimately, we find no additional risk associated with parachute operations over 10,000 ft, and therefore do not find any benefit from excluding this privilege from the DL9P medical standard.

8 Aerobatics

In order to undertake aerobatics under 3,000 ft, a PPL pilot currently requires an aerobatics rating. Rule 91.701 of the Civil Aviation Rules also contains a number of restrictions on aerobatic manoeuvres, including restrictions in relation to aerobatic operations over congested areas of cities and towns, over open-air assemblies of persons, in controlled airspace and at minimum heights.

In the discussion of aerobatics in the NPRM, the CAA states:

3.31 Aerobatics are considered a high-risk activity due to the physical strain aerobatic manoeuvres place on the body, which increase the risk of medical complications arising during flight.

The increased risk of medical incapacitation due to the stress of operating (inverted) below 3,000 feet above ground level is not appropriate for the PPL commercial driver licence medical standard.

Ultimately the CAA proposes that aerobatics be allowed above 3,000 ft on the DL9P medical standard, but pilots must not carry a passenger during aerobatic manoeuvres and cannot obtain an aerobatic rating or exercise the privileges of an aerobatic rating. This means that on the DL9P medical standard, regardless of aerobatic training, pilots will be able to undertake aerobatic manoeuvres over 3,000 ft, as long they are not carrying a passenger.

The NPRM states that this restriction will ensure that risks to third parties, including passengers and persons on the ground, are minimised.

Risk assessment

Table 14: If aerobatics at any height were allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3.5	Hazardous	4	Medium risk	14
Headache	Occasional	4.5	Minimal	1	Low risk	4.5
Hypoxia	Remote	3	Major	3	Medium risk	9
Renal calculi	Remote	3	Major	3	Medium risk	9
Vestibular effects/disorientation	Remote	3.5	Major	3	Medium risk	10.5

Table 15: How do the medical risks associated with aerobatics compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1	1	0	4	4	**0**
Cardiovascular event	3.5	3	0.5	4	4	0	14	12	**2**
Headache	4.5	4	0.5	1	1	0	4.5	4	**0.5**
Hypoxia	3	3	0	3	3	0	9	9	**0**
Renal calculi	3	3	0	3	3	0	9	9	**0**
Vestibular effects/disorientation	3.5	3	0.5	3	3	0	10.5	9	**1.5**

Discussion

As stated in the NPRM, aerobatics place more physical strain on the body. Aerobatic manoeuvres subject pilots and passengers to gravitational effects. Though these effects are unlikely to increase the probability of issues such as gastrointestinal illness, hypoxia or renal calculi, they may increase the probability of some medical events such as cardiovascular events, headaches and vestibular effects/disorientation. We do not consider aerobatics to increase the severity of consequences of a medical event.

Overall, our risk assessment finds aerobatics to involve marginally higher medical-related risk than the base case. However, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate those risks more than a DL9P. We also note that the current class 2 medical certificate does not appear to include any special or different medical standards for pilots who practice or intend to practice aerobatics.

9 Towing and sling loads

Introduction

In the NPRM, the CAA addresses banner, drogue, sling load operations and glider towing in three different sections, in three different ways.

Section 3.37 to 3.39 discusses banner and drogue towing, stating:

3.37 These activities were excluded from the RPL on the basis that they are associated with hire or reward, and military operations.

Neither activity is undertaken in high volume.

3.38 Both require specialist training and pilots to demonstrate a high level of competency.

Medical risk relates to additional damage following a pilot's medical incapacitation.

3.39 On the same grounds as was considered for the RPL restriction, they should not be allowed on the DL9P medical standard.

The following section on sling load operations states:

3.40 These activities are usually associated with hire or reward, however Rule part 33 of CAR does allow PPL holders who have completed the appropriate training to undertake this activity.

3.41 The demonstration of competency is of the most relevance to the ability to perform a sling load operation, and no elements of medical certification are likely to affect the ability of pilots to carry out these operations.

It is therefore proposed that sling load operations be allowed.

As for glider towing, The NPRM states:

3.51 Glider towing require additional ratings.

It was initially excluded from the RPL; however, this was later amended, allowing glider towing (except when for hire and reward);

Glider towing is usually recreational and club-based;

As RPL pilots are allowed to tow glider pilots, there is little reason to limit this activity under the proposed Dl9P medical certificate.

3.55 It is proposed that pilots flying on the commercial driver licence medical standard be able to obtain and exercise the privileges of glider towing.

While these activities are addressed separately in the NPRM, we find them to be similar in a number of ways:

- each requires specialist training/additional ratings;
- each activity is often associated with hire and reward, however, may be undertaken privately;
- there is no causal link between any of these activities and medical incapacitation; and
- for each activity, any additional medical risk relates to the increased severity of the consequences following a pilot's medical incapacitation.

The risk-assessment below therefore applies to towing of banners and drogues, sling load operations and glider towing.

Risk assessment

Table 16: If towing and sling loads were allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1.5	Medium risk	6
Cardiovascular event	Remote	3	Hazardous	4.5	Medium risk	13.5
Headache	Occasional	4	Minimal	1.5	Medium risk	6
Hypoxia	Remote	3	Major	3.5	Medium risk	10.5
Renal calculi	Remote	3	Major	3.5	Medium risk	10.5
Vestibular effects/disorientation	Remote	3	Major	3.5	Medium risk	10.5

Table 17: How do the medical risks associated with towing and sling loads compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1.5	1	0.5	6	4	2
Cardiovascular event	3	3	0	4.5	4	0.5	13.5	12	1.5
Headache	4	4	0	1.5	1	0.5	6	4	2
Hypoxia	3	3	0	3.5	3	0.5	10.5	9	1.5
Renal calculi	3	3	0	3.5	3	0.5	10.5	9	1.5
Vestibular effects/disorientation	3	3	0	3.5	3	0.5	10.5	9	1.5

Discussion

As stated above, with no causative link between these activities and medical incapacitation, we find no difference in probability of medical incapacitation between these activities and the base case.

In regard to severity of consequences of a medical event, we consider the logic used by the NPRM in the CAA's discussion of banners and drogues to apply for each of these cases – ie. the increased medical risk relates to additional damage following a pilot's incapacitation. If a pilot towing a banner, drogue or glider or carrying a sling load suffers from a medical incapacitation, the added complications surrounding towing the object may impede their ability to recover safely, increasing the chance of the medical event resulting in severe consequences.

In addition, sling load operations (depending on what is being lifted) and glider towing may each involve third parties. If a pilot suffers from a medical event, the potential for injury for those who are being towed or lifted increases the severity of consequences of the event. As a result, these activities are assessed as being associated with marginally higher medical risk than the base case.

Overall, our risk assessment finds towing and sling loads to involve marginally higher medical-related risk than the base case. However, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate those risks more than a DL9P.

10 Agricultural operations

Introduction

Agricultural-operations aviation is an important sector in New Zealand. Most agricultural-operations aviation is related to hire and reward, though it is also undertaken privately by farmers on their own land.

The restrictions on undertaking private agriculture operations are discussed briefly in point 3.42 of the NPRM. It states:

3.42 In order to gain an agricultural rating, a pilot must hold at least a PPL.

Agricultural operations are a significant contributor to occurrences in the New Zealand aviation sector.

Due to the risk and commercial nature of the activity, it is proposed that PPL pilots flying on the proposed DL9P medical certificate not be allowed to undertake agricultural operations.

Risk assessment

Table 18: If agriculture operations were allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1.5	Medium risk	6
Cardiovascular event	Remote	3	Hazardous	4.5	Medium risk	13.5
Headache	Occasional	4	Minimal	1.5	Medium risk	6
Hypoxia	Extremely improbable	1	Major	3.5	Low risk	3.5
Renal calculi	Remote	3	Major	3.5	Medium risk	10.5
Vestibular effects/disorientation	Remote	3	Major	3.5	Medium risk	10.5

Table 19: How do the medical risks associated with private agriculture operations compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1.5	1	0.5	6	4	**2**
Cardiovascular event	3	3	0	4.5	4	0.5	13.5	12	**1.5**
Headache	4	4	0	1.5	1	0.5	6	4	**2**
Hypoxia	1	3	-2	3.5	3	0.5	3.5	9	**-5.5**
Renal calculi	3	3	0	3.5	3	0.5	10.5	9	**1.5**
Vestibular effects/disorientation	3	3	0	3.5	3	0.5	10.5	9	**1.5**

Discussion

Aside from hypoxia/barotrauma, we do not find a causal link between private agriculture operations and medical events. In the case of hypoxia/barotrauma, probability of occurrence is considered lower than the base case because private agriculture operations tend to involve low altitude flying. It is therefore assessed as extremely improbable that a pilot develops this kind of altitude related illness while undertaking agricultural flying.

As for the severity of consequences, we have assessed each medical event as 0.5 points higher than in the base case. Private agriculture operations involve more take-offs and landings, flying lower to the ground and closer to potential hazards such as trees, powerlines and birds. If a pilot were to suffer from a medical events mid-air, they have less time and airspace to recover. As a result, the severity of consequences is assessed as marginally higher than in the base case. Aside from hypoxia, this leads to marginal risk ratings of 1.5 to 2 for each medical event.

Our risk assessment finds that due to the higher severity of the consequences of medical events, agricultural flying involves marginally higher risk than the base case. However, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate these risks more than the DL9P.

11 Night flying

Introduction

Night flying is an activity that pilots must train for and obtain a rating to undertake. There are currently no specific medical prerequisites to obtain a night rating.

On night flying, the NPRM states:

3.44 Night flying is more challenging than daytime flying, mainly due to lack of visibility and the difficulties of undertaking a forced landing.

It appears to be a low volume activity in the private flying community and is not traditionally considered a recreational activity.

3.45 CAA subject matter experts advise that pilots subject to less rigorous standards may be more susceptible to specific risks inherent in night flying, including vestibular effects, disorientation and other human factors.

In the class 1 and 2 medicals, pilots must undergo colour vision screening, which can lead to restrictions on night flying. As this is not part of the DL9P medical, if night flying were to be allowed on this medical certificate, the pilot would have to complete separate colour vision testing.

3.47 The third-party risk of flying at night is likely to be the same as during the day.

Landing at night in the case of a medical event is likely to be more challenging.

3.48 Feedback from submitters suggested night flying is a low volume recreational activity.

One submitter mentioned that the airspace is less crowded at night, providing a pilot more room to respond in a medical event.

3.49 The CAA stands by the need for a colour vision test, which would mean that private pilots on the DL9P medical certificate would require an additional test performed by a designated medical examiner at an extra cost.

The CAA consider that this would defeat the purpose of the proposal - to adopt an alternative medical standard for a segment of the PPL pilots that is associated with costs that are commensurate with the risk posed by those pilots.

3.50 While this is a low volume activity, it is proposed that pilots on the DL9P medical standard not be allowed to exercise the privilege of night flying.

Risk assessment

Table 20: If night flying was allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1.5	Medium risk	6
Cardiovascular event	Remote	3	Hazardous	4.5	Medium risk	13.5
Headache	Occasional	4	Minimal	1.5	Medium risk	6
Hypoxia	Remote	3	Major	3.5	Medium risk	10.5
Renal calculi	Remote	3	Major	3.5	Medium risk	10.5
Vestibular effects/disorientation	Remote	3.5	Major	3.5	Medium risk	12.25

Table 21: How do the medical risks associated with night flying compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1.5	1	0.5	6	4	**2**
Cardiovascular event	3	3	0	4.5	4	0.5	13.5	12	**1.5**
Headache	4	4	0	1.5	1	0.5	6	4	**2**
Hypoxia	3	3	0	3.5	3	0.5	10.5	9	**1.5**
Renal calculi	3	3	0	3.5	3	0.5	10.5	9	**1.5**
Vestibular effects/disorientation	3.5	3	0.5	3.5	3	0.5	12.25	9	**3.25**

Discussion

While the probability of most medical events is no different whether in the day or night, as stated in 3.45 of the NPRM, with low visibility and more potential issues like spatial awareness, night flying may increase the probability of vestibular illusion and disorientation. Vestibular/disorientation issues are however likely to decrease if a pilot is also trained in IFR (to be discussed in the next section).

Due to the difficulty of forced landing at night, we find the severity of consequences of each medical event to be higher than the base case. If a medical event were severe enough to require a forced a landing, as per point 3.44 of the NPRM, low visibility would seriously impact on a pilot's ability to do so safely. Most medical events, however, are unlikely to be severe enough to require a forced landing. The large majority may instead require the pilot to bear through significant pain as they return to their airfield. Considering the average of each possible medical scenario, we assess the severity of consequences to be 0.5 higher than the base case for each event.

Except for vestibular effects/disorientation, we find all of the additional risk relating to night flying to be related to the difficulties of forced landing in the event of a medical incident. We also note the low occurrence of medical events likely to require a forced landing. Nevertheless, overall, we find some increased risk of medical events associated with night flying. However, as with agricultural aviation, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate these risks more than the DL9P.

12 Instrument Flight Rules

Introduction

Instrument flight rules (IFR) involves flight where the pilot is solely reliant on reference to the instruments on the flight deck. IFR is a more challenging form of flight than VFR (visual flight rules) and pilots cannot fly IFR without extensive training and holding the IFR rating. PPL pilots can currently attain and use the privileges of an IFR rating, however, they must also pass a class 1 medical certificate hearing test.[15]

In regard to IFR, the NPRM states that:

3.56 IFR flying adds an additional layer of complexity.

To conduct this type of flight, a pilot needs a high standard of hearing, eyesight and good reaction times.

3.57 The subject matter experts advise that IFR increases stress levels for pilots flying in controlled airspace.

There are risks associated with vestibular influence, disorientation, and other human factors that become a significant factor when flying solely on instruments.

3.58 Given the large number of commercial aircraft operating under IFR, there is an increased risk that a PPL pilot on the DL9P will have to interact with other IFR users. This has the potential for serious conflict with commercial traffic, increasing the risk of an accident.

3.61 There is only one recorded accident of a private pilot flying IFR where there were medical issues, which had no causal link between IFR and the accident. The low number of accidents is likely in part due to the low number of private pilots undertaking this activity.

3.61 As more IFR planes enter the country, it is anticipated that IFR flying will become more common in New Zealand.

3.62. Given the complexities and risk associated with IFR flying, it is proposed that pilots on the DL9P medical standard not be allowed to fly IFR.

[15] It is noted that the DL9P medical certificate also includes such a hearing test.

Risk assessment

Table 22: If IFR flying was allowed on the DL9P medical, what is the assessed risk of a medical event?

Medical event	Probability of occurance		Severity of consequences		Risk rating	
Gastrointestinal illness	Occasional	4	Minimal	1	Low risk	4
Cardiovascular event	Remote	3	Hazardous	4	Medium risk	12
Headache	Occasional	4	Minimal	1	Low risk	4
Hypoxia	Remote	3	Major	3	Medium risk	9
Renal calculi	Remote	3	Major	3	Medium risk	9
Vestibular effects/disorientation	Remote	3	Major	3	Medium risk	9

Table 23: How do the medical risks associated with IFR compare with the base case?

	Probability of occurance			Severity of consequences			Assessed risk rating		
Medical event	This case	Base case	Δ	This case	Base case	Δ	This case	Base case	Marginal risk
Gastrointestinal illness	4	4	0	1	1	0	4	4	**0**
Cardiovascular event	3	3	0	4	4	0	12	12	**0**
Headache	4	4	0	1	1	0	4	4	**0**
Hypoxia	3	3	0	3	3	0	9	9	**0**
Renal calculi	3	3	0	3	3	0	9	9	**0**
Vestibular effects/disorientation	3	3	0	3	3	0	9	9	**0**

Discussion

We find no link between the probability of a medical event and flying IFR. In the NPRM, the CAA mentions risks associated with vestibular influence and disorientation as significant risks when flying IFR. However, if a pilot is properly trained to fly on instruments, (which IFR pilots are), they should in fact be less likely to suffer from these medical issues. The pilot in the base case for example, who is flying VFR, seems far more likely to have a vestibular/orientation issue should they, for example, accidentally fly into clouds. They do not have sufficient training to navigate using instruments, which may cause them to lose situational awareness and result in an incident. With 40 hours of training in flying without visual references, annual flight checks and no requirement to rely on the view from the cockpit in order to fly their plane, we do not consider IFR pilots more at risk of vestibular/orientation issues.

The NPRM also mentions increased stress levels for IFR flyers in controlled airspace. On this point, we consider that whether a pilot has increased stress levels while flying IFR is a matter of training and frequency of use. We are not aware of any evidence that a pilot who has undertaken the proper level of training and proven their competency annually in this activity will find it significantly more stressful than a VFR flight. The sense of security an IFR pilot may feel from knowing they can fly the plane safely regardless of visibility may even result in lower stress levels for IFR pilots, and reductions in overall risk.

In regard to severity of consequences of a medical event, we do not find any difference between flying IFR and the base case. Provided a pilot is properly trained to fly the aircraft they are in control of; we see no difference in consequences of a medical event between a VFR and an IFR flight.

Ultimately, we find no difference in risk related to medical events between IFR flying and the base case. Having found no additional risk to mitigate, we find no demonstrated reason to exclude IFR from the DL9P medical standard.

13 Conclusions

As stated in the Ministry of Transport's 2012 'Transport Regulatory Policy Statement':

"Transport regulatory activities are risk-based – risk assessment and empirical enquiry precedes and informs all aspects of regulatory development, design and implementation."

Despite this principle, our review of the CAA's NPRM has found inconsistencies in the way the risks associated with different privileges have been assessed; points which appear to be unsubstantiated/potentially inaccurate; and an overall lack of clarity in the CAA's framework and methodology for assessing risk.

In this report we employ a conventional risk-assessment matrix to systematically analyse the risk related to a number of privileges that face restrictions under the proposed DL9P medical standard. We find:

- no additional medical-related risks associated with multi-engine aircraft, pressurised aircraft, parachute operations or IFR;
- a lack of a causal link in general between private agriculture operations; towing/sling load operations; and night flying and the occurrence of a medical event. [16] However, these activities were found to involve marginally higher risk than the base case due to higher severity of consequences if a medical event were to occur; and
- aerobatics was found to involve marginally higher risk than the base case due to the potential for gravitational effects to increase the probability of some medical events.

For the privileges where we find no additional risk in need of mitigation, we consider there to be no benefit from excluding this privilege under the DL9P medical standard. In the case of multi-engine, pressurised aircraft and IFR, our analysis indicates that this privilege may well reduce risk, in which case permitting rather than restricting these privileges would benefit overall safety in the sector. For some privileges (eg, aerobatics and towing and sling loads) we found marginally higher risk than the base case. However, we have not seen any evidence presented in the NPRM that demonstrates that the class 2 medical assessment would mitigate those risks more than the DL9P.

[16] In the case of night flying, the only exception to this was vestibular effects/disorientation, where we find a possible causal link between night flying and these medical events.

Appendix 1: Privileges and limitations on the current RPL

Privileges: The pilot may:	• act as pilot-in-command of a single engine non-pressurised aircraft with a MCTOW of 2000kg or less, for which the pilot holds an aircraft type rating • act as pilot-in-command of a single engine helicopter with a MCTOW of 1500kg or less, for which the pilot holds an aircraft type rating • carry a passenger, provided the passenger has been informed that the pilot does not hold a medical certificate issued under the Act.
Limitations: The pilot must not act as pilot-in- command or as co-pilot of an aircraft:	• operating outside New Zealand • for remuneration • carrying more than one passenger • if the aircraft is being operated: - for hire or reward - at night - under instrument flight rules (IFR) - into or out of a controlled aerodrome unless the licence holder has provided evidence of colour vision screening test - over a congested area of a city or town, except for of take-off and landing • if the aircraft is conducting: - an air operation - a glider tow operation, where the glider is being operated for hire or reward - a parachute drop operation - an agricultural aircraft operation - an aerobatic flight - a banner tow operation - a drogue tow operation - a sling load operation