EPAS 2020-2024

Best Intervention Strategy for "Road/Gyroplane"

Advisory Body Consultation from 11 July to 16 September 2019

Status	Draft	Yes	1st ESC	1 July 2019	AB	In progress	Final (after 2nd ESC)	tbd	Comments: n.a

A Best Intervention Strategy report with a Full Impact Assessment (IA) is to be developed before the initiation of the Rulemaking Task Terms of References. It ensures that a rulemaking task is duly justified to streamline the rule adoption at EASA Committee level.

These are questions to assess the support of the proposed regulatory changes for gyroplanes:

Question 1 - Do you support that EASA issues an Opinion in 2020 to address the regulatory gaps identified in this report?

- Yes / No => if no, please provide comments

Question 2 – From your point of view, for each rule domain: is the regulatory proposal mature for a prompt and smooth adoption at EASA Committee level?

	Scale for the maturity of a regulatory proposal 1 – very far from adoption 2 3 4 5 – Very close for adoption
CAW	
FCL	
OPS	

Question 3 – Do you perceive obstacles for adoption of these regulatory proposals? If yes, could you explain them?

- answer : free text

There are also additionnal questions inserted in the report for specific items.

All comments to this BIS report and answers to these questions are to be answered in a separate file attached to the consultation email.

Note

The rule proposal was initiated by CAA NL. EASA assessed if they could be part of this report at least as an initial proposal. There are 2 cases:

1) When the NL proposals have not been further amended by EASA, there is the mention "NL initial proposal".

2) When the NL proposals were reviewed by EASA (and possibly amended), there is the mention "NL initial proposal reviewed by EASA".

In both cases, these rule proposals have to be seen as initial proposals to be commented by the Advisory Bodies. Then EASA will review the comments and may decide* to set up an expert group involving Competent Authorities and stakeholders before a final rule text is proposed.

**This decision should be taken in October 2019.*

Best Intervention Strategy for “Road/Gyroplane”

Executive Summary

1 - Why to intervene?

With the EASA Basic Regulation adopted in 2018 (Regulation (EU) 2018/1139), gyroplanes above 600 kg MTOW are now in the scope of EASA framework. The gyroplanes below 600 kg MTOW are still addressed by national rules.

The EASA framework to cater for gyroplanes is adapted for the initial airworthiness (IAW) domain, i.e. gyroplanes can be certified without a specific amendment to certification rules in Part 21 of Regulation (EU) 748/2012. However, other Implementing Regulations (e.g. Continuous Aiworthiness, Flight Crew Licensing, OPS.) are not adapted for gyroplane operations.

Currently EASA is in the process of certifying the PAL-V (Personal Air and Land Vehicle) and the project has reached a mature development. Therefore it is now decided to start assessing to which extent the rules need to be amended.

In addition the PAL-V brings a new concept with the the dual transport usage of this vehicle. It can either be operated on the road or in the air. This was never addressed in an EASA certification project or in the European aviation regulatory framework before. Also this aspect needs to be part of the rulemaking assessment.

2 - Summary of the best intervention strategy

General

To ensure that EASA and Advisory Bodies resources are efficiently used:

1. The planning for new rules may be adapted if the certification timing is delayed;
2. The scope of the rules has to match the certification needs;
3. Advisory Bodies support is expected to be significant to streamline and facilitate the changes to the rules. It can be either through initial rules proposals by at least one Member State and/or stakeholder or by commenting to the rules proposals and their justifications.

Gyroplane case

1. PAL-V is intended to be certified by 2020/Q2, however this timing is considered very challenging.
2. The current need is to develop NCO VFR day/night rules for gyroplanes. Going beyond this scope would require additional ressources which are not available. This will be reconsidered in the future if there would be SPO or CAT gyroplane operations.
3. The initial rules proposals in this report have been provided by the Ministry of Infrastructure and Water Management of the Netherlands on 12 February 2019.

Actions per rule domain

CAW, FCL and OPS are the rules domains where gyroplane could require new developments. No change require for ATM and aerodromes rules.

3 - Next steps

At the end of the BIS consultation period, a summary of the AB comments with an assessment of the available ressources and the status of the certification process will form the main inputs to decide on the next rulemaking step (e.g. NPA and/or Opinion schedules).

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Introduction

The current regulatory European aviation safety framework has been designed for conventional fixed wing, rotorcraft, balloons and sailplanes. It relies for instance on human being in the loop assisted by automation, be it on board or on the ground, and propulsion is foreseen to be only piston and turbine engine.

The introduction of new technologies and concepts of air transport (from multi-modal vehicle to autonomous vehicles) requires to revisit this framework. The purpose of a new RMT is to develop rules or amend existing ones, where necessary, to address new technologies and operational air transport concepts, with the objective to be agile and to adapt the regulatory framework in line with Performance Based Regulations principles. The resulting framework should be operation centric and address the total aviation system.

This RMT is now included in the draft EPAS 2020-2024: "RMT. 0731 - New Air Mobility". EASA is still at conceptual phase with regards to the set-up of this RMT. It is expected to have a concept of operations decided by the time EPAS 2020-2024 will be finalised. This RMT is expected to lead to different streams of activity. For instance, draft rules for gyroplanes (type of aircraft currently not addressed by EASA rules), including interfaces with multi-modal operational solutions (e.g. flying car), is one of such streams. A general principle that will govern this RMT is to ensure that future requirements are technology-neutral where possible, while ensuring legal certainty.

The current Best Intervention Strategy (BIS) report is aimed at providing justifications and initial rule proposals for a dual transport mode vehicle with road and gyroplane transportation capabilities. The RMT.0731 justification starts with this topic as it is the most advanced in terms of rule proposals.

1 Issue analysis

1.1 Why does EASA need to intervene?

With the EASA Basic Regulation adopted in 2018 (Regulation (EU) 2018/1139), gyroplanes above 600 kg MTOW are now in the scope of EASA framework. The gyroplanes below 600 kg MTOW are still addressed by national rules[1].

The EASA framework to cater for gyroplanes is only adapted for the initial airworthiness (IAW) domain, i.e. gyroplanes can be certified without a specific amendment to certification rules in Part 21 of Regulation (EU) 748/2012. However, other implementing Regulations are not adapted for gyroplane operations falling in the field of other rule domains (e.g. Continuous Aiworthiness, Flight Crew Licensing, OPS.).

Currently EASA is in the process of certifying the PAL-V (Personal Air and Land Vehicle)[2] and the project has reached a mature development. The Type Certificate is envisaged for 2020/Q2 (however this is only indicative and is considered very challenging, delays could occur as for any certification project).

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[1] Gyroplanes were not exluded from EASA scope in the first Basic Regulation 1592/2002 annex II. However the revision of the Basic Regulation 216/2008 Annex II excluded gyroplanes when MTOM was below 560 kg. According to Annex I point 1 (f) of current Regulation 2018/1139, single and two seater gyroplanes with a MTOM not exceeding 600 Kg are not subject to the NBR but to national rules.

[2] https://www.pal-v.com/

The Agency has also received another application for a gyroplane above 600 kg MTOW, however the certification has not yet started.

Therefore it is now decided to begin with this report the assessment to which extent the rules needs to be amended.

In additionl the PAL-V brings a new concept with the the dual transport usage of this vehicle. It can either be operated on the road or in the air. This was never addressed in an EASA certification project or in the European aviation regulatory framework before. Also this aspect needs to be addressed in the rulemaking assessment.

1.2 Scope for the gyroplane rules and gyroplane definition

1.2.1 Scope

Based on the need of PAL-V (and the potential other projects not yet started), the scope is to amend the rules to include gyroplanes Non Commercial Operations with VFR Day/Night flights.

This rather limited scope creates already significant constraints in terms of workload for the rulemaking planning and potential issues at EASA Committee level with the number of Opinions to be approved per year.

On a longer term, other types of operations and also IFR capabilities could be envisaged, however it is proposed to addressed that when the needs would be more materialised.

1.2.2 Gyroplane definition

“Gyroplane” means a heavier-than-air aircraft supported in flight chiefly by one or more non-engine-driven rotors.

Note: Gyroplane is part of the rotorcraft product family.

1.3 Gyroplane development

1.3.1 Facts on current gyroplane activity status below 600kg MTOW

The gyroplanes have been so far only addressed by national rules. EASA would like to gain knowledge on this activity with general facts. **The following questions can be answered in the comment file attached to the consultation email.**

Questions for NAAs (MAB - Member State Advisory Body and its related committees)

- Rules
  - MS current framework: are there rules at national level already existing for gyroplanes?
  - If yes, what do they cover? CAW, FCL, OPS
- Fleet
  - Number of gyroplanes registered & Flight Hours
  - Fleet profile according number of seats, date of manufacturing, MTOW
- Pilot training
  - Number of gyroplanes pilots and instructors (and what other license they have)

  - Number of training organisation for gyroplane
- Maintenance
  - Number of maintenance organisations with gyroplane maintenance
  - Number of maintenance staff involved in gyroplane work
  - which types of (national) licences?
  - Number of maintenance training organisations addressing gyroplane
- Competent Authorities
  - Please provide information on potential gyroplanes projects which could fall under EASA certification.
  - Number of CA experts dealing with gyroplane maintenance and gyroplane pilot licenses
  - What is the estimated number of estimated number of hours spent by CA experts on gyroplane?
  - What would be an estimated cost and number of hours to be spent by CA experts to set up the relevant activities for the gyroplanes now in EASA scope?
    - One-off hours (to initiate the change once the new European common requirements have been adopted)
    - Recurrent hours (after rules have been implemented)
    - Other costs (IT, …)
- Rules of the Air
  - For the airspace under your responsibility, are they any specific derogations for gyroplane regarding SERA rules?

Questions for the industry (SAB - Stakeholder Advisory Body and its related committees)
  - Please provide information on potential gyroplanes projects which could fall under EASA certification.

1.3.2 Gyroplane products in EASA scope

1.3.2.1 PAL-V development

<u>**Information from PAL-V:**</u>

"Key financial indicators of PAL-V company
Developing, selling, maintaining and training for flying car products is the only activity of PAL-V. By now about €50,0 mln has been invested. This comes from investors in 5 European countries plus grants, loans and subsidies from the Dutch Government and from the European Union. As the company has only been developing the flying car technology and products since its start the company has no turnover yet. Turnover is expected to grow to €380 million in it first 5 years of production.

Number of Staff
About 70 people are working directly for the company: 50 engineers, 10 persons marketing and sales and 10 in purchasing and production preparation and indirects. Total number of employees is expected to grow in 5 years time to over 600 people.

Partner suppliers
PALV is integrating the technology of partners from quite a number of European countries. Partner suppliers develop components and systems for PAL-V. PAL-V is only doing final assembly. It is estimated that at the moment another 150 persons are doing activities for PAL-V in companies in European countries. Partner suppliers for PAL-V are at the moment located in the following European countries: Netherlands, UK, Spain, Belgium, Germany, Austria, Italy, France, Slovenia, Poland.

Production capability

Number of PAL-V unit per month

Initial production capacity will be 100 Units per year. This is planned to be growing in 5 years time to 1300 per year in the base case. Delivery of the first vehicles will start within a month after the EASA TC has been issued.

Factory location

Final assembly is in the Netherlands. Parts supply and assembly of subsystems is done in Netherlands, UK, Spain, Belgium, Germany, Austria, Italy, France, Slovenia, Poland.

Customer per country

There is a continuously growing order book. Most of current PALV buyers are non-pilots (80%). The first customers have started to train for their license. Current customers are form the following European countries: Netherlands, UK, Finland, Germany, Belgium, Spain, Switzerland, Poland, Slovenia, France, Greece.”

EASA Certification development status

Currently, the PAL-V Type Certificate is foreseen for 2020 Quarter 2. This is considered very challenging in terms of timing.

1.3.2.2 Other gyroplane projects under EASA scope

Other models which could fall under EASA certification are for instance from TRENDAK company: e.g. http://www.trendak.eu/en/modele/t6-prototype/ .

This does not preclude that these models are under the process to be certified by EASA.

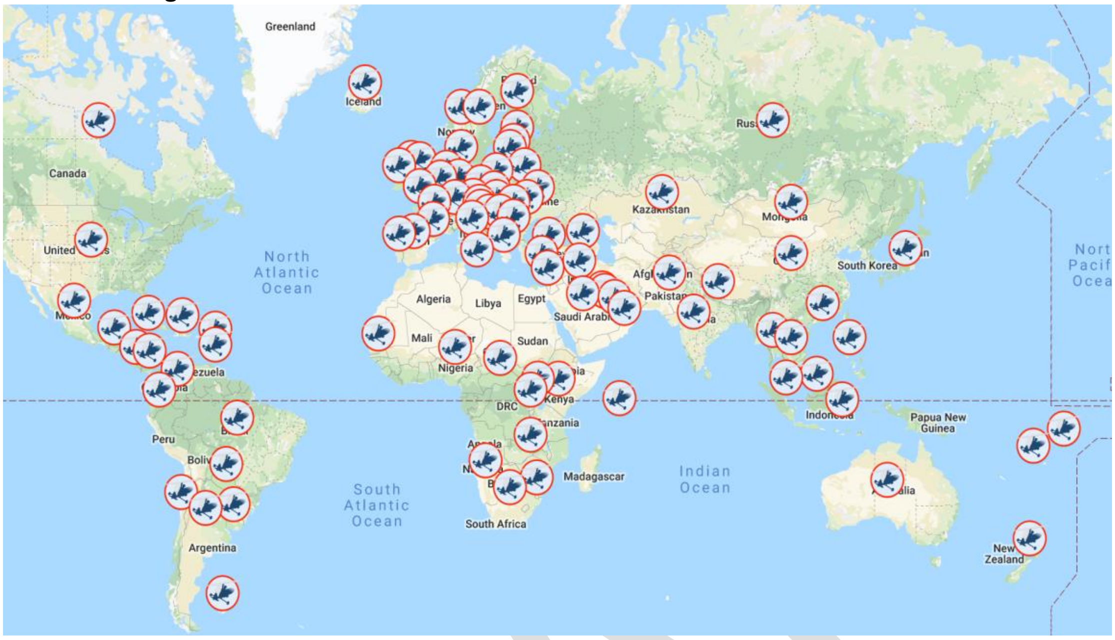
1.3.3 Industry support for rule development

1.3.3.1 Flight crew licensing

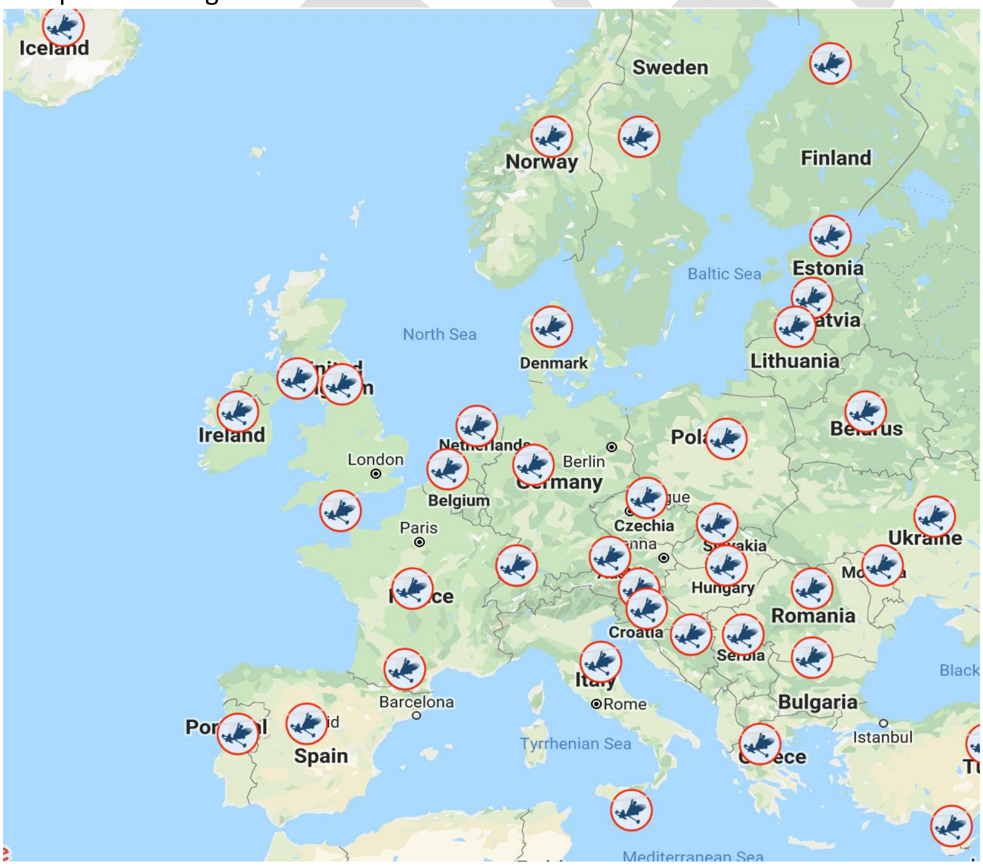
Gyroplane training industry started in 2013 a collaboration project known as The International Association of Professional Gyroplane Training (IAPGT) (https://iapgt.org/). There are currently 2907 members (pilots and instructors) in the Association from 97 countries who have joined since 1st April 2013.

There are some individuals registered who work for regulators but they do not necessarily contribute in their official capacity. Normally they register to review the content (high level) as part of their information gathering on gyroplanes. It is an ‘instructor to instructor’ collaboration system.

World coverage view:



European coverage view



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In 2015 a conference was held with the following global objectives:

Global Objectives

In the early years Gyroplanes had a poor reputation for safety. Over the past 10 years perceptions of Gyroplane safety have improved dramatically and the skepticism is slowly being reduced. However, with such rapid expansion in the availability of factory built Gyroplanes existing expertise in flight training is being, and will continue to be, diluted. It is vital that all, including the very newest, Gyroplane Instructors instruct to high standards and Gyroplane Pilots fly safely.

Failure to train good quality instructors will eventually lead to a downward spiral of pilot skills, an increase in the number of accidents and a regression in our reputation. The Gyroplane Community/Industry may be sitting on a ticking time-bomb.

The Gyroplane Industry must work together to recognize this and do whatever they can to protect the safety of pilots and the reputation of the industry. The IAPGT project is a vehicle to achieve this and this conference is key for planning the implementation.

This conference enables the set up of a common gyroplane pilot training syllabus and common instructor requirements. This is the main input for the draft training syllabus proposed for Advisory Body consultation (see section 10.3.2).

IAPTG maintains a syllabus cross-country reference such as:

International Standard Lesson Structure

	Instructor Course	ASRA	CH	CZ	DE	LI	UK
Stage 1 : The Fundamentals of Gyroplane Flying							
Lesson 1 : An Introductory Flight in a Gyroplane	ICF1		AS 3	1	Ex 3	1	Ex 1a
Lesson 2 : Essentials Plus Basic Skills 1 - Turning Left and Right to Follow Features at a Constant Speed	ICF1	4	AS 5	2	Ex 4	2	Ex 1b
Lesson 3 : Basic Skills 2 - Flying in Trim, Maintaining Height and Flying in Balance	ICF1	5	AS 5	2	Ex 4	2	Ex 1b
Lesson 4 : Basic Skills 3 - Ground Handling and Introduction to Pre-Flight Planning	ICF0	2 3	AS 4	2	Ex 2 Ex 5a Ex 5b	2	Ex 1c
Stage 2 : General Handling							
Lesson 5 : Developing Muscle Memory - Coordinating Stick and Pedal with Power Changes	ICF2	5	AS 5	2	Ex 4	2	Ex 1d
Lesson 6 : Coordinating Throttle and Pedal to Maintain Height, Speed and Balance when Turning	ICF2	8	AS 6	2	Ex 10	3	Ex 2c
Lesson 7 : The Effect of Wind when Flying in a Straight Line	ICF3	5	AS 6	2	Ex 6	2	Ex 2a
Lesson 8 : Fine Tuning Accuracy when Maintaining Height and Speed	ICF2	5		2	Ex 6	2	Ex 1d
Lesson 9 : Climbing and Descending to Pre-Determined Levels	ICF3	6 7	AS 7	2	Ex 7 Ex 8	2	Ex 2d
Lesson 10 : Climbing and Descending Whilst Turning	ICF3	8	AS 7	6	Ex 11	4	Ex 2e
Lesson 11 : Purposefully Increase and Decrease Speed Between Slow Cruise and Fast Cruise	ICF3	5	AS 6	2	Ex 6	2	Ex 2b Ex 6d
Stage 3 : Flying at the Airfield							
Lesson 12 : Flying the Circuit Pattern and Going Around	ICF5	11	AS 12	3	Ex 13	5	Ex 2f
Lesson 13 : Take-Offs 1 - Rotor Management	ICF4	3 10	AS 11	3	Ex 12	5	Ex 3a Ex 6h
Lesson 14 : Take-Offs 2 - Wind Close to the Runway Heading, Landing Ahead	ICF4	10	AS 11 AS 15	4	Ex 12	5	Ex 3b Ex 3d
Lesson 15 : Take-Offs 3 - Different Weather Conditions and Ground Surfaces	ICF4	10	AS 11	9	Ex 19	5	Ex 6a
Lesson 16 : Landings 1 - Wind Close to the Runway Heading	ICF5	12	AS 13	4	Ex 13	5	Ex 3c
Lesson 17 : Landings 2 - Different Wind Conditions and Ground Surfaces	ICF5	12	AS 13	9	Ex 19	10	Ex 6b
Lesson 18 : Landings 3 - To be Able to Land Close to a Designated Point with Power Available	ICF5	12	AS 14	5	Ex 13	7	Ex 3e
Lesson 19 : Landings 4 - To be Able to Land Close to a Designated Point when Power is at Idle	ICF5	12	AS 14	16	Ex 13	5	Ex 6b
Stage 4 : Advanced Handling							
Lesson 20 : Departing and Arriving at Airfields	ICF6	11	AS 12	2	Ex 23	19	Ex 7a
Lesson 21 : Slow Flight at Level Altitude and Flying Stationary in Relation to a Ground Reference (Helicopter Mode)	ICF6	9	AS 8	6	Ex 9b	6	Ex 6c
Lesson 22 : Descending at Slow Airspeed on Idle Power (Parachute Mode)	ICF6	8	AS 9	6	Ex 9b	4	Ex 6e
Lesson 23 : Higher Bank Angle Level Turns and Turning in Relation to Ground Reference Features	ICF6	8	AS 10	6	Ex 16	4	Ex 6f
Lesson 24 : Avoiding, Recognising and Recovery from Unusual Attitudes	ICF6	9	AS 16	10	Ex 9b	9	Ex 4e
Lesson 25 : The Dangers Associated with Low Flying	ICF6			10	Ex 18		Ex 6g
Lesson 26 : Consolidation of General Handling, Pre-flight Preparation and En Route Airmanship	ICF8	17	AS 2	10	Ex 23	19	Ex 2g

Stage 5 : Emergencies							
Lesson 27 : Emergencies 1 - Coping with In-Flight Issues	ICF7	13	AS 16	7	Ex 22	11 9	Ex 4d
Lesson 28 : Emergencies 2 - Making a Precautionary Landing	ICF7	14	AS 16	7	Ex 20	8	Ex 7b
Lesson 29 : Emergencies 3 - Landing Safely Should the Engine Stop in Flight	ICF7	13	AS 16	8	Ex 21	9	Ex 4a Ex 7c
Lesson 30 : Emergencies 4 - Being Prepared, Should the Engine Stop when Flying in the Circuit Pattern	ICF7	13	AS 16	8	Ex 21	9	Ex 4b Ex 4c
Stage 6 : Solo Flying							
Lesson 31 : Checking you are Ready for your First Solo Flight		15	AS 18	11	Ex 13	12	Ex 5a
Lesson 32 : Your First Solo Flight	ICF8	15	AS 18	12	Ex 14a	13	Ex 5b
Lesson 33 : Consolidating your Skills when Flying Solo		15	AS 18	14 15	Ex 14b	15 16 17 18	Ex 5c
Stage 7 : Cross-Country and Navigation							
Lesson 34 : Navigating and Flying a Route Without Getting Lost		18	AS 17	18	Ex 23	19	Ex 7d
Lesson 35 : Landing at Airfields Other Than the Home Airfield		11	AS 17	18	Ex 23	20	Ex 7a
Lesson 36 : Consolidating your Navigation Skills - Flying Solo		18	AS 17	19	Ex 23	21	Ex 7d
Lesson 37 : Flying the Navigation Flights Required Prior to your Pilot Licence Issue		18	AS 17	20	Ex 23	21	Ex 7e
Stage 8 : Preparation for the Flying Test							
Lesson 38 : Preparation for Your Flying Check Flight with an Assessor	ICF8	16	AS 19	17		14	Ex 8a

Analysis from current approaches in Member States and credits from other licences

(Status in 2015, no change versus 2019 according IAPGT)

The following is extracted from the “Working paper for gyroplane licensing wrt PAL-V for EASA”, PAL-V, paper reviewed by Phil Harrwood

“The following Member States have significant experience with Gyrocopter: UK, Germany, France and Spain with a combined fleet of 1000-2000 Gyroplanes in use and many decades of experience. A more detailed description can be found in Annex E, but the summary shows the following.

*1. In the **United Kingdom** the CAA has made a separate category for the Gyroplane: the PPL(G). In many aspects the requirements are identical to the Aeroplane licence. There is no difference in crediting based on an Aeroplane or Helicopter licence.*

*2. Within **Germany** the Gyroplane is a separate category within the Pilot Sport Licence structure (Tragschrauber). The crediting towards a Gyroplane licence with an Aeroplane licence is bigger than with a Helicopter licence.*

*3. In **France** the Gyroplane licence is a separate category within the Micro Light licence. There is no credit difference whether coming from an Aeroplane licence or a Helicopter licence.*

*4. The same applies to **Spain.** The Gyroplane licence is a separate category within the Micro Light licence. There is no credit difference whether coming from an Aeroplane licence or a Helicopter licence.*

*Outside Europe many countries like **Australia, New-Zeeland** and **South Africa** follow the United Kingdom system. The **United States** has a similar requirements with a licence structure for the Gyroplane consisting of the Rotorcraft category with Gyroplane class rating.*

*In the **Netherlands** the Gyroplane falls under the helicopter licence structure as a class rating with the following definition. "a Gyroplane is a helicopter of which the rotor is not driven by the engine[3].*
There is no difference in crediting for Aeroplane or Helicopter experience.

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3 Wet Luchtvaart

The current situation is that different Member States treat the Gyroplane in different ways (see for more information on the national licences Annex E). Based on crediting it can be seen that the Gyroplane overall is regarded as a separate category with most similarities to an Aeroplane. "

1.3.3.2 Other rule domains

Apart from the training development with IAPGT, there was no such attempt for international harmonization regarding other rule domains (OPS, CAW, …).

1.4 Safety analysis

This chapter provides safety risk assessment of the gyroplanes to support the decision making for this Best Intervention Strategy.

As there is no certified in service gyroplane with maximum take-off mass above 600 kg, safety risk assessment is based on in-service gyroplanes of so called 2nd generation[4]. First generation gyroplane accidents are not taken into account as they are considered as legacy and might not be representative as safety issues have been corrected and addressed by design improvements over the time.

Results are compared and put in the context with analysis results from IAPGT for the gyroplane accidents that occurred in the UK (2006-2018), used to support their syllabus for pilots. For more information, please refer to section 10.5.

Safety risk assessment will be indirectly extrapolated towards the future gyrioplanes with MTOW>600 kg and of dual use (aircraft/car).

1.4.1 Current safety analysis based on gyropanes < 600kg

This analysis will focus on gyroplane accidents recorded in the European Central Repository of civil aviation occurrences and EASA occurrence database (2009-2018). The reason is a better data quality and availability of information of the causes of these accidents. They are also exposing real risks that have resulted in the accidents for the present (non-certified) in-service fleets.

> NOTE: the data represented there is based on the information available in the ECR and it is subject to the data quality of the records as provided/coded by different authorities integrating this information to the ECR. E.g. 40 of all the accidents have no event coded, these are not appearing in the analysis of events below.

The subset for this analysis comprises 279 accidents recorded, out of which 63 were fatal and 216 – non-fatal accidents. Incidents were not included in this assessment.

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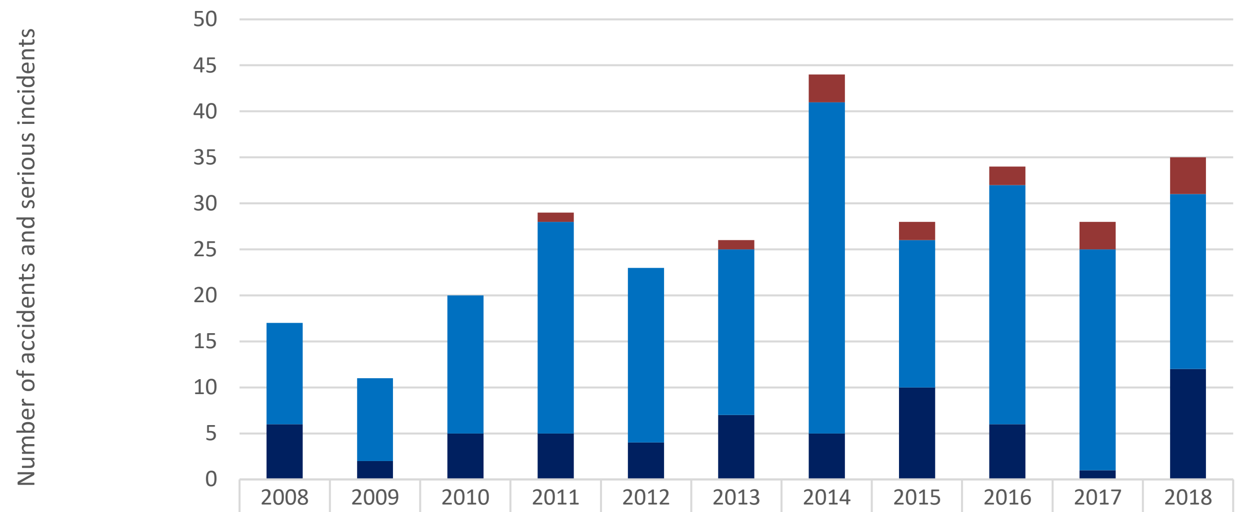
[4] Accidents involving single seat gyroplanes (mostly Benson), RAF2000 and VPM have been excluded from this analysis report as these are considered legacy gyroplanes (1st generation) and not indicative of the standards of factory built gyroplanes, the standard closest to the type of gyroplanes that will require an EASA Gyroplane Pilot Licence.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Serious incident				1		1	3	2	2	3	4
Non Fatal Accident	11	9	15	23	19	18	36	16	26	24	19
Fatal accident	6	2	5	5	4	7	5	10	6	1	12

Figure 1.4-1: Shows the distribution of gyroplane accidents and serious incidents recoreded in the ECR for years 2009-2018. *Source ECR & EASA DB.*

The averge number of fatalities has been around 7 fatalities a year. There is an increased number of fatalities recorded in 2018 [13][5] in comparison to year before - 2017 [1].

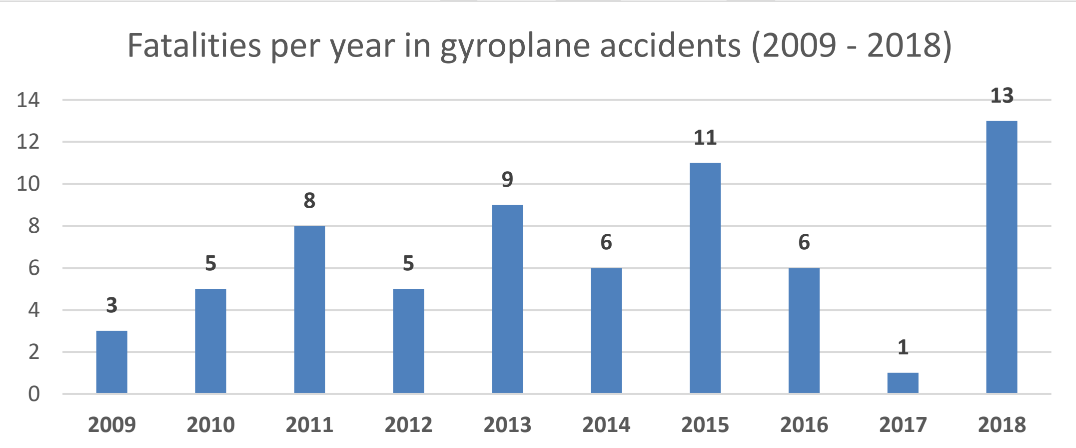


Figure 1.4-2: Distribution of fatalities/serious injuries per year (2009-2018). *Source ECR & EASA DB.*

__Overview – all accidents[6]/all events__

This section is composed of events analysis for the accidents to detect the most common safety issues. Severity can be considered high as this information is based on realized accidents. The number of events encountered in the scenarios show the frequency.

[5] Number for safety information are given between [ ]

[6] There can be more than one event recorded per occurrence, as events represent what occurred during an occurrence in a chronological order.

Filter:	
UTC YEAR	(Multiple Items)
Event type [Instance Identifier]	(All)
Occurrence class	Accident
Total fatalities	(All)
PHASE	(All)
Results:	
Event type	**Count**
Operational	**373**
Consequential Events	**160**
Equipment	**79**
(blank)	**40**
Personnel	**37**
Unknown	**16**
Any Other Events	**4**
Organisational	**1**
Grand Total	**710**

Figure 1.4-3: Distribution of all events for accidents (2009-2018). *Source ECR*.

Overview of all accidents (2009-2018) and all events is depicted in the Figure 1.4-3. Majority of events are Operational [373], and Equipment [79] related. Consequential events are the ones which most probably accounted for the damages or injuries following triggering events.

Vast majority of the Operational occurrences are Aircraft Flight operations related such as Aircraft Upset (Dynamic roll-over [16], deviation bank/roll or directional control), Aircraft handling (Hard landing [14], Rotor strike, speed control – low speed), terrain/obstacle conflict (collisions with terrain/obstacles), and Weather and environmental encounters (cross-wind, tailwind, high wind). Others have been Abrupt manoeuvre and ground conflict related. There have been also a few Aerodromes operations related events.

For Equipment related events, the majority are attributed to reciprocating engines [23] and Fire events. This is followed by landing gear system issues.

Personnel related events are attributed to personnel decision making and actions, Situational awareness, experience and knowledge events.

Majority of the consequential events account for damage to aircraft and injuries. For flight ops outcomes – Nose down overturns [19]; precautionary landing. Emergency situations – forced landing [29].

The type of safety issues that are more specific for gyroplanes:

1. **Operational issues**
   a. **Low and slow flight [4]**
   Although gyroplanes can fly slowly this is not without risk. There is a certain airspeed at which, if not maintained with full power, the gyroplane will descend. The descent can initially be quite slow and therefore it is easy for the pilot to be unaware it is happening. Pilots can be distracted or a contributor can be cross-wind/tail-wind. The experience of the pilots plays a role to identify these situations and act. This type of accident is particular to a gyroplane.
   There have been 4 accidents related with Low speed. [2] cases where attributed to Personnel / Experience and Knowledge Events / Qualifications and Experience Events / Recent

Proficiency/Experience. Also Tail wind encounter caused a deviation form intended airspeed. In one case Recent instruction/training and erroneous airspeed indicator had led to a too low speed.

b. Execution of a Takeoff

It appears that Takeoff phase is the most critical phase where the majority of accidents have occurred [74]. The technique for taking off in a gyroplane is different from that for fixed wing. A significant number of these accidents involve fixed wing pilots with a high number of flying hours. When the workload is increased in a takeoff situation, it is likely that the pilots ‘revert to type’ and takeoff as if it were a fixed wing. Safety issues at Takeoff can be listed as follows:

a) Attributed to take off techniques:
   a. Taking off in strong winds in prerotation with no forward speed
   b. Take-off from a wet grass surface
   c. Failure to recognize that rotor RPM are decaying – swith between prerotation (after disconnecting the prerotator) and rotor acceleration [3]
   d. Taking off with stick forward
   e. Take of with nose excessively high during rotation (unsticking)
   f. Failure to achieve the safe climb-out speed before initiating the climb

c. Execusion of an approach/landing

Approach and landings are the second critical phases, where accidents occurred. These are the main

a) Roll over during excessive side-ways drift, usully in a crosswind
b) Rolling over immediately after landing (initiating the taxi before slowing down during laning)

<u>Emergency landings</u>

In accidents there have been 29 forced landings recorded. As the reasons for the forced landing were Reciprocating engine related aspects [10], Aircraft handling [3], followed by Birdstrike [2].

2. Design aspects

A gyroplane is stable in flight, however it might be relatively unstable on the ground due to these reasons:

- A close coupled triangular wheel system consisting of a nosewheel and a relatively narrow distance between the main wheels.
- A high centre of gravity due to the heavy rotor blades installed at the top of the gyroplane.
- When the rotor blades are turning above, say, 120 rpm there is some element of lift opposing the weight of the gyroplane.

3. Equipment

In [21] occurrences Reciprocating engine related issue triggered or was part of the chain of events. In majority of cases Reciprocating engine related issue was the 1st event. In one of these cases there was carburettor icing. In others Fuel contamination, starvation or fuel distribution system related aspects. [4] accidents were with fatalities.

1.4.2 Safety analysis for gyropanes > 600kg

The safety issues derived from the analysis of the 2nd generation non-certified gyroplanes with MTOW <600kg cannot be directly attributed to the future certified gyroplanes like PAL-V, which will undergo a full certification process, and will be operated by licenced pilots. The general flying characteristics due to higher mass, should not be affected, however this aspect needs to be covered during the product certification process, e.g. for PAL-V the landing distance no wind is 30m (the same as for present gyroplanes). Risks are foreseen due to a dual role of the vehicle – aircraft vs car.

However, the experience from the present designs and their operation indicates on areas, where attention needs to be addressed. The safety issues (learnt from previous designs, pontentially applicable to new gyroplanes):

- Underlying risk: The risks and accidents are more related to people flying gyroplanes like aeroplanes (insufficient training) as opposed to understanding the gyroplane.
- Low and slow flight: this risk remains as related with the specifics of a gyroplane flying priciples. It should be compensated by a pilot training.
- Failure to recognise RPM decay. RPM has to be within a specific range, much wider than on a helicopter. The pilot should not enter into 0 or negative g manoeuvres to avoid RPM decrease. It should be compensated by pilot training. In addition On-board warning systems might be appropriate, however, installation of safety warnings (linked to rotor speed or g for example) need to be carefully analysed in the sense that, if the pilot does not have sufficient recognition and reaction time to do an appropriate maneuver restoring normal conditions, then the whole advise has no effect.
- The roll-over risks (to be confirmed if a more robust design has increased the flying stability).

New generation, certified gyroplanes related safety issues:

- Potential issue: the gyroplane roll-over to the side due to the engine torque if the power to weight ratio of gyroplanes increases, especially with the introduction of higher power engines (to be confirmed if mitigated by geometry and increased MTOW).
- Aircraft/Car dual use:
    - Unreported damage e.g. encountered during car mode. Composite material damage might not be visible from outside, structure strength can be compromised in-flight. This risk needs to be mitigated by a strictly defined use in the car mode on road.
    - Configuration control: prior the use as aircraft or a car. Is aircraft ready for the in-flight use – all systems connected, all pins secured. Is the vehicle ready for the car mode – that no damage is induced to aerodynamic surfaces, etc.
    - All weather ops – the car can be used in almost any wether. There could be an operational pressure/tendency to do the same for the aircraft mode. It is noted that the present scope is VFR Day/Night flights only. Thus this risk to be reconsidered once the scope is extended to IFR.

Note on the occurrence reporting. To capture in-service issues with the new generation certified gyroplanes of dual use, occurrences encountered during the road use, should be subject to occurrence reporting requirements in addition for the in-flight use.

Conclusions

The new fully certified gyroplane designs will ensure that many in-service issues encountered with non-certified gyroplanes are addressed. The pilots licensing (with appropriate syllabus) will ensure minimum requirements for pilots to operate such aircraft. This reduces the risks. However, there could be new safety issues introduced that need to be addressed by rulemaking, safety promotion, certification activities to ensure a smooth integration into an aviation system (OPS, ATM, AD, CAW, etc.).
The majority of these new risks are related with the dual use role in the air and on the road that need to be tackled to ensure a safe introduction of these new designs into operation.

1.5 High level gap analysis with EASA rules

Rule domain	General explanations	Amend IR?	Amend CS/AMC/GM?
IAW	Current applications for the type certification of gyroplane design are being certified on the basis of the provisions of the applicable rotorcraft certification specifications (CS-29, CS-27 or CS-VLR). Where those do not provide the adequate or appropriate design specification because of novel or unusual design features or the unconventional intended use of the product, EASA currently established project specific special conditions in accordance with points 21.A.17A and 16B of Annex I (Part 21) of Regulation (EU) No 748/2012.	No	Yes (long term)
CAW	Regulation 1321/2014 itself caters for rotorcraft, as does the new Part ML, Part CAO caters for aeroplanes and helicopters, not for gyroplanes and there are no Part 66 AML requirements for gyroplanes defined. Part 147 can be applicable for gyroplane AML training. In addition, maintenance rules for aircraft being also used in another transport have to be considered. This new topic brought by the PAL-V case has never been considered in the CAW rules.	Yes	Yes
FCL	Regulation 1178/2011 does not cater for gyroplanes.	Yes	Yes
OPS	Regugulation 965/2012 does not cater for gyroplanes.	Yes	Yes
ATM	Gyroplane needs to follow SERA. There is no need to amend the rules.	No	No
ADR	No change required.	No	No

1.6 Who is affected?

The stakeholders affected by the scope of this BIS are:

- Gyroplane manufacturers
- Maintenance organisations
- Training organisations
- Pilots
- Competent Authorities

1.7 Baseline scenario

If there were no actions developed <u>on time</u> to match the certification timing and the European rule framework for gyroplane > 600 kg MTOW, the following could happen:

- PAL-V could have financial difficulties in the proportion of the time gap between the issuance of the Type Certificate and the date of entry into force of the regulatory changes;
- European customers of PAL-V will be the owners of an aircraft which cannot freely be flown within the European airspace, except with the authorisations of each Member State

concenerned and overflown. Even when only used as a road vehicle it cannot be legaly maintained in an airworthy condition.

Note that the planning of this rulemaking development is highly dependent on the level of buy-in of the Advisory Bodies regarding the proposal regulatory changes in Annexes. It cannot be excluded that there could be a gap between this first gyroplane project certified by EASA and the adoption of the rules.

2 Objectives

The general objectives are:

- to ensure a safe integration of new technologies and operational air transport concepts
- to support the European aviation industry competition
- to accompany new market developments

3 Best Intervention Strategy actions to develop the gyroplane rules

3.1 Principles

General

In order that EASA and Advisory Bodies ressources are efficiently used:

1. the planning for new rules may be adapted if the certification timing would be delayed
2. the scope of the rules has to match the certification needs (e.g. if a new product is intended to be used under NCO rules, there is no need to develop the other types of operational unless the additional effort would be very minimal)
3. Advisory Bodies support is expected to be significant to streamline and facilitate the changes to the rules. It can be either through initial rules proposals by at least one Member State and/or stakeholder or by commenting to the rules proposals and their justifications.

Gyroplane case

4. PAL-V is intended to be certified by 2020/Q2, however this timing is considered very challenging.
5. The current need is to develop NCO VFR day/night rules for gyroplanes. Going beyond this scope would require additional ressources which are not available. This will be reconsidered in the future if there would be SPO or CAT gyroplane operations.
6. The initial rules proposals in this report have been provided by the Ministry of Infrastructure and Water Management of the Netherlands on 12 February 2012. It is indicated in this report when the NL rules proposals were reviewed by EASA with possible amendments.

3.2 BIS actions per rule domain

CAW, FCL and OPS are the rules domains where gyroplane could require new developments. No change foreseen for ATM and aerodromes rules.

#	Domain	Type of action	Description
1	IAW	RM	Long term: develop new or amend existing certification specifications in order to provide generic technical specification for those novel or unusual design features and to address the unconventional intended use, which can then be used by future applicants to base its gyroplane design on.
2	CAW	RM	Part-CAO (change helicopter by rotorcraft), Part 66 maintenance training syllabus for gyroplane, associated AMC/GM In addition, maintenance rules for aircraft being also used in another transport have to be considered.
3	FCL	RM	FCL rules with a new license for gyroplane, associated AMC/GM
4	OPS	RM	OPS rules for NCO VFR day/night (change helicopter by rotorcraft), associated AMC/GM
5	ATM	Survey with MS	To be checked if SERA exemptions were provided by MS

3.3 Support from Advisory Bodies

Unless you have answered to the email “nomination of gyroplane experts” sent by EASA to Aircrew TeB and FS.TEC on 29 April 2019, GA.TEB on 8 May 2019, EM.TEC and PCAW.TEB on 21/05/2019, EASA would welcome Member States and Stakeholders to identify gyroplane experts who could support the development of these rules. **The following can be answered in the comment file attached to the consultation email.**

4 Action 1 – IAW

Current applications for the type certification of gyroplane design are being certified on the basis of the provisions of the applicable rotorcraft certification specifications (CS-29, CS-27 or CS-VLR). Where those do not provide the adequate or appropriate design specification because of novel or unusual design features or the unconventional intended use of the product, EASA currently established project specific special conditions in accordance with points 21.A.17A and 16B of Annex I (Part 21) of Regulation (EU) No 748/2012.

Once the Agency has gathered sufficient experiences on the airworthiness of gyroplane designs it will develop new or amend existing certification specifications in order to provide generic technical specification for those novel or unusual design features and to address the unconventional intended use, which can then be used by future applicants to base its gyroplane design on.

5 Action 2 – CAW

The following changes are foreseen:

- minor change to the Part-CAO rules to expand rules from helicopters to gyroplanes;
- new maintenance training syllabus of certifying staff willing to obtain a Part-66 license to release gyroplanes;
- assessment to be performed considering that Pal-V is also a vehicle for road transportation. This is probably the most challenging part.

Note: In addition, if time allows, there could be consideration for alleviations allowed today for the continuing airworthiness of small aircraft that today are based on aircraft category. Strictly speaking this rule change is not required to operate the machine.

5.1 Minor change to the rules

The new Part-CAO has been reviewed and it is proposed to ensure that gyroplanes are covered with the word "helicopter" replaced by "rotorcraft".

The initial rules proposal is based on the NL proposal and is to be commented in section 10.2.1.

5.2 Maintenance training syllabus

The EU continuing airworthiness rules are not adequate today for a product like the PAL-V. One of the reasons for this is that there are no certifying staff (CS) licenses for gyroplanes. There will be a need to amend the rule in this respect and for this purpose we will need to create a syllabus for the basic training of category A, B1 and B3-equivalent certifying staff entitled to release to service gyroplanes (to be checked). It is necessary to draft a syllabus for such basic training, together with the 'knowledge levels' for each of these categories contained in Appendix I of Part-66.

The syllabus are defined by 'Modules', some being generic modules (e.g. Module 1: mathematics, Module 2: physics), some others being specific for each aircraft category (e.g. Module 11B: Piston Aeroplane Aerodynamics, Structures and systems, similar for Module 11C applicable to B3 CS).

The syllabus for the basic training of gyroplane CS will need to cover systems which are gyroplane specific. This should be captured in new training 'Modules' specific for gyroplanes, considering the gyroplane architecture.

For more information see: appendix in pages 506 to 564 of the document indicated in footnote[7].

Privileges associated with each category of license in point 66.A.20 of the same document.

The draft syllabus was proposed by PAL-V and is to be commented in section 10.2.2

7 https://www.easa.europa.eu/sites/default/files/dfu/Easy%20Access%20Rules%20for%20Continuing%20Airworthiness%20%28Jun%202017%29.pdf

5.3 Dual transport mode capability

There is an interface between operations and airworthiness (logbook, pre-flight checks, etc) to be considered, considering Pal-V has also a road usage. Rules aiming to be generic, it is necessary to identify if these is a need to regulate the maintenance aspects of terrestrial use of a vehicle when it has to follow the aviation maintenance rules.

What matters here is to assess the risk not to follow the Continous Airworthiness Requirements when an aircraft is not anymore only used in an aviation environment. When an aircraft on the ground is in an airport environment, it is considered to be in an environement with aviation culture. However in the case of a flying car for instance, the use of the vehicle outside the traditional aviation environment could lead to scenarios that would invalidate the aircraft Certificate of Airworthiness.

Initial feedback from CAA NL is that when the whole vehicle is covered under the EASA Type Certificate, there may not be a legal gap within the rules itself, the issue then left is the awareness of driving an aircraft with all users and the consequences of that.

One possible action apart the rule analysis would be to make safety promotion for non-pilot users who only drive the vehicle on the road to raise awareness that they are driving an aircraft, with set specific requirements for maintenance and occurrence reporting.

A thorough analysis will be performed after the BIS consultation due to current workload constraints.

Question for Advisory Bodies
Advisory Bodies are welcome to provide their views on this topic in the attached form to collect comments.

6 Action 3 – FCL

Regulation (EU) No 1178/2011 needs to be amended in order to include requirements for a European gyroplane pilot licence (GPL). Such a Part-FCL GPL will however not include ICAO privileges, since ICAO Annex 1 does not cover gyroplanes. The NL proposal for gyroplane training was based on the inputs from the IAPGT which has gathered a wide international expertise in this field, as explained in Section 1.

EASA reviewed the NL proposal, revised it, where necessary, and prepared the following initial proposals for AB comments:

- Amendment to FCL rules in section 10.3.1
- Amendment to FCL AMC/GM in section 10.3.2.

In principal, it is proposed to introduce a gyroplane pilot licence (GPL) for non-commercial VFR operation of gyroplanes. The GPL training course encompasses theoretical knowledge and flight instruction which in principal equals current PPL training requirements, while the privileges of a GPL holder need to be maintained by complying with recency requirements, as it is the case already today for the LAPL, the SPL and the BPL. For GPL holders, it is proposed to require a class 2 medical certificate to be held. Additionally, new instructor certificates for gyroplanes (FI(G), FE(G)) will be available. GPL training as well as training for the FI(G) and standardisation for the FE(G) will be possible at declared training organisations (DTO). On the licence format set out in Part-ARA, it will be clarified that the GPL will not comply with ICAO standards. Finally, Part-ORA and Part-DTO are proposed to be amended to allow competent authorities to authorise the use of gyroplanes that fall under Annex I to Regulation (EU) 2018/1139 for Part-FCL training.

Within the scope of Regulation (EU) 2018/1139, existing national gyroplane licences issued by the Member States will need to be converted into a GPL through the already-known conversion report mechanism established in Article 4 of Regulation (EU) No 1178/2011. Also, training under national requirements of the Member States will be given credit for the purpose of obtaining a Part-FCL GPL on the basis of the credit report mechanism established in Article 9 of Regulation (EU) No 1178/2011. Finally, any previous PIC experience on gyroplanes (e.g. through gyroplane licences issued by a third country) will potentially lead to a reduction of training course duration and content (see draft for point FCL.210.G(c)).

7 Action 4 – OPS

The NL initial rules proposal is to extend the OPS rules for helicopter to rotorcraft operations when it comes to Non Commercial Operations with VFR Day/Night flights.

The NL initial proposal was found sufficient after a review by EASA. However, an amendment to the cover regulation to OPS regulation 965/2012 may be required to ensure that IFR is out of the scope of the following amended regulations for gyropanes:

- Amendment to OPS regulation 965/2012 in section 10.4.1
- Amendment to OPS regulation 965/2012 Annexes in section 10.4.2
- Amendment to OPS regulation 965/2012 Sub-Part IDE in section 10.4.3
- Amendment to OPS AMC/GM in section 10.4.4

8 Action 5 – ATM

There is no foreseen changes to the ATM domain.

Note: a question on SERA was included in the comment file attached to the consultation email.

9 Conclusions

At the end of the BIS consultation period, a summary of the AB comments with an assessment of the available ressources and the status of the certification process will form the main inputs to decide on the next rulemaking step (e.g. NPA and/or Opinion schedules).

10 Appendices

10.1 Appendix 1 – List of acronyms

BIS	Best Intervention Strategy
CAT	Commercial Air Transport
ESC	EASA Safety Committee (internal to EASA)
FW	Fixed Wing
IA	Impact Assessment
NCO	Non Commercial Operations
OEM	Original Equipment Manufacturer
SIA	Safety Issue Assessment

10.2 Appendix 2 – CAW regulatory proposal

10.2.1 CAW rules – Part CAO (NL initial proposal)

NL proposals for amendments to the continuous airworthiness regulation 1321/2014

The text of the amendment is arranged to show deleted text, new or amended text as shown below:
— deleted text is ~~struck through~~;
— new or amended rule text is in red;

Text is based on the EASA opinion for Part ML and Part CAO.

New Annex: Part ML
Applicability is for Rotorcraft until 1200 kg MTOM, 4 pax max.
➔ No changes needed.

New Annex: Part CAO
CAO.A.020, Terms of approval and Appendix I, Terms of schedule of approval, both needs to include gyroplanes, ➔ Helicopter to change into rotorcraft

CAO.A.020 Terms of approval

(a) The organisation shall specify the scope of work deemed to constitute approval in its CAE, as described in CAO.A.025.

(1) For aeroplanes of more than 2 730 kg maximum take-off mass (MTOM) and for ~~helicopters~~ rotorcraft of more than 1 200 kg MTOM or certified for more than 4 occupants, the scope of work shall indicate the particular aircraft types. Changes to this scope of work shall be approved by the competent authority in accordance with CAO.A.105(a) and CAO.B.065(a).

Appendix 1, Combined airworthiness organisation (CAO) certificate, Page 2 of 2

CLASS	RATING	PRIVILEGES (***)
AIRCRAFT (**)	Aeroplanes — other-than-complex motor-powered aircraft (**)	□ Maintenance

		□ Continuing-airworthiness management □ Airworthiness review □ Permit to fly
	Aeroplanes up to 2 730 kg maximum take-off mass (MTOM) (**)	□ Maintenance □ Continuing airworthiness management □ Airworthiness review □ Permit to fly
	~~Helicopters~~ Rotorcraft — other-than-complex motor-powered aircraft (**)	□ Maintenance □ Continuing airworthiness management □ Airworthiness review □ Permit to fly
	~~Helicopters~~ Rotorcraft up to 1 200 kg MTOM, certified for a maximum of up to 4 occupants (**)	□ Maintenance □ Continuing airworthiness management □ Airworthiness review □ Permit to fly

10.2.2 Maintenance training syllabus (PAL-V proposal)

PAL-V has developed a proposal for what it could be Basic Knowledge Requirements to obtain a Part-66 for the aircraft category 'gyrocopter'. This includes subjects required and knowledge levels, similarly to existing Basic Knowledge Requirements for other Part-66 license categories (i.e. aeroplanes, helicopters,…):

The proposal considers the following categories:

- A and B1 licenses for gyroplanes with a powerplant Turbine or Piston Engine
- B3-type license for gyroplanes with piston engines and up to 2000 Kg MTOM

The proposal is presented here-below.

Note: Appendix III to Part-66 — "*Aircraft type training and examination standard — On the job training*" needs to be adapted as well. This is not part of this document.

Regulation (EU) No 1321/2014 - APPENDICES TO ANNEX III (Part-66)

Appendix I — Basic Knowledge Requirements (except for category L licence)

1. Knowledge levels for category A, B1, B2, B2L, B3 and C aircraft maintenance licences

Regulation (EU) 2018/1142

Basic knowledge for categories A, B1, B2, B2L and B3 is indicated by knowledge levels (1, 2 or 3) of each applicable subject. Category C applicants shall meet either the category B1 or the category B2 basic knowledge levels.

The knowledge level indicators are defined on 3 levels as follows:

— *LEVEL 1: A familiarisation with the principal elements of the subject.*

Objectives:

(a) The applicant should be familiar with the basic elements of the subject.

(b) The applicant should be able to give a simple description of the whole subject, using common words and examples.

(c) The applicant should be able to use typical terms.

— *LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject and an ability to apply that knowledge.*

Objectives:

(a) The applicant should be able to understand the theoretical fundamentals of the subject.

(b) The applicant should be able to give a general description of the subject using, as appropriate, typical examples.

(c) The applicant should be able to use mathematical formulae in conjunction with physical laws describing the subject.

(d) The applicant should be able to read and understand sketches, drawings and schematics describing the subject.

(e) The applicant should be able to apply his knowledge in a practical manner using detailed procedures.

— *LEVEL 3: A detailed knowledge of the theoretical and practical aspects of the subject and a capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.*

Objectives:

(a) The applicant should know the theory of the subject and interrelationships with other subjects.

(b) The applicant should be able to give a detailed description of the subject using theoretical fundamentals and specific examples.

(c) The applicant should understand and be able to use mathematical formulae related to the subject.

(d) The applicant should be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.

(e) The applicant should be able to apply his knowledge in a practical manner using manufacturer's instructions.

(f) The applicant should be able to interpret results from various sources and measurements and apply corrective action where appropriate.

2. Modularisation

Regulation (EU) 2018/1142

Qualification on basic subjects for each aircraft maintenance licence category or subcategory shall be in accordance with the following matrix, where applicable subjects are indicated by an 'X':

For categories A, B1 and B3:

Subject module	A or B1 aeroplane with:		A or B1 helicopter with:		A or B1 gyroplane with:		B3 aeroplane	B3 gyroplane
	Turbine engine(s)	Piston engine(s)	Turbine engine(s)	Piston engine(s)	Turbine engine(s)	Piston engine(s)	Piston engine non-pressurised 2 000 kg MTOM and below	Piston engine(s) non-pressurised 2 000 kg MTOM and below
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X
7A	X	X	X	X	X	X		
7B							X	X
8	X	X	X	X	X	X	X	X
9A	X	X	X	X	X	X		
9B							X	X
10	X	X	X	X	X	X	X	X
11A	X							
11B		X						
11C							X	
12			X	X	X[1)]	X[1)]		X[1)]
13								
14								
15	X		X		X			
16		X		X		X	X	X
17A	X	X			X	X		
17B							X	X

18					X[1)]	X[1)]	X[1)]
19					X[1)]	X[1)]	X[1)]

1) For gyroplanes, select Module 12 in combination with Module 19 or only Module 18. Module 19 is created for personnel already qualified for Module 12.

Best Intervention Strategy for "Road/Gyroplane"

For categories B2 and B2L:

Subject module/submodules	B2	B2L
1	X	X
2	X	X
3	X	X
4	X	X
5	X	X
6	X	X
7A	X	X
7B		
8	X	X
9A	X	X
9B		
10	X	X
11A		
11B		
11C		
12		
13.1 and 13.2	X	X
13.3(a)	X	X (for system rating 'Autoflight')
13.3(b)	X	
13.4(a)	X	X (for system rating 'Com/Nav')
13.4(b)	X	X (for system rating 'Surveillance')
13.4(c)	X	
13.5	X	X
13.6	X	
13.7	X	X (for system rating 'Autoflight')
13.8	X	X (for system rating 'Instruments')
13.9	X	X
13.10	X	
13.11 to 13.18	X	X (for system rating 'Airframe systems')
13.19 to 13.22	X	
14	X	X (for system rating 'instruments' and 'Airframe systems')
15		
16		
17A		
17B		
18		
19		

MODULE 1. MATHEMATICS

Regulation (EU) 2018/1142

MODULE 1. MATHEMATICS	LEVEL			
	A	**B1**	**B2 B2L**	**B3**
1.1 Arithmetic Arithmetical terms and signs, methods of multiplication and division, fractions and decimals, factors and multiples, weights, measures and conversion factors, ratio and proportion, averages and percentages, areas and volumes, squares, cubes, square and cube roots.	1	2	2	2
1.2 Algebra (a) Evaluating simple algebraic expressions, addition, subtraction, multiplication and division, use of brackets, simple algebraic fractions;	1	2	2	2
(b) Linear equations and their solutions; Indices and powers, negative and fractional indices; Binary and other applicable numbering systems; Simultaneous equations and second degree equations with one unknown; Logarithms.	—	1	1	1
1.3 Geometry (a) Simple geometrical constructions;	—	1	1	1
(b) Graphical representation; nature and uses of graphs, graphs of equations/functions;	2	2	2	2
(c) Simple trigonometry; trigonometrical relationships, use of tables and rectangular and polar coordinates.	—	2	2	2

MODULE 2. PHYSICS

Regulation (EU) 2018/1142

MODULE 2. PHYSICS	LEVEL			
	A	B1	B2 B2L	B3
2.1 Matter Nature of matter: the chemical elements, structure of atoms, molecules; Chemical compounds; States: solid, liquid and gaseous; Changes between states.	1	1	1	1
2.2 Mechanics *2.2.1 Statics* Forces, moments and couples, representation as vectors; Centre of gravity; Elements of theory of stress, strain and elasticity: tension, compression, shear and torsion; Nature and properties of solid, fluid and gas; Pressure and buoyancy in liquids (barometers).	1	2	1	1
2.2.2 Kinetics Linear movement: uniform motion in a straight line, motion under constant acceleration (motion under gravity); Rotational movement: uniform circular motion (centrifugal/centripetal forces); Periodic motion: pendular movement; Simple theory of vibration, harmonics and resonance; Velocity ratio, mechanical advantage and efficiency.	1	2	1	1
2.2.3 Dynamics (a) Mass; Force, inertia, work, power, energy (potential, kinetic and total energy), heat, efficiency;	1	2	1	1
(b) Momentum, conservation of momentum; Impulse; Gyroscopic principles; Friction: nature and effects, coefficient of friction (rolling resistance).	1	2	2	1
2.2.4 Fluid dynamics (a) Specific gravity and density;	2	2	2	2
(b) Viscosity, fluid resistance, effects of streamlining; Effects of compressibility on fluids; Static, dynamic and total pressure: Bernoulli's Theorem, venturi.	1	2	1	1
2.3 Thermodynamics (a) Temperature: thermometers and temperature scales: Celsius, Fahrenheit and Kelvin; Heat definition;	2	2	2	2
(b) Heat capacity, specific heat; Heat transfer: convection, radiation and conduction; Volumetric expansion; First and second law of thermodynamics; Gases: ideal gases laws; specific heat at constant volume and constant pressure, work done by expanding gas;	—	2	2	1

MODULE 2. PHYSICS	LEVEL			
	A	B1	B2 B2L	B3
Isothermal, adiabatic expansion and compression, engine cycles, constant volume and constant pressure, refrigerators and heat pumps; Latent heats of fusion and evaporation, thermal energy, heat of combustion.				
2.4 Optics (Light) Nature of light; speed of light; Laws of reflection and refraction: reflection at plane surfaces, reflection by spherical mirrors, refraction, lenses; Fibre optics.	—	2	2	—
2.5 Wave Motion and Sound Wave motion: mechanical waves, sinusoidal wave motion, interference phenomena, standing waves; Sound: speed of sound, production of sound, intensity, pitch and quality, Doppler effect.	—	2	2	—

MODULE 3. ELECTRICAL FUNDAMENTALS

Regulation (EU) 2018/1142

MODULE 3. ELECTRICAL FUNDAMENTALS	LEVEL			
	A	**B1**	**B2 B2L**	**B3**
3.1 Electron Theory Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.	1	1	1	1
3.2 Static Electricity and Conduction Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Units of charge, Coulomb's Law; Conduction of electricity in solids, liquids, gases and a vacuum.	1	2	2	1
3.3 Electrical Terminology The following terms, their units and factors affecting them: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.	1	2	2	1
3.4 Generation of Electricity Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion.	1	1	1	1
3.5 DC Sources of Electricity Construction and basic chemical action of: primary cells, secondary cells, lead acid cells, nickel cadmium cells, other alkaline cells; Cells connected in series and parallel; Internal resistance and its effect on a battery; Construction, materials and operation of thermocouples; Operation of photo-cells.	1	2	2	2
3.6 DC Circuits Ohms Law, Kirchoff's Voltage and Current Laws; Calculations using the above laws to find resistance, voltage and current; Significance of the internal resistance of a supply.	—	2	2	1
3.7 Resistance/Resistor (a) Resistance and affecting factors; Specific resistance; Resistor colour code, values and tolerances, preferred values, wattage ratings; Resistors in series and parallel; Calculation of total resistance using series, parallel and series parallel combinations; Operation and use of potentiometers and rheostats; Operation of Wheatstone Bridge;	—	2	2	1
(b) Positive and negative temperature coefficient conductance; Fixed resistors, stability, tolerance and limitations, methods of construction; Variable resistors, thermistors, voltage dependent resistors; Construction of potentiometers and rheostats; Construction of Wheatstone Bridge.	—	1	1	—

<table>
<tr><th rowspan="2">MODULE 3. ELECTRICAL FUNDAMENTALS</th><th colspan="4">LEVEL</th></tr>
<tr><th>A</th><th>B1</th><th>B2
B2L</th><th>B3</th></tr>
<tr><td>3.8 Power
Power, work and energy (kinetic and potential);
Dissipation of power by a resistor;
Power formula;
Calculations involving power, work and energy.</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>3.9 Capacitance/Capacitor
Operation and function of a capacitor;
Factors affecting capacitance area of plates, distance between plates, number of plates, dielectric and dielectric constant, working voltage, voltage rating;
Capacitor types, construction and function;
Capacitor colour coding;
Calculations of capacitance and voltage in series and parallel circuits;
Exponential charge and discharge of a capacitor, time constants;
Testing of capacitors.</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>3.10 Magnetism
(a) Theory of magnetism;
Properties of a magnet;
Action of a magnet suspended in the Earth's magnetic field;
Magnetisation and demagnetisation;
Magnetic shielding;
Various types of magnetic material;
Electromagnets construction and principles of operation;
Hand clasp rules to determine: magnetic field around current carrying conductor;</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>(b) Magnetomotive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force reluctance, saturation point, eddy currents;
Precautions for care and storage of magnets.</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>3.11 Inductance/Inductor
Faraday's Law;
Action of inducing a voltage in a conductor moving in a magnetic field;
Induction principles;
Effects of the following on the magnitude of an induced voltage: magnetic field strength, rate of change of flux, number of conductor turns;
Mutual induction;
The effect the rate of change of primary current and mutual inductance has on induced voltage;
Factors affecting mutual inductance: number of turns in coil, physical size of coil, permeability of coil, position of coils with respect to each other;
Lenz's Law and polarity determining rules;
Back emf, self induction;
Saturation point;
Principle uses of inductors.</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
<tr><td>3.12 DC Motor/Generator Theory
Basic motor and generator theory;
Construction and purpose of components in DC generator;</td><td>—</td><td>2</td><td>2</td><td>1</td></tr>
</table>

MODULE 3. ELECTRICAL FUNDAMENTALS	LEVEL			
	A	**B1**	**B2 B2L**	**B3**
Operation of, and factors affecting output and direction of current flow in DC generators; Operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors; Series wound, shunt wound and compound motors; Starter Generator construction.				
3.13 AC Theory Sinusoidal waveform: phase, period, frequency, cycle; Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values, in relation to voltage, current and power; Triangular/Square waves; Single/3 phase principles.	1	2	2	1
3.14 Resistive (R), Capacitive (C) and Inductive (L) Circuits Phase relationship of voltage and current in L, C and R circuits, parallel, series and series parallel; Power dissipation in L, C and R circuits; Impedance, phase angle, power factor and current calculations; True power, apparent power and reactive power calculations.	—	2	2	1
3.15 Transformers Transformer construction principles and operation; Transformer losses and methods for overcoming them; Transformer action under load and no-load conditions; Power transfer, efficiency, polarity markings; Calculation of line and phase voltages and currents; Calculation of power in a three phase system; Primary and Secondary current, voltage, turns ratio, power, efficiency; Auto transformers.	—	2	2	1
3.16 Filters Operation, application and uses of the following filters: low pass, high pass, band pass, band stop.	—	1	1	—
3.17 AC Generators Rotation of loop in a magnetic field and waveform produced; Operation and construction of revolving armature and revolving field type AC generators; Single phase, two phase and three phase alternators; Three phase star and delta connections advantages and uses; Permanent Magnet Generators.	—	2	2	1
3.18 AC Motors Construction, principles of operation and characteristics of: AC synchronous and induction motors both single and polyphase; Methods of speed control and direction of rotation; Methods of producing a rotating field: capacitor, inductor, shaded or split pole.	—	2	2	1

MODULE 4. ELECTRONIC FUNDAMENTALS

MODULE 4. ELECTRONIC FUNDAMENTALS	LEVEL A	B1	B2 B2L	B3
4.1 Semiconductors *4.1.1 Diodes* (a) Diode symbols; Diode characteristics and properties; Diodes in series and parallel; Main characteristics and use of silicon controlled rectifiers (thyristors), light emitting diode, photo conductive diode, varistor, rectifier diodes; Functional testing of diodes.	—	2	2	1
(b) Materials, electron configuration, electrical properties; P and N type materials: effects of impurities on conduction, majority and minority characters; PN junction in a semiconductor, development of a potential across a PN junction in unbiased, forward biased and reverse biased conditions; Diode parameters: peak inverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation; Operation and function of diodes in the following circuits: clippers, clampers, full and half wave rectifiers, bridge rectifiers, voltage doublers and triplers; Detailed operation and characteristics of the following devices: silicon controlled rectifier (thyristor), light emitting diode, Schottky diode, photo conductive diode, varactor diode, varistor, rectifier diodes, Zener diode.	—	—	2	—
4.1.2 Transistors (a) Transistor symbols; Component description and orientation; Transistor characteristics and properties.	—	1	2	1
(b) Construction and operation of PNP and NPN transistors; Base, collector and emitter configurations; Testing of transistors; Basic appreciation of other transistor types and their uses; Application of transistors: classes of amplifier (A, B, C); Simple circuits including: bias, decoupling, feedback and stabilisation; Multistage circuit principles: cascades, push-pull, oscillators, multivibrators, flip-flop circuits.	—	—	2	—
4.1.3 Integrated Circuits (a) Description and operation of logic circuits and linear circuits/operational amplifiers;	—	1	—	1
(b) Description and operation of logic circuits and linear circuits; Introduction to operation and function of an operational amplifier used as: integrator, differentiator, voltage follower, comparator; Operation and amplifier stages connecting methods: resistive capacitive, inductive (transformer), inductive resistive (IR), direct; Advantages and disadvantages of positive and negative feedback.	—	—	2	—

MODULE 4. ELECTRONIC FUNDAMENTALS	LEVEL			
	A	B1	B2 B2L	B3
4.2 Printed Circuit Boards Description and use of printed circuit boards.	—	1	2	—
4.3 Servomechanisms (a) Understanding of the following terms: Open and closed loop systems, feedback, follow up, analogue transducers; Principles of operation and use of the following synchro system components/features: resolvers, differential, control and torque, transformers, inductance and capacitance transmitters;	—	1	—	—
(b) Understanding of the following terms: Open and closed loop, follow up, servomechanism, analogue, transducer, null, damping, feedback, deadband; Construction operation and use of the following synchro system components: resolvers, differential, control and torque, E and I transformers, inductance transmitters, capacitance transmitters, synchronous transmitters; Servomechanism defects, reversal of synchro leads, hunting.	—	—	2	—

MODULE 5. DIGITAL TECHNIQUES/ELECTRONIC INSTRUMENT SYSTEMS

Regulation (EU) 2018/1142

MODULE 5. DIGITAL TECHNIQUES/ELECTRONIC INSTRUMENT SYSTEMS	LEVEL				
	A	**B1.1 B1.3 B1.5**	**B1.2 B1.4 B1.6**	**B2 B2L**	**B3**
5.1 Electronic Instrument Systems Typical systems arrangements and cockpit layout of electronic instrument systems.	1	2	2	3	1
5.2 Numbering Systems Numbering systems: binary, octal and hexadecimal; Demonstration of conversions between the decimal and binary, octal and hexadecimal systems and vice versa.	—	1	—	2	—
5.3 Data Conversion Analogue Data, Digital Data; Operation and application of analogue to digital, and digital to analogue converters, inputs and outputs, limitations of various types.	—	1	—	2	—
5.4 Data Buses Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications. Aircraft Network/Ethernet.	—	2	—	2	—
5.5 Logic Circuits (a) Identification of common logic gate symbols, tables and equivalent circuits; Applications used for aircraft systems, schematic diagrams.	—	2	—	2	—
(b) Interpretation of logic diagrams.	—	—	—	2	—
5.6 Basic Computer Structure (a) Computer terminology (including bit, byte, software, hardware, CPU, IC, and various memory devices such as RAM, ROM, PROM); Computer technology (as applied in aircraft systems).	1	2	—	—	—
(b) Computer related terminology; Operation, layout and interface of the major components in a micro computer including their associated bus systems; Information contained in single and multiaddress instruction words; Memory associated terms; Operation of typical memory devices; Operation, advantages and disadvantages of the various data storage systems.	—	—	—	2	—
5.7 Microprocessors Functions performed and overall operation of a microprocessor; Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit.	—	—	—	2	—
5.8 Integrated Circuits Operation and use of encoders and decoders;	—	—	—	2	—

MODULE 5. DIGITAL TECHNIQUES/ELECTRONIC INSTRUMENT SYSTEMS	LEVEL				
	A	B1.1 B1.3 B1.5	B1.2 B1.4 B1.6	B2 B2L	B3
Function of encoder types; Uses of medium, large and very large scale integration.					
5.9 Multiplexing Operation, application and identification in logic diagrams of multiplexers and demultiplexers.	—	—	—	2	—
5.10 Fibre Optics Advantages and disadvantages of fibre optic data transmission over electrical wire propagation; Fibre optic data bus; Fibre optic related terms; Terminations; Couplers, control terminals, remote terminals; Application of fibre optics in aircraft systems.	—	1	1	2	—
5.11 Electronic Displays Principles of operation of common types of displays used in modern aircraft, including Cathode Ray Tubes, Light Emitting Diodes and Liquid Crystal Display.	—	2	1	2	1
5.12 Electrostatic Sensitive Devices Special handling of components sensitive to electrostatic discharges; Awareness of risks and possible damage, component and personnel anti-static protection devices.	1	2	2	2	1
5.13 Software Management Control Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programmes.	—	2	1	2	1
5.14 Electromagnetic Environment Influence of the following phenomena on maintenance practices for electronic system: EMC-Electromagnetic Compatibility EMI-Electromagnetic Interference HIRF-High Intensity Radiated Field Lightning/lightning protection.	—	2	2	2	1
5.15 Typical Electronic/Digital Aircraft Systems General arrangement of typical electronic/digital aircraft systems and associated BITE (Built In Test Equipment) such as: (a) For B1 and B2 only: ACARS-ARINC Communication and Addressing and Reporting System EICAS-Engine Indication and Crew Alerting System FBW-Fly-by-Wire FMS-Flight Management System IRS-Inertial Reference System; (b) For B1, B2 and B3: ECAM-Electronic Centralised Aircraft Monitoring EFIS-Electronic Flight Instrument System GPS-Global Positioning System	—	2	2	2	1

MODULE 5. DIGITAL TECHNIQUES/ELECTRONIC INSTRUMENT SYSTEMS	LEVEL				
	A	B1.1 B1.3 B1.5	B1.2 B1.4 B1.6	B2 B2L	B3
TCAS-Traffic Alert Collision Avoidance System Integrated Modular Avionics Cabin Systems Information Systems.					

MODULE 6. MATERIALS AND HARDWARE

Regulation (EU) 2018/1142

MODULE 6. MATERIALS AND HARDWARE	LEVEL			
	A	B1	B2 B2L	B3
6.1 Aircraft Materials — Ferrous (a) Characteristics, properties and identification of common alloy steels used in aircraft; Heat treatment and application of alloy steels.	1	2	1	2
(b) Testing of ferrous materials for hardness, tensile strength, fatigue strength and impact resistance.	—	1	1	1
6.2 Aircraft Materials — Non-Ferrous (a) Characteristics, properties and identification of common non-ferrous materials used in aircraft; Heat treatment and application of non-ferrous materials;	1	2	1	2
(b) Testing of non-ferrous material for hardness, tensile strength, fatigue strength and impact resistance.	—	1	1	1
6.3 Aircraft Materials — Composite and Non-Metallic *6.3.1 Composite and non-metallic other than wood and fabric* (a) Characteristics, properties and identification of common composite and non-metallic materials, other than wood, used in aircraft; Sealant and bonding agents;	1	2	2	2
(b) The detection of defects/deterioration in composite and non-metallic material; Repair of composite and non-metallic material.	1	2	—	2
6.3.2 Wooden structures Construction methods of wooden airframe structures; Characteristics, properties and types of wood and glue used in aeroplanes; Preservation and maintenance of wooden structure; Types of defects in wood material and wooden structures; The detection of defects in wooden structure; Repair of wooden structure.	1	2	—	2
6.3.3 Fabric covering Characteristics, properties and types of fabrics used in aeroplanes; Inspections methods for fabric; Types of defects in fabric; Repair of fabric covering.	1	2	—	2
6.4 Corrosion (a) Chemical fundamentals; Formation by, galvanic action process, microbiological, stress;	1	1	1	1
(b) Types of corrosion and their identification; Causes of corrosion; Material types, susceptibility to corrosion.	2	3	2	2
6.5 Fasteners *6.5.1 Screw threads* Screw nomenclature; Thread forms, dimensions and tolerances for standard threads used in aircraft;	2	2	2	2

MODULE 6. MATERIALS AND HARDWARE	LEVEL			
	A	B1	B2 B2L	B3
Measuring screw threads.				
6.5.2 Bolts, studs and screws Bolt types: specification, identification and marking of aircraft bolts, international standards; Nuts: self locking, anchor, standard types; Machine screws: aircraft specifications; Studs: types and uses, insertion and removal; Self tapping screws, dowels.	2	2	2	2
6.5.3 Locking devices Tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick release fasteners, keys, circlips, cotter pins.	2	2	2	2
6.5.4 Aircraft rivets Types of solid and blind rivets: specifications and identification, heat treatment.	1	2	1	2
6.6 Pipes and Unions (a) Identification of, and types of rigid and flexible pipes and their connectors used in aircraft;	2	2	2	2
(b) Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes.	2	2	1	2
6.7 Springs Types of springs, materials, characteristics and applications.	—	2	1	1
6.8 Bearings Purpose of bearings, loads, material, construction; Types of bearings and their application.	1	2	2	1
6.9 Transmissions Gear types and their application; Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; Belts and pulleys, chains and sprockets.	1	2	2	1
6.10 Control Cables Types of cables; End fittings, turnbuckles and compensation devices; Pulleys and cable system components; Bowden cables; Aircraft flexible control systems.	1	2	1	2
6.11 Electrical Cables and Connectors Cable types, construction and characteristics; High tension and co-axial cables; Crimping; Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes.	1	2	2	2

MODULE 7A. MAINTENANCE PRACTICES

Regulation (EU) 2018/1142

Note: This module does not apply to category B3. Relevant subject matters for category B3 are defined in module 7B.

MODULE 7A. MAINTENANCE PRACTICES	LEVEL		
	A	**B1**	**B2 B2L**
7.1 Safety Precautions-Aircraft and Workshop Aspects of safe working practices including precautions to take when working with electricity, gases especially oxygen, oils and chemicals. Also, instruction in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge on extinguishing agents.	3	3	3
7.2 Workshop Practices Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, standards of workmanship; Calibration of tools and equipment, calibration standards.	3	3	3
7.3 Tools Common hand tool types; Common power tool types; Operation and use of precision measuring tools; Lubrication equipment and methods. Operation, function and use of electrical general test equipment.	3	3	3
7.4 Avionic General Test Equipment Operation, function and use of avionic general test equipment.	—	2	3
7.5 Engineering Drawings, Diagrams and Standards Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identifying title block information; Microfilm, microfiche and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.	1	2	2
7.6 Fits and Clearances Drill sizes for bolt holes, classes of fits; Common system of fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings and other parts.	1	2	1
7.7 Electrical Wiring Interconnection System (EWIS) Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Co-axial cables: testing and installation precautions; Identification of wire types, their inspection criteria and damage tolerance.	1	3	3

MODULE 7A. MAINTENANCE PRACTICES	LEVEL		
	A	B1	B2 B2L
Wiring protection techniques: Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding; EWIS installations, inspection, repair, maintenance and cleanliness standards.			
7.8 Riveting Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.	1	2	—
7.9 Pipes and Hoses Bending and belling/flaring aircraft pipes; Inspection and testing of aircraft pipes and hoses; Installation and clamping of pipes.	1	2	—
7.10 Springs Inspection and testing of springs.	1	2	—
7.11 Bearings Testing, cleaning and inspection of bearings; Lubrication requirements of bearings; Defects in bearings and their causes.	1	2	—
7.12 Transmissions Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push-pull rod systems.	1	2	—
7.13 Control Cables Swaging of end fittings; Inspection and testing of control cables; Bowden cables; aircraft flexible control systems.	1	2	—
7.14 Material handling *7.14.1 Sheet Metal* Marking out and calculation of bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.	—	2	—
7.14.2 Composite and non-metallic Bonding practices; Environmental conditions; Inspection methods.	—	2	—
7.15 Welding, Brazing, Soldering and Bonding (a) Soldering methods; inspection of soldered joints.	—	2	2
(b) Welding and brazing methods; Inspection of welded and brazed joints; Bonding methods and inspection of bonded joints.	—	2	—
7.16 Aircraft Weight and Balance (a) Centre of Gravity/Balance limits calculation: use of relevant documents;	—	2	2
(b) Preparation of aircraft for weighing; Aircraft weighing.	—	2	—

MODULE 7A. MAINTENANCE PRACTICES	LEVEL		
	A	B1	B2 B2L
7.17 Aircraft Handling and Storage Aircraft taxiing/towing and associated safety precautions; Aircraft jacking, chocking, securing and associated safety precautions; Aircraft storage methods; Refuelling/defuelling procedures; De-icing/anti-icing procedures; Electrical, hydraulic and pneumatic ground supplies. Effects of environmental conditions on aircraft handling and operation.	2	2	2
7.18 Disassembly, Inspection, Repair and Assembly Techniques (a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection;	2	3	3
(b) General repair methods, Structural Repair Manual; Ageing, fatigue and corrosion control programmes;	—	2	—
(c) Non-destructive inspection techniques including, penetrant, radiographic, eddy current, ultrasonic and boroscope methods;	—	2	1
(d) Disassembly and re-assembly techniques;	2	2	2
(e) Trouble shooting techniques.	—	2	2
7.19 Abnormal Events (a) Inspections following lightning strikes and HIRF penetration;	2	2	2
(b) Inspections following abnormal events such as heavy landings and flight through turbulence.	2	2	—
7.20 Maintenance Procedures Maintenance planning; Modification procedures; Stores procedures; Certification/release procedures; Interface with aircraft operation; Maintenance Inspection/Quality Control/Quality Assurance; Additional maintenance procedures; Control of life limited components.	1	2	2

MODULE 7B. MAINTENANCE PRACTICES

Regulation (EU) 2018/1142

Note: The scope of this module shall reflect the technology of aeroplanes relevant to the B3 category.

MODULE 7B. MAINTENANCE PRACTICES	LEVEL
	B3
7.1 Safety Precautions-Aircraft and Workshop Aspects of safe working practices including precautions to take when working with electricity, gases especially oxygen, oils and chemicals. Also, instruction in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge on extinguishing agents.	3
7.2 Workshop Practices Care of tools, control of tools, use of workshop materials; Dimensions, allowances and tolerances, standards of workmanship; Calibration of tools and equipment, calibration standards.	3
7.3 Tools Common hand tool types; Common power tool types; Operation and use of precision measuring tools; Lubrication equipment and methods; Operation, function and use of electrical general test equipment.	3
7.4 Avionic General Test Equipment Operation, function and use of avionic general test equipment.	1
7.5 Engineering Drawings, Diagrams and Standards Drawing types and diagrams, their symbols, dimensions, tolerances and projections; Identifying title block information; Microfilm, microfiche and computerised presentations; Specification 100 of the Air Transport Association (ATA) of America; Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; Wiring diagrams and schematic diagrams.	2
7.6 Fits and Clearances Drill sizes for bolt holes, classes of fits; Common system of fits and clearances; Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; Standard methods for checking shafts, bearings and other parts.	2
7.7 Electrical Cables and Connectors Continuity, insulation and bonding techniques and testing; Use of crimp tools: hand and hydraulic operated; Testing of crimp joints; Connector pin removal and insertion; Co-axial cables: testing and installation precautions; Wiring protection techniques: Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding.	2
7.8 Riveting Riveted joints, rivet spacing and pitch; Tools used for riveting and dimpling; Inspection of riveted joints.	2

MODULE 7B. MAINTENANCE PRACTICES	LEVEL B3
7.9 Pipes and Hoses Bending and belling/flaring aircraft pipes; Inspection and testing of aircraft pipes and hoses; Installation and clamping of pipes.	2
7.10 Springs Inspection and testing of springs.	2
7.11 Bearings Testing, cleaning and inspection of bearings; Lubrication requirements of bearings; Defects in bearings and their causes.	2
7.12 Transmissions Inspection of gears, backlash; Inspection of belts and pulleys, chains and sprockets; Inspection of screw jacks, lever devices, push-pull rod systems.	2
7.13 Control Cables Swaging of end fittings; Inspection and testing of control cables; Bowden cables; aircraft flexible control systems.	2
7.14 Material handling *7.14.1 Sheet Metal* Marking out and calculation of bend allowance; Sheet metal working, including bending and forming; Inspection of sheet metal work.	2
7.14.2 Composite and non-metallic Bonding practices; Environmental conditions; Inspection methods.	2
7.15 Welding, Brazing, Soldering and Bonding	
(a) Soldering methods; inspection of soldered joints;	2
(b) Welding and brazing methods; Inspection of welded and brazed joints; Bonding methods and inspection of bonded joints.	2
7.16 Aircraft Weight and Balance	
(a) Centre of Gravity/Balance limits calculation: use of relevant documents;	2
(b) Preparation of aircraft for weighing; Aircraft weighing.	2
7.17 Aircraft Handling and Storage Aircraft taxiing/towing and associated safety precautions; Aircraft jacking, chocking, securing and associated safety precautions; Aircraft storage methods; Refuelling/defuelling procedures; De-icing/anti-icing procedures; Electrical, hydraulic and pneumatic ground supplies; Effects of environmental conditions on aircraft handling and operation.	2
7.18 Disassembly, Inspection, Repair and Assembly Techniques	
(a) Types of defects and visual inspection techniques; Corrosion removal, assessment and reprotection;	3
(b) General repair methods, Structural Repair Manual;	2

MODULE 7B. MAINTENANCE PRACTICES	LEVEL B3
Ageing, fatigue and corrosion control programmes;	
(c) Non-destructive inspection techniques including, penetrant, radiographic, eddy current, ultrasonic and boroscope methods;	2
(d) Disassembly and re-assembly techniques;	2
(e) Trouble shooting techniques.	2
7.19 Abnormal Events	
(a) Inspections following lightning strikes and HIRF penetration.	2
(b) Inspections following abnormal events such as heavy landings and flight through turbulence.	2
7.20 Maintenance Procedures Maintenance planning; Modification procedures; Stores procedures; Certification/release procedures; Interface with aircraft operation; Maintenance Inspection/Quality Control/Quality Assurance; Additional maintenance procedures; Control of life limited components.	2

MODULE 8. BASIC AERODYNAMICS

Regulation (EU) 2018/1142

MODULE 8. BASIC AERODYNAMICS	LEVEL			
	A	**B1**	**B2 B2L**	**B3**
8.1 Physics of the Atmosphere International Standard Atmosphere (ISA), application to aerodynamics.	1	2	2	1
8.2 Aerodynamics Airflow around a body; Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio; Thrust, Weight, Aerodynamic Resultant; Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall; Aerofoil contamination including ice, snow, frost.	1	2	2	1
8.3 Theory of Flight Relationship between lift, weight, thrust and drag; Glide ratio; Steady state flights, performance; Theory of the turn; Influence of load factor: stall, flight envelope and structural limitations; Lift augmentation.	1	2	2	1
8.4 Flight Stability and Dynamics Longitudinal, lateral and directional stability (active and passive).	1	2	2	1

MODULE 9A. HUMAN FACTORS

Regulation (EU) 2018/1142

Note: This module does not apply to category B3. Relevant subject matters for category B3 are defined in module 9B.

MODULE 9A. HUMAN FACTORS	LEVEL		
	A	**B1**	**B2 B2L**
9.1 General The need to take human factors into account; Incidents attributable to human factors/human error; ‘Murphy's’ law.	1	2	2
9.2 Human Performance and Limitations Vision; Hearing; Information processing; Attention and perception; Memory; Claustrophobia and physical access.	1	2	2
9.3 Social Psychology Responsibility: individual and group; Motivation and de-motivation; Peer pressure; ‘Culture’ issues; Team working; Management, supervision and leadership.	1	1	1
9.4 Factors Affecting Performance Fitness/health; Stress: domestic and work related; Time pressure and deadlines; Workload: overload and underload; Sleep and fatigue, shiftwork; Alcohol, medication, drug abuse.	2	2	2
9.5 Physical Environment Noise and fumes; Illumination; Climate and temperature; Motion and vibration; Working environment.	1	1	1
9.6 Tasks Physical work; Repetitive tasks; Visual inspection; Complex systems.	1	1	1
9.7 Communication Within and between teams; Work logging and recording; Keeping up to date, currency; Dissemination of information.	2	2	2
9.8 Human Error Error models and theories;	1	2	2

MODULE 9A. HUMAN FACTORS	LEVEL		
	A	B1	B2 B2L
Types of error in maintenance tasks; Implications of errors (i.e. accidents); Avoiding and managing errors.			
9.9 Hazards in the Workplace Recognising and avoiding hazards; Dealing with emergencies.	1	2	2

MODULE 9B. HUMAN FACTORS

Regulation (EU) No 1321/2014

Note: The scope of this module shall reflect the less demanding environment of maintenance for B3 licence holders.

MODULE 9B. HUMAN FACTORS	LEVEL B3
9.1 General The need to take human factors into account; Incidents attributable to human factors/human error; 'Murphy's' law.	2
9.2 Human Performance and Limitations Vision; Hearing; Information processing; Attention and perception; Memory; Claustrophobia and physical access.	2
9.3 Social Psychology Responsibility: individual and group; Motivation and de-motivation; Peer pressure; 'Culture' issues; Team working; Management, supervision and leadership.	1
9.4 Factors Affecting Performance Fitness/health; Stress: domestic and work related; Time pressure and deadlines; Workload: overload and underload; Sleep and fatigue, shiftwork; Alcohol, medication, drug abuse.	2
9.5 Physical Environment Noise and fumes; Illumination; Climate and temperature; Motion and vibration; Working environment.	1
9.6 Tasks Physical work; Repetitive tasks; Visual inspection; Complex systems.	1
9.7 Communication Within and between teams; Work logging and recording; Keeping up to date, currency; Dissemination of information.	2
9.8 Human Error Error models and theories; Types of error in maintenance tasks;	2

MODULE 9B. HUMAN FACTORS	LEVEL B3
Implications of errors (i.e. accidents); Avoiding and managing errors.	
9.9 Hazards in the Workplace Recognising and avoiding hazards; Dealing with emergencies.	2

MODULE 10. AVIATION LEGISLATION

Regulation (EU) 2018/1142

MODULE 10. AVIATION LEGISLATION	LEVEL			
	A	**B1**	**B2 B2L**	**B3**
10.1 Regulatory Framework Role of the International Civil Aviation Organisation; Role of the European Commission; Role of EASA; Role of the Member States and National Aviation Authorities; Regulation (EC) No 216/2008 and its implementing rules Regulations (EU) No 748/2012 and (EU) No 1321/2014; Relationship between the various Annexes (Parts) such as Part-21, Part-M, Part-145, Part-66, Part-147 and Regulation (EU) No 965/2012.	1	1	1	1
10.2 Certifying Staff — Maintenance Detailed understanding of Part-66.	2	2	2	2
10.3 Approved Maintenance Organisations Detailed understanding of Part-145 and Part-M Subpart F.	2	2	2	2
10.4 Air operations General understanding of Regulation (EU) No 965/2012. Air Operators Certificates; Operator's responsibilities, in particular regarding continuing airworthiness and maintenance; Aircraft Maintenance Programme; MEL//CDL; Documents to be carried on board; Aircraft placarding (markings).	1	1	1	1
10.5 Certification of aircraft, parts and appliances (a) General General understanding of Part-21 and EASA certification specifications CS-23, 25, 27, 29.	—	1	1	1
(b) Documents Certificate of Airworthiness; restricted certificates of airworthiness and permit to fly; Certificate of Registration; Noise Certificate; Weight Schedule; Radio Station Licence and Approval.	—	2	2	2
10.6 Continuing airworthiness Detailed understanding of Part-21 provisions related to continuing airworthiness. Detailed understanding of Part-M.	2	2	2	2
10.7 Applicable National and International Requirements for (if not superseded by EU requirements). (a) Maintenance Programmes, Maintenance checks and inspections; Airworthiness Directives;	1	2	2	2

MODULE 10. AVIATION LEGISLATION		LEVEL			
		A	B1	B2 B2L	B3
	Service Bulletins, manufacturers service information; Modifications and repairs; Maintenance documentation: maintenance manuals, structural repair manual, illustrated parts catalogue, etc.; Only for A to B2 licences: Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists;				
(b)	Continuing airworthiness; Minimum equipment requirements — Test flights; Only for B1 and B2 licences: ETOPS, maintenance and dispatch requirements; All Weather Operations, Category 2/3 operations.	—	1	1	1

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A1	B1.1
11.1 Theory of Flight *11.1.1. Aeroplane Aerodynamics and Flight Controls* Operation and effect of: — roll control: ailerons and spoilers, — pitch control: elevators, stabilators, variable incidence stabilisers and canards, — yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flaperons; Drag inducing devices, spoilers, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices; Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels.	1	2
11.1.2. High Speed Flight Speed of sound, subsonic flight, transonic flight, supersonic flight; Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; Factors affecting airflow in engine intakes of high speed aircraft; Effects of sweepback on critical Mach number.	1	2
11.2 Airframe Structures — General Concepts (a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision; Aircraft bonding.	2	2
(b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.	1	2
11.3 Airframe Structures — Aeroplanes *11.3.1 Fuselage (ATA 52/53/56)* Construction and pressurisation sealing; Wing, stabiliser, pylon and undercarriage attachments; Seat installation and cargo loading system; Doors and emergency exits: construction, mechanisms, operation and safety devices; Windows and windscreen construction and mechanisms.	1	2

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A1	B1.1
11.3.2 Wings (ATA 57) Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.	1	2
11.3.3 Stabilisers (ATA 55) Construction; Control surface attachment.	1	2
11.3.4 Flight Control Surfaces (ATA 55/57) Construction and attachment; Balancing — mass and aerodynamic.	1	2
11.3.5 Nacelles/Pylons (ATA 54) Nacelles/Pylons: — Construction, — Firewalls, — Engine mounts.	1	2
11.4 Air Conditioning and Cabin Pressurisation (ATA 21) *11.4.1 Air supply* Sources of air supply including engine bleed, APU and ground cart.	1	2
11.4.2 Air Conditioning Air conditioning systems; Air cycle and vapour cycle machines; Distribution systems; Flow, temperature and humidity control system.	1	3
11.4.3 Pressurisation Pressurisation systems; Control and indication including control and safety valves; Cabin pressure controllers.	1	3
11.4.4 Safety and warning devices Protection and warning devices.	1	3
11.5 Instruments/Avionic Systems *11.5.1 Instrument Systems (ATA 31)* Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Angle of attack indication, stall warning systems; Glass cockpit; Other aircraft system indication.	1	2
11.5.2 Avionic Systems Fundamentals of system lay-outs and operation of: — Auto Flight (ATA 22), — Communications (ATA 23), — Navigation Systems (ATA 34).	1	1
11.6 Electrical Power (ATA 24) Batteries Installation and Operation; DC power generation; AC power generation; Emergency power generation;	1	3

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A1	B1.1
Voltage regulation; Power distribution; Inverters, transformers, rectifiers; Circuit protection; External/Ground power.		
11.7 Equipment and Furnishings (ATA 25) (a) Emergency equipment requirements; Seats, harnesses and belts.	2	2
(b) Cabin lay-out; Equipment lay-out; Cabin Furnishing installation; Cabin entertainment equipment; Galley installation; Cargo handling and retention equipment; Airstairs.	1	1
11.8 Fire Protection (ATA 26) (a) Fire and smoke detection and warning systems; Fire extinguishing systems; System tests;	1	3
(b) Portable fire extinguisher.	1	2
11.9 Flight Controls (ATA 27) Primary controls: aileron, elevator, rudder, spoiler; Trim control; Active load control; High lift devices; Lift dump, speed brakes; System operation: manual, hydraulic, pneumatic, electrical, fly-by-wire; Artificial feel, Yaw damper, Mach trim, rudder limiter, gust lock systems; Balancing and rigging; Stall protection/warning system.	1	3
11.10 Fuel Systems (ATA 28) System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling; Longitudinal balance fuel systems.	1	3
11.11 Hydraulic Power (ATA 29) System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems.	1	3
11.12 Ice and Rain Protection (ATA 30)	1	3

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A1	B1.1
Ice formation, classification and detection; Anti-icing systems: electrical, hot air and chemical; De-icing systems: electrical, hot air, pneumatic and chemical; Rain repellent; Probe and drain heating; Wiper systems.		
11.13 Landing Gear (ATA 32) Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and autobraking; Tyres; Steering; Air-ground sensing.	2	3
11.14 Lights (ATA 33) External: navigation, anti collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	2	3
11.15 Oxygen (ATA 35) System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings.	1	3
11.16 Pneumatic/Vacuum (ATA 36) System lay-out; Sources: engine/APU (Auxiliary Power Unit), compressors, reservoirs, ground supply; Pressure and vacuum pumps; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.	1	3
11.17 Water/Waste (ATA 38) Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects.	2	3
11.18 On Board Maintenance Systems (ATA 45) Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).	1	2
11.19 Integrated Modular Avionics (ATA42) Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others:	1	2

MODULE 11A. TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A1	**B1.1**
Bleed Management, Air Pressure Control, Air Ventilation and Control, Avionics and Cockpit Ventilation Control, Temperature Control, Air Traffic Communication, Avionics Communication Router, Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control, Landing Gear Extension and Retraction, Tyre Pressure Indication, Oleo Pressure Indication, Brake Temperature Monitoring, etc. Core System; Network Components.		
11.20 Cabin Systems (ATA44) The units and components which furnish a means of entertaining the passengers and providing communication within the aircraft (Cabin Intercommunication Data System (CIDS)) and between the aircraft cabin and ground stations (Cabin Network Service (CNS)). They include voice, data, music and video transmissions. CIDS provides an interface between cockpit/cabin crew and cabin systems. These systems support data exchange between the different related Line Replaceable Units (LRUs) and they are typically operated via Flight Attendant Panels (FAPs). CNS typically consists of a server, interfacing with, among others, the following systems: — Data/Radio Communication; — Cabin Core System (CCS); — In-flight Entertainment System (IFES); — External Communication System (ECS); — Cabin Mass Memory System (CMMS); — Cabin Monitoring System (CMS); — Miscellaneous Cabin Systems (MCSs). CNS may host functions such as: — access to pre-departure/departure reports; — e-mail/intranet/internet access; passenger database.	1	2
11.21 Information Systems (ATA46) The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include Air Traffic and Information Management Systems and Network Server Systems Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	1	2

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

Note 1: This module does not apply to category B3. Relevant subject matters for category B3 are defined in module 11C.

Note 2: The scope of this Module shall reflect the technology of aeroplanes pertinent to the A2 and B1.2 subcategory.

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A2	**B1.2**
11.1 Theory of Flight *11.1.1. Aeroplane Aerodynamics and Flight Controls* Operation and effect of: — roll control: ailerons and spoilers, — pitch control: elevators, stabilators, variable incidence stabilisers and canards, — yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flaperons; Drag inducing devices, spoilers, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices; Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels.	1	2
11.1.2. High Speed Flight — N/A	—	—
11.2 Airframe Structures — General Concepts (a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision; Aircraft bonding.	2	2
(b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.	1	2
11.3 Airframe Structures — Aeroplanes *11.3.1 Fuselage (ATA 52/53/56)* Construction and pressurisation sealing; Wing, tail-plane, pylon and undercarriage attachments; Seat installation; Doors and emergency exits: construction and operation; Windows and windscreen attachment.	1	2
11.3.2 Wings (ATA 57)	1	2

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A2	B1.2
Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.		
11.3.3 Stabilisers (ATA 55) Construction; Control surface attachment.	1	2
11.3.4 Flight Control Surfaces (ATA 55/57) Construction and attachment; Balancing — mass and aerodynamic.	1	2
11.3.5 Nacelles/Pylons (ATA 54) Nacelles/Pylons: — Construction, — Firewalls, — Engine mounts.	1	2
11.4 Air Conditioning and Cabin Pressurisation (ATA 21) Pressurisation and air conditioning systems; Cabin pressure controllers, protection and warning devices; Heating systems.	1	3
11.5 Instruments/Avionic Systems *11.5.1 Instrument Systems (ATA 31)* Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Angle of attack indication, stall warning systems; Glass cockpit; Other aircraft system indication.	1	2
11.5.2 Avionic Systems Fundamentals of system lay-outs and operation of: — Auto Flight (ATA 22), — Communications (ATA 23), — Navigation Systems (ATA 34).	1	1
11.6 Electrical Power (ATA 24) Batteries Installation and Operation; DC power generation; Voltage regulation; Power distribution; Circuit protection; Inverters, transformers.	1	3
11.7 Equipment and Furnishings (ATA 25) (a) Emergency equipment requirements; Seats, harnesses and belts;	2	2
(b) Cabin lay-out; Equipment lay-out; Cabin Furnishing installation; Cabin entertainment equipment; Galley installation; Cargo handling and retention equipment; Airstairs.	1	1
11.8 Fire Protection (ATA 26)		

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL A2	LEVEL B1.2
(a) Fire and smoke detection and warning systems; Fire extinguishing systems; System tests;	1	3
(b) Portable fire extinguisher.	1	2
11.9 Flight Controls (ATA 27) Primary controls: aileron, elevator, rudder; Trim tabs; High lift devices; System operation: manual; Gust locks; Balancing and rigging; Stall warning system.	1	3
11.10 Fuel Systems (ATA 28) System lay-out; Fuel tanks; Supply systems; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	1	3
11.11 Hydraulic Power (ATA 29) System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical; Filters; Pressure Control; Power distribution; Indication and warning systems.	1	3
11.12 Ice and Rain Protection (ATA 30) Ice formation, classification and detection; De-icing systems: electrical, hot air, pneumatic and chemical; Probe and drain heating; Wiper systems.	1	3
11.13 Landing Gear (ATA 32) Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and autobraking; Tyres; Steering; Air-ground sensing.	2	3
11.14 Lights (ATA 33) External: navigation, anti collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	2	3
11.15 Oxygen (ATA 35) System lay-out: cockpit, cabin; Sources, storage, charging and distribution;Supply regulation; Indications and warnings.	1	3
11.16 Pneumatic/Vacuum (ATA 36)	1	3

MODULE 11B. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL	
	A2	B1.2
System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure and vacuum pumps; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.		
11.17 Water/Waste (ATA 38) Water system lay-out, supply, distribution, servicing and draining; Toilet system lay-out, flushing and servicing; Corrosion aspects.	2	3

MODULE 11C. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) No 1321/2014

Note: The scope of this module shall reflect the technology of aeroplanes pertinent to the B3 category.

MODULE 11C. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL B3.1
11.1 Theory of Flight Aeroplane Aerodynamics and Flight Controls Operation and effect of: — roll control: ailerons, — pitch control: elevators, stabilators, variable incidence stabilisers and canards, — yaw control, rudder limiters; Control using elevons, ruddervators; High lift devices, slots, slats, flaps, flaperons; Drag inducing devices, lift dumpers, speed brakes; Effects of wing fences, saw tooth leading edges; Boundary layer control using, vortex generators, stall wedges or leading edge devices; Operation and effect of trim tabs, balance and anti-balance (leading) tabs, servo tabs, spring tabs, mass balance, control surface bias, aerodynamic balance panels.	1
11.2 Airframe Structures — General Concepts (a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision; Aircraft bonding;	2
(b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning; Airframe symmetry: methods of alignment and symmetry checks.	2
11.3 Airframe Structures — Aeroplanes *11.3.1 Fuselage (ATA 52/53/56)* Construction; Wing, tail-plane, pylon and undercarriage attachments; Seat installation; Doors and emergency exits: construction and operation; Window and windscreen attachment.	1
11.3.2 Wings (ATA 57) Construction; Fuel storage; Landing gear, pylon, control surface and high lift/drag attachments.	1
11.3.3 Stabilisers (ATA 55) Construction; Control surface attachment.	1

MODULE 11C. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL B3.1
11.3.4 Flight Control Surfaces (ATA 55/57) Construction and attachment; Balancing — mass and aerodynamic.	1
11.3.5 Nacelles/Pylons (ATA 54) Nacelles/Pylons: — Construction, — Firewalls, — Engine mounts.	1
11.4 Air Conditioning (ATA 21) Heating and ventilation systems.	1
11.5 Instruments/Avionic Systems *11.5.1 Instrument Systems (ATA 31)* Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Angle of attack indication, stall warning systems; Glass cockpit; Other aircraft system indication.	1
11.5.2 Avionic Systems Fundamentals of system lay-outs and operation of: — Auto Flight (ATA 22), — Communications (ATA 23), — Navigation Systems (ATA 34).	1
11.6 Electrical Power (ATA 24) Batteries Installation and Operation; DC power generation; Voltage regulation; Power distribution; Circuit protection; Inverters, transformers.	2
11.7 Equipment and Furnishings (ATA 25) Emergency equipment requirements; Seats, harnesses and belts.	2
11.8 Fire Protection (ATA 26) Portable fire extinguisher.	2
11.9 Flight Controls (ATA 27) Primary controls: aileron, elevator, rudder; Trim tabs; High lift devices; System operation: manual; Gust locks; Balancing and rigging; Stall warning system.	3
11.10 Fuel Systems (ATA 28) System lay-out; Fuel tanks; Supply systems;	2

MODULE 11C. PISTON AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL **B3.1**
Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	
11.11 Hydraulic Power (ATA 29) System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical; Filters; Pressure Control; Power distribution; Indication and warning systems.	2
11.12 Ice and Rain Protection (ATA 30) Ice formation, classification and detection; De-icing systems: electrical, hot air, pneumatic and chemical; Probe and drain heating; Wiper systems.	1
11.13 Landing Gear (ATA 32) Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, brakes, antiskid and autobraking; Tyres; Steering.	2
11.14 Lights (ATA 33) External: navigation, anti collision, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	2
11.15 Oxygen (ATA 35) System lay-out: cockpit, cabin; Sources, storage, charging and distribution; Supply regulation; Indications and warnings.	2
11.16 Pneumatic/Vacuum (ATA 36) System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure and vacuum pumps Pressure control; Distribution; Indications and warnings; Interfaces with other systems.	2

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A3 A4 A5* A6*	**B1.3 B1.4 B1.5* B1.6***	**B3.2***
12.1 Theory of Flight — Rotary Wing Aerodynamics Terminology; Effects of gyroscopic precession; Torque reaction and directional control; Dissymmetry of lift, Blade tip stall; Translating tendency and its correction; Coriolis effect and compensation; Vortex ring state, power settling, overpitching; Auto-rotation; Ground effect.	1	2	1
12.2 Flight Control Systems Cyclic control; Collective control; Swashplate; Yaw control: Anti-Torque Control, Tail rotor, bleed air; Main Rotor Head: Design and Operation features; Blade Dampers: Function and construction; Rotor Blades: Main and tail rotor blade construction and attachment; Trim control, fixed and adjustable stabilisers; System operation: manual, hydraulic, electrical and fly-by-wire; Artificial feel; Balancing and rigging.	2	3	3
12.3 Blade Tracking and Vibration Analysis Rotor alignment; Main and tail rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance.	1	3	2
12.4 Transmission Gear boxes, main and tail rotors; Clutches, free wheel units and rotor brake; Tail rotor drive shafts, flexible couplings, bearings, vibration dampers and bearing hangers.	1	3	2
12.5 Airframe Structures (a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision;	2	2	2
(b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties,	1	2	2

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A3 A4 A5* A6*	B1.3 B1.4 B1.5* B1.6*	B3.2*
beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection. Pylon, stabiliser and undercarriage attachments; Seat installation; Doors: construction, mechanisms, operation and safety devices; Windows and windscreen construction; Fuel storage; Firewalls; Engine mounts; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning. Airframe symmetry: methods of alignment and symmetry checks.			
12.6 Air Conditioning (ATA 21) *12.6.1 Air supply* Sources of air supply including engine bleed and ground cart.	1	2	2
12.6.2 Air conditioning Air conditioning systems; Distribution systems; Flow and temperature control systems; Protection and warning devices.	1	3	2
12.7 Instruments/Avionic Systems *12.7.1 Instrument Systems (ATA 31)* Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Vibration indicating systems — HUMS; Glass cockpit; Other aircraft system indication.	1	2	2
12.7.2 Avionic Systems Fundamentals of system layouts and operation of: Auto Flight (ATA 22); Communications (ATA 23); Navigation Systems (ATA 34).	1	1	1
12.8 Electrical Power (ATA 24) Batteries Installation and Operation; DC power generation, AC power generation; Emergency power generation; Voltage regulation, Circuit protection. Power distribution; Inverters, transformers, rectifiers; External/Ground power.	1	3	2
12.9 Equipment and Furnishings (ATA 25) (a) Emergency equipment requirements; Seats, harnesses and belts;	2	2	2

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A3 A4 A5* A6*	B1.3 B1.4 B1.5* B1.6*	B3.2*
Lifting systems;			
(b) Emergency flotation systems; Cabin lay-out, cargo retention; Equipment lay-out; Cabin Furnishing Installation.	1	1	1
12.10 Fire Protection (ATA 26) Fire and smoke detection and warning systems; Fire extinguishing systems; System tests.	1	3	2
12.11 Fuel Systems (ATA 28) System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	1	3	2
12.12 Hydraulic Power (ATA 29) System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems.	1	3	2
12.13 Ice and Rain Protection (ATA 30) Ice formation, classification and detection; Anti-icing and De-icing systems: electrical, hot air and chemical; Rain repellent and removal; Probe and drain heating; Wiper system.	1	3	2
12.14 Landing Gear (ATA 32) Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, Tyres, brakes; Steering; Air-ground sensing; Skids, floats.	2	3	2
12.15 Lights (ATA 33) External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	2	3	2
12.16 Pneumatic/Vacuum (ATA 36)	1	3	2

MODULE 12. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A3 A4 A5* A6*	B1.3 B1.4 B1.5* B1.6*	B3.2*
System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure and vacuum pumps; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.			
12.17 Integrated Modular Avionics (ATA42) Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others: Bleed Management, Air Pressure Control, Air Ventilation and Control, Avionics and Cockpit Ventilation Control, Temperature Control, Air Traffic Communication, Avionics Communication Router, Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control, Landing Gear Extension and Retraction, Tyre Pressure Indication, Oleo Pressure Indication, Brake Temperature Monitoring, etc. Core System; Network Components.	1	2	2
12.18 On Board Maintenance Systems (ATA45) Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).	1	2	2
12.19 Information Systems (ATA46) The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include Air Traffic and Information Management Systems and Network Server Systems. Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	1	2	2

***) For gyroplanes select module 12 in combination with module 19, or only module 18.**

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL **B2** **B2L**
13.1 *Theory of Flight* (a) *Aeroplane Aerodynamics and Flight Controls* Operation and effect of: — roll control: ailerons and spoilers; — pitch control: elevators, stabilators, variable incidence stabilisers and canards; and — yaw control: rudder limiters; Control using elevons, ruddervators; High lift devices: slots, slats, flaps; Drag inducing devices: spoilers, lift dumpers, speed brakes; and Operation and effect of trim tabs, servo tabs and control surface bias.	1
(b) *High Speed Flight* Speed of sound, subsonic flight, transonic flight, supersonic flight; Mach number, critical Mach number.	1
(c) *Rotary Wing Aerodynamics* Terminology; Operation and effect of cyclic, collective and anti-torque controls.	1
13.2 *Structures — General Concepts* Fundamentals of Structural Systems	1
Zonal and Station Identification Systems	2
Electrical bonding	2
Lightning strike protection provision.	2
13.3 *Autoflight (ATA 22)* *(a)* Fundamentals of automatic flight control including working principles and current terminology; Command signal processing; Modes of operation: roll, pitch and yaw channels; Yaw dampers; Stability Augmentation System in helicopters; Automatic trim control; Autopilot navigation aids interface;	3
(b) Autothrottle systems; Automatic landing systems: principles and categories, modes of operation, approach, glideslope, land, go-around, system monitors and failure conditions.	3
13.4 *Communication/Navigation (ATA 23/34)* *(a)* Fundamentals of radio wave propagation, antennas, transmission lines, communication, receiver and transmitter; Working principles of following systems: — Very High Frequency (VHF) communication; — High Frequency (HF) communication; — Audio;	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL B2 B2L
— Emergency Locator Transmitters (ELTs); — Cockpit Voice Recorder (CVR); — Very High Frequency Omnidirectional Range (VOR); — Automatic Direction Finding (ADF); — Instrument Landing System (ILS); — Flight Director Systems (FDSs), Distance Measuring Equipment (DME); — Area navigation, RNAV systems; — Flight Management Systems (FMSs); — Global Positioning System (GPS), Global Navigation Satellite Systems (GNSSs); — Data Link.	
(b) — Air Traffic Control transponder, secondary surveillance radar; — Traffic Alert and Collision Avoidance System (TCAS); — Weather avoidance radar; — Radio altimeter; — Automatic Dependent Surveillance — Broadcast (ADS-B).	3
(c) — Microwave Landing System (MLS); — Very Low Frequency and hyperbolic navigation (VLF/Omega); — Doppler navigation; — Inertial Navigation System (INS); — ARINC (Aircraft Radio Incorporated) communication and reporting.	3
13.5 *Electrical Power (ATA 24)* Batteries installation and operation; Direct Current (DC) power generation; Alternating Current (AC) power generation; Emergency power generation; Voltage regulation; Power distribution; Inverters, transformers, rectifiers; Circuit protection; External/Ground power.	3
13.6 *Equipment and Furnishings (ATA 25)* Electronic emergency equipment requirements; Cabin entertainment equipment.	3
13.7 *Flight Controls (ATA 27)* *(a)* Primary controls: aileron, elevator, rudder, spoiler; Trim control; Active load control; High lift devices; Lift dump, speed brakes; System operation: manual, hydraulic, pneumatic; Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks; Stall protection systems.	2
(b) System operation: electrical, fly-by-wire.	3
13.8 *Instruments (ATA 31)* Classification; Atmosphere;	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL **B2** **B2L**
Terminology; Pressure-measuring devices and systems; Pitot-static systems; Altimeters; Vertical-speed indicators; Airspeed indicators; Machmeters; Altitude-reporting/alerting systems; Air data computers; Instrument pneumatic systems; Direct-reading pressure and temperature gauges; Temperature-indicating systems; Fuel-quantity-indicating systems; Gyroscopic principles; Artificial horizons; Slip indicators; Directional gyros; Ground Proximity Warning Systems (GPWSs); Compass systems; Flight Data Recording Systems (FDRSs); Electronic Flight Instrument Systems (EFISs); Instrument warning systems including master warning systems and centralised warning panels; Stall warning systems and angle of attack-indicating systems; Vibration measurement and indication; Glass cockpit.	
13.9 *Lights (ATA 33)* External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	3
13.10 *On Board Maintenance Systems (ATA 45)* Central maintenance computers; Data-loading system; Electronic-library system; Printing system; Structure-monitoring (damage tolerance monitoring).	3
13.11 *Air Conditioning and Cabin Pressurisation (ATA 21)* 13.11.1. *Air supply* Sources of air supply including engine bleed, APU and ground cart;	2
13.11.2. *Air Conditioning* Air-conditioning systems;	2
Air cycle and vapour cycle machines;	3
Distribution systems;	1
Flow, temperature and humidity control system.	3
13.11.3. *Pressurisation* Pressurisation systems; Control and indication including control and safety valves; Cabin pressure controllers.	3
13.11.4. *Safety and warning devices*	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL **B2** **B2L**
Protection and warning devices.	
13.12 *Fire Protection (ATA 26)* *(a)* Fire and smoke detection and warning systems; Fire-extinguishing systems; System tests;	3
(b) Portable fire extinguisher.	1
13.13 *Fuel Systems (ATA 28)*	
System layout;	1
Fuel tanks;	1
Supply systems;	1
Dumping, venting and draining;	1
Cross feed and transfer;	2
Indications and warnings;	3
Refuelling and defuelling;	2
Longitudinal-balance fuel systems.	3
13.14 Hydraulic Power (ATA 29)	
System layout;	1
Hydraulic fluids;	1
Hydraulic reservoirs and accumulators;	1
Pressure generation: electrical, mechanical, pneumatic;	3
Emergency pressure generation;	3
Filters;	1
Pressure control;	3
Power distribution;	1
Indication and warning systems;	3
Interface with other systems.	3
13.15 Ice and Rain Protection (ATA 30)	
Ice formation, classification and detection;	2
Anti-icing systems: electrical, hot-air and chemical;	2
De-icing systems: electrical, hot-air, pneumatic, chemical;	3
Rain-repellent;	1
Probe and drain-heating;	3
Wiper systems.	1
13.16 *Landing Gear (ATA 32)*	
Construction, shock absorbing;	1
Extension and retraction systems: normal and emergency;	3
Indications and warnings;	3
Wheels, brakes, antiskid and automatic braking systems;	3
Tyres;	1
Steering;	3
Air-ground sensing.	3
13.17 *Oxygen (ATA 35)*	
System layout: cockpit, cabin;	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL B2 B2L
Sources, storage, charging and distribution;	3
Supply regulation;	3
Indications and warnings.	3
13.18 *Pneumatic/Vacuum (ATA 36)*	
System layout;	2
Sources: engine/APU, compressors, reservoirs, ground supply;	2
Pressure control;	3
Distribution;	1
Indications and warnings;	3
Interfaces with other systems.	3
13.19 *Water/Waste (ATA 38)* Water system layout, supply, distribution, servicing and draining; Toilet system layout, flushing and servicing.	2
13.20 *Integrated Modular Avionics (ATA 42)* Core system; Network components. *Note: Functions that may be typically integrated into the IMA modules are among others:* *— bleed management;* *— air pressure control;* *— air ventilation and control;* *— avionics and cockpit ventilation control, temperature control;* *— air traffic communication;* *— avionics communication router;* *— electrical load management;* *— circuit breaker monitoring;* *— electrical system Built-In Test Equipment (BITE);* *— fuel management;* *— braking control;* *— steering control;* *— landing gear extension and retraction;* *— tyre pressure indication;* *— oleo pressure indication;* *— brake temperature monitoring.*	3
13.21 *Cabin Systems (ATA 44)* The units and components which furnish a means of entertaining the passengers and providing communication within the aircraft (Cabin Intercommunication Data System (CIDS)) and between the aircraft cabin and ground stations (Cabin Network Service (CNS)). They include voice, data, music and video transmissions. CIDS provides an interface between cockpit/cabin crew and cabin systems. These systems support data exchange between the different related Line Replaceable Units (LRUs) and they are typically operated via Flight Attendant Panels (FAPs). CNS typically consists of a server, interfacing with, among others, the following systems: — Data/Radio Communication; — Cabin Core System (CCS); — In-flight Entertainment System (IFES); — External Communication System (ECS); — Cabin Mass Memory System (CMMS);	3

MODULE 13. AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL **B2** **B2L**
— Cabin Monitoring System (CMS); — Miscellaneous Cabin Systems (MCSs). CNS may host functions such as: — access to pre-departure/departure reports; — e-mail/intranet/internet access; — passenger database.	
13.22 *Information Systems (ATA 46)* The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. They include units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller, but they do not include units or components installed for other uses and shared with other systems, such as flight deck printer or general-use display. Typical examples include: — Air Traffic and Information Management systems and Network Server systems. — Aircraft general information system; — Flight deck information system; — Maintenance information system; — Passenger cabin information system; — Miscellaneous information systems.	3

MODULE 14. PROPULSION

Regulation (EU) 2018/1142

MODULE 14. PROPULSION	LEVEL **B2** **B2L**
14.1 Turbine Engines (a) Constructional arrangement and operation of turbojet, turbofan, turboshaft and turbopropeller engines;	1
(b) Electronic Engine control and fuel metering systems (FADEC).	2
14.2 Engine Indicating Systems Exhaust gas temperature/Interstage turbine temperature systems; Engine speed; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure, temperature and flow; Manifold pressure; Engine torque; Propeller speed.	2
14.3 Starting and Ignition Systems Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements.	2

MODULE 15. GAS TURBINE ENGINE

Regulation (EU) No 1321/2014

MODULE 15. GAS TURBINE ENGINE	LEVEL	
	A	**B1**
15.1 Fundamentals Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; The relationship between force, work, power, energy, velocity, acceleration; Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop.	1	2
15.2 Engine Performance Gross thrust, net thrust, choked nozzle thrust, thrust distribution, resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; Engine efficiencies; By-pass ratio and engine pressure ratio; Pressure, temperature and velocity of the gas flow; Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations.	—	2
15.3 Inlet Compressor inlet ducts Effects of various inlet configurations; Ice protection.	2	2
15.4 Compressors Axial and centrifugal types; Constructional features and operating principles and applications; Fan balancing; Operation: Causes and effects of compressor stall and surge; Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; Compressor ratio.	1	2
15.5 Combustion Section Constructional features and principles of operation.	1	2
15.6 Turbine Section Operation and characteristics of different turbine blade types; Blade to disk attachment; Nozzle guide vanes; Causes and effects of turbine blade stress and creep.	2	2
15.7 Exhaust Constructional features and principles of operation; Convergent, divergent and variable area nozzles; Engine noise reduction; Thrust reversers.	1	2
15.8 Bearings and Seals Constructional features and principles of operation.	—	2
15.9 Lubricants and Fuels Properties and specifications; Fuel additives; Safety precautions.	1	2
15.10 Lubrication Systems System operation/lay-out and components.	1	2

MODULE 15. GAS TURBINE ENGINE	LEVEL	
	A	B1
15.11 Fuel Systems Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.	1	2
15.12 Air Systems Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.	1	2
15.13 Starting and Ignition Systems Operation of engine start systems and components; Ignition systems and components; Maintenance safety requirements.	1	2
15.14 Engine Indication Systems Exhaust Gas Temperature/Interstage Turbine Temperature; Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; Oil pressure and temperature; Fuel pressure and flow; Engine speed; Vibration measurement and indication; Torque; Power.	1	2
15.15 Power Augmentation Systems Operation and applications; Water injection, water methanol; Afterburner systems.	—	1
15.16 Turbo-prop Engines Gas coupled/free turbine and gear coupled turbines; Reduction gears; Integrated engine and propeller controls; Overspeed safety devices.	1	2
15.17 Turbo-shaft Engines Arrangements, drive systems, reduction gearing, couplings, control systems.	1	2
15.18 Auxiliary Power Units (APUs) Purpose, operation, protective systems.	1	2
15.19 Powerplant Installation Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	1	2
15.20 Fire Protection Systems Operation of detection and extinguishing systems.	1	2
15.21 Engine Monitoring and Ground Operation Procedures for starting and ground run-up; Interpretation of engine power output and parameters; Trend (including oil analysis, vibration and boroscope) monitoring; Inspection of engine and components to criteria, tolerances and data specified by engine manufacturer; Compressor washing/cleaning; Foreign Object Damage.	1	3

MODULE 15. GAS TURBINE ENGINE	LEVEL	
	A	B1
15.22 Engine Storage and Preservation Preservation and depreservation for the engine and accessories/systems.	—	2

MODULE 16. PISTON ENGINE

Regulation (EU) No 1321/2014

MODULE 16. PISTON ENGINE	LEVEL		
	A	**B1**	**B3**
16.1 Fundamentals Mechanical, thermal and volumetric efficiencies; Operating principles — 2 stroke, 4 stroke, Otto and Diesel; Piston displacement and compression ratio; Engine configuration and firing order.	1	2	2
16.2 Engine Performance Power calculation and measurement; Factors affecting engine power; Mixtures/leaning, pre-ignition.	1	2	2
16.3 Engine Construction Crank case, crank shaft, cam shafts, sumps; Accessory gearbox; Cylinder and piston assemblies; Connecting rods, inlet and exhaust manifolds; Valve mechanisms; Propeller reduction gearboxes.	1	2	2
16.4 Engine Fuel Systems *16.4.1 Carburettors* Types, construction and principles of operation; Icing and heating.	1	2	2
16.4.2 Fuel injection systems Types, construction and principles of operation.	1	2	2
16.4.3 Electronic engine control Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.	1	2	2
16.5 Starting and Ignition Systems Starting systems, pre-heat systems; Magneto types, construction and principles of operation; Ignition harnesses, spark plugs; Low and high tension systems.	1	2	2
16.6 Induction, Exhaust and Cooling Systems Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems — air and liquid.	1	2	2
16.7 Supercharging/Turbocharging Principles and purpose of supercharging and its effects on engine parameters; Construction and operation of supercharging/turbocharging systems; System terminology; Control systems; System protection.	1	2	2
16.8 Lubricants and Fuels Properties and specifications; Fuel additives; Safety precautions.	1	2	2

MODULE 16. PISTON ENGINE	LEVEL		
	A	B1	B3
16.9 Lubrication Systems System operation/lay-out and components.	1	2	2
16.10 Engine Indication Systems Engine speed; Cylinder head temperature; Coolant temperature; Oil pressure and temperature; Exhaust Gas Temperature; Fuel pressure and flow; Manifold pressure.	1	2	2
16.11 Powerplant Installation Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.	1	2	2
16.12 Engine Monitoring and Ground Operation Procedures for starting and ground run-up; Interpretation of engine power output and parameters; Inspection of engine and components: criteria, tolerances, and data specified by engine manufacturer.	1	3	2
16.13 Engine Storage and Preservation Preservation and depreservation for the engine and accessories/systems.	—	2	1

MODULE 17A. PROPELLER

Regulation (EU) No 1321/2014

Note: This module does not apply to category B3. Relevant subject matters for category B3 are defined in module 17B.

MODULE 17A. PROPELLER	LEVEL	
	A	**B1**
17.1 Fundamentals Blade element theory; High/low blade angle, reverse angle, angle of attack, rotational speed; Propeller slip; Aerodynamic, centrifugal, and thrust forces; Torque; Relative airflow on blade angle of attack; Vibration and resonance.	1	2
17.2 Propeller Construction Construction methods and materials used in wooden, composite and metal propellers; Blade station, blade face, blade shank, blade back and hub assembly; Fixed pitch, controllable pitch, constant speeding propeller; Propeller/spinner installation.	1	2
17.3 Propeller Pitch Control Speed control and pitch change methods, mechanical and electrical/electronic; Feathering and reverse pitch; Overspeed protection.	1	2
17.4 Propeller Synchronising Synchronising and synchrophasing equipment.	—	2
17.5 Propeller Ice Protection Fluid and electrical de-icing equipment.	1	2
17.6 Propeller Maintenance Static and dynamic balancing; Blade tracking; Assessment of blade damage, erosion, corrosion, impact damage, delamination; Propeller treatment/repair schemes; Propeller engine running.	1	3
17.7 Propeller Storage and Preservation Propeller preservation and depreservation.	1	2

MODULE 17B. PROPELLER

Regulation (EU) No 1321/2014

Note: The scope of this Module shall reflect the propeller technology of aeroplanes pertinent to the B3 category.

MODULE 17B. PROPELLER	LEVEL B3
17.1 Fundamentals Blade element theory; High/low blade angle, reverse angle, angle of attack, rotational speed; Propeller slip; Aerodynamic, centrifugal, and thrust forces; Torque; Relative airflow on blade angle of attack; Vibration and resonance.	2
17.2 Propeller Construction Construction methods and material used in wooden, composite and metal propellers; Blade station, blade face, blade shank, blade back and hub assembly; Fixed pitch, controllable pitch, constant speeding propeller; Propeller/spinner installation.	2
17.3 Propeller Pitch Control Speed control and pitch change methods, mechanical and electrical/electronic; Feathering and reverse pitch; Overspeed protection.	2
17.4 Propeller Synchronising Synchronising and synchrophasing equipment.	2
17.5 Propeller Ice Protection Fluid and electrical de-icing equipment.	2
17.6 Propeller Maintenance Static and dynamic balancing; Blade tracking; Assessment of blade damage, erosion, corrosion, impact damage, delamination; Propeller treatment/repair schemes; Propeller engine running.	2
17.7 Propeller Storage and Preservation Propeller preservation and depreservation.	2

MODULE 18. GYROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

MODULE 18. GYROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A5 A6	**B1.5 B1.6**	**B3.2**
18.1 Theory of Flight — Rotary Wing Aerodynamics Terminology; Effects of gyroscopic precession; Blade lift and drag; Dissymmetry of lift; Auto-rotation; Ground effect; Pre-rotate, take off, flight, and landing characteristics Gyroplane pitch stability, influence of center of gravity, body aerodynamics, Thrust line, Horizontal tail; Gyroplane yaw stability; Taxi stability and roll-over risk Power pushover, Pilot induced oscillations, low-g maneuvers	1	2	1
18.2 Flight Control Systems Rotor control systems; Yaw control systems; Main Rotor Head: Design and operation features; Rotor Blades: Structure, attachments; Trim control; System operation: manual, hydraulic, electrical and fly-by-wire; Artificial feel; Balancing and rigging.	2	3	3
18.3 Blade Tracking and Vibration Analysis Rotor alignment; Rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance.	1	3	2
18.4 Transmission Gearboxes for pre-rotator and propeller; Pre-rotator systems Clutches, free wheel units and rotor brake; Flexible couplings, drive shafts, bearings, vibration dampers and bearing hangers.	1	3	2
18.5 Airframe Structures (a) Airworthiness requirements for structural strength; Structural classification, primary, secondary and tertiary; Fail safe, safe life, damage tolerance concepts; Zonal and station identification systems; Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; Drains and ventilation provisions; System installation provisions; Lightning strike protection provision;	2	2	2

MODULE 18. GYROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A5 A6	**B1.5 B1.6**	**B3.2**
(b) Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection. Pylon, stabiliser and undercarriage attachments; Seat installation; Doors: construction, mechanisms, operation and safety devices; Windows and windscreen construction; Fuel storage; Firewalls; Engine mounts; Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; Surface cleaning. Airframe symmetry: methods of alignment and symmetry checks.	1	2	2
18.6 Air Conditioning (ATA 21) *18.6.1 Air supply* Sources of air supply including engine bleed and ground cart.	1	2	2
18.6.2 Air conditioning Air conditioning systems; Distribution systems; Flow and temperature control systems; Protection and warning devices.	1	3	2
18.7 Instruments/Avionic Systems *18.7.1 Instrument Systems (ATA 31)* Pitot static: altimeter, air speed indicator, vertical speed indicator; Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; Compasses: direct reading, remote reading; Vibration indicating systems — HUMS; Glass cockpit; Other aircraft system indication.	1	2	2
18.7.2 Avionic Systems Fundamentals of system layouts and operation of: Auto Flight (ATA 22); Communications (ATA 23); Navigation Systems (ATA 34).	1	1	1
18.8 Electrical Power (ATA 24) Batteries Installation and Operation; DC power generation, AC power generation; Emergency power generation; Voltage regulation, Circuit protection. Power distribution; Inverters, transformers, rectifiers; External/Ground power.	1	3	2
18.9 Equipment and Furnishings (ATA 25) (a) Emergency equipment requirements; Seats, harnesses and belts;	2	2	2

MODULE 18. GYROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A5 **A6**	**B1.5** **B1.6**	**B3.2**
Lifting systems;			
(b) Emergency flotation systems; Cabin lay-out, cargo retention; Equipment lay-out; Cabin Furnishing Installation.	1	1	1
18.10 Fire Protection (ATA 26) Fire and smoke detection and warning systems; Fire extinguishing systems; System tests.	1	3	2
18.11 Fuel Systems (ATA 28) System lay-out; Fuel tanks; Supply systems; Dumping, venting and draining; Cross-feed and transfer; Indications and warnings; Refuelling and defuelling.	1	3	2
18.12 Hydraulic Power (ATA 29) System lay-out; Hydraulic fluids; Hydraulic reservoirs and accumulators; Pressure generation: electric, mechanical, pneumatic; Emergency pressure generation; Filters; Pressure Control; Power distribution; Indication and warning systems; Interface with other systems.	1	3	2
18.13 Ice and Rain Protection (ATA 30) Ice formation, classification and detection; Anti-icing and De-icing systems: electrical, hot air and chemical; Rain repellent and removal; Probe and drain heating; Wiper system.	1	3	2
18.14 Landing Gear (ATA 32) Construction, shock absorbing; Extension and retraction systems: normal and emergency; Indications and warning; Wheels, Tyres, brakes; Steering; Air-ground sensing; Skids, floats.	2	3	2
18.15 Lights (ATA 33) External: navigation, landing, taxiing, ice; Internal: cabin, cockpit, cargo; Emergency.	2	3	2
18.16 Pneumatic/Vacuum (ATA 36)	1	3	2

MODULE 18. GYROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A5 A6	**B1.5 B1.6**	**B3.2**
System lay-out; Sources: engine/APU, compressors, reservoirs, ground supply; Pressure and vacuum pumps; Pressure control; Distribution; Indications and warnings; Interfaces with other systems.			
18.17 Integrated Modular Avionics (ATA42) Functions that may be typically integrated in the Integrated Modular Avionic (IMA) modules are, among others: Bleed Management, Air Pressure Control, Air Ventilation and Control, Avionics and Cockpit Ventilation Control, Temperature Control, Air Traffic Communication, Avionics Communication Router, Electrical Load Management, Circuit Breaker Monitoring, Electrical System BITE, Fuel Management, Braking Control, Steering Control, Landing Gear Extension and Retraction, Tyre Pressure Indication, Oleo Pressure Indication, Brake Temperature Monitoring, etc. Core System; Network Components.	1	2	2
18.18 On Board Maintenance Systems (ATA45) Central maintenance computers; Data loading system; Electronic library system; Printing; Structure monitoring (damage tolerance monitoring).	1	2	2
18.19 Information Systems (ATA46) The units and components which furnish a means of storing, updating and retrieving digital information traditionally provided on paper, microfilm or microfiche. Includes units that are dedicated to the information storage and retrieval function such as the electronic library mass storage and controller. Does not include units or components installed for other uses and shared with other systems, such as flight deck printer or general use display. Typical examples include Air Traffic and Information Management Systems and Network Server Systems. Aircraft General Information System; Flight Deck Information System; Maintenance Information System; Passenger Cabin Information System; Miscellaneous Information System.	1	2	2

MODULE 19. GYROPLANE SPECIFIC AERODYNAMICS, STRUCTURES AND SYSTEMS

Regulation (EU) 2018/1142

Module 19 is created for personnel already qualified for Module 12. Module 18 qualification is not required for personnel qualified for Module 12 and 19.

MODULE 19. GYROPLANE SPECIFIC AERODYNAMICS, STRUCTURES AND SYSTEMS	LEVEL		
	A5 A6	B1.5 B1.6	B3.2
19.1 Theory of Flight — Gyroplane Aerodynamics Terminology; Blade lift and drag; Auto-rotation; Ground effect; Pre-rotate, take off, flight, and landing characteristics Gyroplane pitch stability, influence of centre of gravity, body aerodynamics, Thrust line, Horizontal tail; Gyroplane yaw stability; Taxi stability and roll-over risk; Power pushover, pilot induced oscillations, low-g manoeuvres.	1	2	1
19.2 Flight Control Systems Rotor control systems; Yaw control systems; Main Rotor Head: Design and operation features; Rotor Blades: Structure, attachments; Trim control.	2	3	3
19.3 Blade Tracking and Vibration Analysis Rotor alignment; Rotor tracking; Static and dynamic balancing; Vibration types, vibration reduction methods; Ground resonance.	1	3	2
19.4 Transmission Gearboxes for pre-rotator and propeller; Pre-rotator systems Clutches, free wheel units and rotor brake; Flexible couplings, drive shafts, bearings, vibration dampers.	1	3	2

10.3 Appendix 3 – FCL regulatory proposal (NL initial proposal reviewed by EASA)

10.3.1 FLC rules

Initial Draft amendments to Regulation (EU) No 1178/2011

Note:

- Highlighted text indicates novelties
- Basis for the text: Regulation (EU) No 1178/2011 as proposed to be updated with Opinions No 05/2017 and 01/2019

10.3.1.1 Regulation (EU) No 1178/2011

Regulation (EU) No 1178/2011 is amended as follows:

In Article 9, paragraph 2 is replaced by the following:

‘2. Training commenced prior to the application of this Regulation in accordance with Annex 1 to the Chicago Convention or, in the case of gyroplanes, in accordance with national flight crew licensing requirements shall be given credit for the purposes of issuing Part-FCL licences on the basis of a credit report established by the Member State in consultation with the Agency.’.

10.3.1.2 Annex I (Part-FCL) to Regulation (EU) No 1178/2011

Annex I (Part-FCL) to Regulation (EU) No 1178/2011 is amended as follows:

(1) In point FCL.010, the following definition is inserted after the definition of "Flight and Navigation Procedures Trainer":
'"Gyroplane" means a heavier-than-air aircraft which is supported in flight chiefly by one or more non-engine-driven rotors.';

(2) in point FCL.025, point (i) of point (c)(1) is replaced by the following:
'(i) for the issue of a light aircraft pilot licence, a private pilot licence or a gyroplane pilot licence, for a period of 24 months;';

(3) in point FCL.055, point (a) is replaced by the following:
'(a) General. Aeroplane, helicopter, powered-lift, airship and gyroplane pilots required to use the radio telephone shall not exercise the privileges of their licences and ratings unless they have a language proficiency endorsement on their licence in either English or the language used for radio communications involved in the flight. The endorsement shall indicate the language, the proficiency level and the validity date, and it shall be obtained in accordance with a procedure established by a competent authority. The minimum acceptable proficiency level is the operational level (Level 4) in accordance with Appendix 2.';

(4) in point FCL.060, the introductory phrase of point (b) is replaced by the following:
'(b) Aeroplanes, helicopters, powered-lift aircraft, airships and gyroplanes. A pilot shall not operate an aircraft in commercial air transport or to carry passengers:';

(5) the title of Subpart C is replaced by the following
'PRIVATE PILOT LICENCE (PPL) AND GYROPLANE PILOT LICENCE (GPL)'

(6) point FCL.200 is replaced by the following:
'FCL.200 Minimum age
An applicant for a GPL or a PPL shall be at least 17 years of age.';

(7) in point FCL.210, point (a) and (b) are replaced by the following:
'(a) Applicants for a GPL or a PPL shall complete a training course at an ATO or a DTO.
(b) The course shall include theoretical knowledge and flight instruction appropriate to the privileges of the GPL or the PPL applied for.';

(8) in point FCL.215, the introductory sentence is replaced by the following:
'Applicants for a GPL or a PPL shall demonstrate a level of theoretical knowledge appropriate to the privileges granted through examinations in the following subjects:';

(9) in point FCL.235, point (a) is replaced by the following:
'(a) Applicants for a GPL or a PPL shall demonstrate through the completion of a skill test the ability to perform, as PIC on the appropriate aircraft category, the relevant procedures and manoeuvres with the competency appropriate to the privileges granted.';

(10) in Subpart C, a new Section 5 is added:

'*SECTION 5*

Specific requirements for the gyroplane pilot licence (GPL)

FCL.205.G GPL – Privileges and conditions

(a) The privileges of a GPL holder are to act as PIC in gyroplanes:
   (1) without remuneration in non-commercial operations; and
   (2) including the carriage of passengers only when he or she has completed 10 hours of flight time as PIC on gyroplanes after the issuance of the licence.

(b) By way of derogation from point (a), a GPL holder with instructor or examiner privileges may receive remuneration for:
   (1) the provision of flight instruction for the GPL;
   (2) the conduct of skill tests and proficiency checks for the GPL; and
   (3) the training, testing and checking for the ratings attached to a GPL.

(c) The exercise of the privileges granted by a GPL shall be dependent upon the compliance of the licence holder with the applicable recency requirements and upon the validity of the medical certificate.

FCL.210.G GPL – Experience requirements and crediting

(a) Applicants for a GPL shall have completed at least 45 hours of flight instruction in gyroplanes, 5 of which may have been completed in an FSTD, including at least:
   (1) 25 hours of dual flight instruction; and
   (2) 10 hours of supervised solo flight time, including at least 5 hours of solo cross-country flight time with at least 1 cross-country flight of at least 185 km (100 NM), during which full stop landings at 2 aerodromes different from the aerodrome of departure shall be made.

(b) Applicants holding a pilot licence for another category of aircraft, with the exception of balloons, shall be credited with 10 % of their total flight time as PIC on such aircraft up to a maximum of 20 hours. The amount of credit given shall in any case not include the requirements in point (a)(2).

(c) Applicants with prior experience as PIC on gyroplanes may receive credits towards the requirements of point (a) and the requirements for theoretical knowledge instruction. The amount of credit shall be decided by the DTO or the ATO where the pilot undergoes the training course, on the basis of pre-entry theoretical knowledge and flight assessments.

FCL.235.G GPL – Extension of privileges to another variant of gyroplane

Before a GPL holder can exercise the privileges of the licence on another variant of gyroplane than the one used for the skill test, the pilot shall either undertake differences training or do a familiarisation. The differences training shall be entered in the pilot's logbook or equivalent document and signed by the instructor.

FCL.240.G GPL – Recency requirements

(a) A GPL holder shall only exercise the privileges of his or her license when he or she has, in gyroplanes, in the last 24 months:
   (1) completed:

(i) at least 12 hours of flight time, including 12 take-offs and landings as PIC or flying dual or solo under the supervision of an FI(G); and

(ii) refresher training of at least 1 hour of total flight time with an instructor; or

(2) passed a proficiency check with an FE(G). The proficiency check shall be based on the skill test for GPL.’;

(11) in point (a) of point FCL.810, the introductory phrase and point (1) are replaced by the following:

‘(a) Aeroplanes, TMGs, airships, gyroplanes

(1) If the privileges of an LAPL or a PPL for aeroplanes, TMGs or airships or of a GPL are to be exercised in VFR conditions at night, applicants shall have completed a training course at a DTO or at an ATO. The course shall comprise:’;

(12) in point FCL.905.FI, point (a) is replaced by the following:

‘(a) a GPL as well as a PPL and LAPL in the appropriate aircraft category;’;

(13) point FCL.910.FI is amended as follows:

(a) in point (a), point (1) is replaced by the following:

‘(1) for the issue of the PPL, LAPL and GPL;’;

(b) in point (c), a new point (4) is added:

‘(4) for the FI(G):

(i) 100 hours of flight instruction in gyroplanes and, in addition, has supervised at least 25 student solo flight air exercises; or

(ii) in the case of an FI(G) who also holds an FI(A) or FI(H) certificate and complies with points (c)(1) or (c)(2), as applicable, 25 hours of flight instruction in gyroplanes and, in addition, has supervised at least 10 student solo flight air exercises.’;

(14) point FCL.915.FI, a new point (e) is added as follows:

‘(e) for an FI(G), completed at least 150 hours of flight time on gyroplanes, of which at least 100 hours as PIC.’;

(15) point FCL.930.FI is amended as follows:

(a) in point (b)(3), point (i) is replaced by the following:

‘(i) in the case of an FI(A), (H) and (G), at least 30 hours of flight instruction, of which 25 hours shall be dual flight instruction, of which 5 hours may be conducted in an FFS, an FNPT I or II or an FTD 2/3;’;

(b) in point (b), point (4) is replaced by the following:

‘(4) When applying for:

(i) an FI certificate in another category of aircraft, pilots holding or having held an FI(A), (H), (As) or (G) certificate shall be credited with 55 hours towards the requirement in point (b)(2);

(ii) an FI(G) certificate, pilots holding or having held an FI(A), (H) or (As) certificate shall be credited with 15 hours towards the requirement in point (b)(3)(i), of which a maximum of 10 hours shall be a credit towards the dual flight instruction time.’;

(16) point FCL.940.FI is amended as follows:

(a) in point (a)(1)(i), point (A) is replaced by the following:

(A) in the case of an FI(A), FI(H) and FI(G), at least 50 hours of flight instruction in the appropriate aircraft category during the period of validity of the certificate as FIs, TRIs, CRIs, IRIs, MIs or examiners. If the privileges to instruct for the BIR and the IR are to be revalidated, 10 of these 50 hours shall be flight instruction for an IR or BIR and shall have been completed within the last 12 months immediately preceding the expiry date of the FI certificate;';

(b) in point (a), point (2) is replaced by the following:

'(2) For at least each alternative subsequent revalidation, in the case of FI(A), FI(H) or FI(G), or each third revalidation, in the case of FI(As), the holder shall have to pass an assessment of competence in accordance with point FCL.935.';

(17) in point FCL.1005.FE, a new point (d) is added:

'(d) FE(G). The privileges of an FE for gyroplanes are to conduct skill tests and proficiency checks for the GPL, provided that the examiner has completed at least 1000 hours of flight time as a pilot on gyroplanes, including at least 250 hours of flight instruction of which up to 100 hours may be flight instruction conducted as FI(A) or FI(H).';

(18) in point FCL.1005.FIE, point (c) is replaced by the following:

'(c) FIE(As), (G). The privileges of an FIE on airships and gyroplanes are to conduct assessments of competence for the issue, revalidation or renewal of instructor certificates in the appropriate aircraft category, provided that the relevant instructor certificate is held.';

(19) in FCL.1010.FIE, a new point (d) is added:

'(d) FIE(G). Applicants for an FIE certificate for gyroplanes shall:

(1) hold the relevant instructor certificate, as applicable;

(2) have completed 2000 hours of flight time as a pilot on gyroplanes; and

(3) have completed at least 100 hours of flight time instructing applicants for an instructor certificate. In the case of applicants holding a valid FIE(A) or FIE(H) certificate, this requirement is reduced to 50 hours.';

(20) Appendix 1 is amended as follows:

(a) the title of point 1. is replaced by the following:

'1. LAPL, PPL and GPL';

(b) point 1.2 is replaced by the following:

'1.2. For the issue of an LAPL, a PPL or a GPL, holders of a GPL or a PPL, CPL or ATPL in another category of aircraft shall be fully credited with theoretical knowledge on the common subjects established in point FCL.215(a). This credit shall also apply to applicants for an LAPL or a PPL who hold a BPL issued in accordance with Annex III (Part-BFCL) to Commission Regulation (EU) 2018/395 or an SPL issued in accordance with Annex III (Part-SFCL) to Commission Implementing Regulation (EU) 2018/1976, except that the subject 'navigation' shall not be credited.'.

10.3.1.3 Annex IV (Part-MED) to Regulation (EU) No 1178/2011

Annex IV (Part-MED) to Regulation (EU) No 1178/2011 is amended as follows:

In point (c) of point MED.A.030, point (2) is replaced by the following:

'(2) private pilot licence (PPL) or a gyroplane pilot licence (GPL), the pilot shall hold at least a valid class 2 medical certificate;'.

10.3.1.4 Annex VI (Part-ARA) to Regulation (EU) No 1178/2011

Annex VI (Part-ARA) to Regulation (EU) No 1178/2011 is amended as follows:

(1) In point ARA.GEN.305, paragraph (ca) is replaced by the following:

'(ca) Notwithstanding point (c), for organisations only providing training towards the LAPL, PPL, GPL, SPL or BPL and associated ratings and certificates, an oversight planning cycle not exceeding 48 months shall be applied. The oversight planning cycle shall be reduced if there is evidence that the safety performance of the organisation holder has decreased.';

~~(1)~~(2) In Appendix I, in the template following paragraph (c), with the heading 'Cover page' (EASA Form 141 Issue 2), the phrase 'This licence complies with ICAO standards, except for the LAPL and EIR privileges' is replaced by the following:

'This licence complies with ICAO standards, except for the LAPL; GPL and BIR privileges or when accompanied by an LAPL medical certificate'.

10.3.1.5 Annex VII (Part-ORA) to Regulation (EU) No 1178/2011

Annex VII (Part-ORA) to Regulation (EU) No 1178/2011 is amended as follows:

(1) In point ORA.GEN.200, point (c) is replaced by the following:

'(c) Notwithstanding point (a), in an organisation providing training only for the LAPL, PPL, GPL, SPL or BPL and the associated ratings or certificates, safety risk management and compliance monitoring defined in points (a)(3) and (a)(6) may be accomplished by an organisational review, to be performed at least once every calendar year. The competent authority shall be notified about the results of this review by the organisation without undue delay.'.

(2) in point (a) of point ORA.GEN.135, point (1) is replaced by the following:

(a) The ATO shall use an adequate fleet of training aircraft or FSTDs appropriately equipped for the training courses provided. The fleet of aircraft shall be composed of aircraft that comply with all requirements defined in Regulation (EU) No 2018/1139. Aircraft that fall under points (a), (b), (c), (d) or (f) of point (1) of Annex I to Regulation (EU) No 2018/1139, may be used for training if all of the following conditions are met:

10.3.1.6 Annex VIII (Part-DTO) to Regulation (EU) No 1178/2011

Annex VIII (Part-DTO) to Regulation (EU) No 1178/2011 is amended as follows:

(1) Point DTO.GEN.110 is amended as follows:
(a) in point (a), a new point (5) is added as follows:

'(5) for gyroplanes:

(a) theoretical knowledge instruction for GPL;

(b) flight instruction for GPL;

(c) training towards night rating;

(d) training towards flight instructor rating FI(G);

(e) FI(G) refresher training.';

(b) point (b) is replaced by the following:

'(b) A DTO shall be entitled to also provide all of the following, provided that the DTO has submitted a declaration in accordance with point DTO.GEN.115 and the competent authority has approved the training programme in accordance with point DTO.GEN.230(c):

(1) for the FE(G) and FIE(G), the examiner courses referred to in points FCL.1015(a) and FCL.1025(b)(2);

(2) the examiner courses referred to in points BFCL.430 and BFCL.460(b)(1) of Annex III (Part-BFCL) to Commission Regulation (EU) 2018/395 for FE(B);

(3) the examiner courses referred to in points SFCL.430 and SFCL.460(b)(1) of Annex III (Part-SFCL) to Commission Implementing Regulation (EU) 2018/1976 for FE(S).';

(2) In point (a) of DTO.GEN.240, point (1) is replaced by the following:
'(a) A DTO shall use an adequate fleet of training aircraft or FSTDs appropriately equipped for the training course provided. The fleet of aircraft shall be composed of aircraft that comply with all requirements defined in Regulation (EU) No 2018/1139. Aircraft that fall under points (a), (b), (c), (d) or (f) of point (1) of Annex I to Regulation (EU) No 2018/1139, may be used for training if all of the following conditions are met:'.

10.3.2 Pilot training syllabus

10.3.2.1 ED Decision 2011/016/R

The Annex to ED Decision 2011/016/R of 15 December 2011 is amended as follows:

(1) In GM1 FCL.060, the headline is amended as follows:
'AEROPLANES, HELICOPTERS, POWERED-LIFT, ~~AND~~ AIRSHIPS AND GYROPLANES';

(2) AMC1 FCL.210; FCL.215 is amended as follows:

'SYLLABUS OF THEORETICAL KNOWLEDGE FOR THE PPL(A) AND PPL(H)

The following tables contain the syllabi for the courses of theoretical knowledge, as well as for the theoretical knowledge examinations for the PPL(A), ~~and~~ PPL(H) and GPL. The training and examination should cover aspects related to non-technical skills in an integrated manner, taking into account the particular risks associated to the licence and the activity.
The DTO or the ATO responsible for the training should check if all the appropriate elements of the training course of theoretical knowledge instruction have been completed to a satisfactory standard before recommending the applicant for the examination.
The applicable items for each licence are marked with 'x'. An 'x' on the main title of a subject means that all the sub-divisions are applicable.

		Aeroplane		**Helicopter**		**Gyroplane**	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
1.	**AIR LAW AND ATC PROCEDURES**						
	International law: conventions, agreements and organisations						
	The Convention on international civil aviation (Chicago) Doc. 7300/6						
	Part I Air Navigation: relevant parts of the following chapters: (a) general principles and application of the convention; (b) flight over territory of Contracting States; (c) nationality of aircraft; (d) measures to facilitate air navigation; (e) conditions to be fulfilled on aircraft; (f) international standards and recommended practices;	x		x		x	

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(g) validity of endorsed certificates and licences; (h) notification of differences.						
	Part II The International Civil Aviation Organisation (ICAO): objectives and composition	x		x		x	
	Annex 8: Airworthiness of aircraft						
	Foreword and definitions	x		x		x	
	Certificate of airworthiness	x		x		x	
	Annex 7: Aircraft nationality and registration marks						
	Foreword and definitions	x		x		x	
	Common- and registration marks	x		x		x	
	Certificate of registration and aircraft nationality	x		x		x	
	Annex 1: Personnel licensing						
	Definitions	x		x		x	
	Relevant parts of Annex 1 connected to Part-FCL and Part-Medical	x		x		x	
	Annex 2: Rules of the air						
	Essential definitions, applicability of the rules of the air, general rules (except water operations), visual flight rules, signals and interception of civil aircraft	x		x		x	
	Procedures for air navigation: aircraft operations doc. 8168-ops/611, volume 1						
	Altimeter setting procedures (including IACO doc. 7030 – regional supplementary procedures)						
	Basic requirements (except tables), procedures applicable to operators and pilots (except tables)	x		x		x	
	Secondary surveillance radar transponder operating procedures (including ICAO Doc. 7030 – regional supplementary procedures)						
	Operation of transponders	x		x		x	
	Phraseology	x		x		x	
	Annex 11: Doc. 4444 air traffic management						
	Definitions	x		x		x	
	General provisions for air traffic services	x		x		x	
	Visual separation in the vicinity of aerodromes	x		x		x	
	Procedures for aerodrome control services	x		x		x	
	Radar services	x		x		x	
	Flight information service and alerting service	x		x		x	
	Phraseologies	x		x		x	
	Procedures related to emergencies, communication failure and contingencies	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Annex 15: Aeronautical information service						
	Introduction, essential definitions	x		x		x	
	AIP, NOTAM, AIRAC and AIC	x		x		x	
	Annex 14, volume 1 and 2: Aerodromes						
	Definitions	x		x		x	
	Aerodrome data: conditions of the movement area and related facilities	x		x		x	
	Visual aids for navigation: (a) indicators and signalling devices; (b) markings; (c) lights; (d) signs; (e) markers.	x		x		x	
	Visual aids for denoting obstacles: (a) marking of objects; (b) lighting of objects.	x		x		x	
	Visual aids for denoting restricted use of areas	x		x		x	
	Emergency and other services: (a) rescue and fire fighting; (b) apron management service.	x		x		x	
	Annex 12: Search and rescue						
	Essential definitions	x		x		x	
	Operating procedures: (a) procedures for PIC at the scene of an accident; (b) procedures for PIC intercepting a distress transmission; (c) search and rescue signals.	x		x		x	
	Search and rescue signals: (a) signals with surface craft; (b) ground or air visual signal code; (c) air or ground signals.	x		x		x	
	Annex 17: Security						
	General: aims and objectives	x		x		x	
	Annex 13: Aircraft accident investigation						
	Essential definitions	x		x		x	
	Applicability	x		x		x	
	National law						
	National law and differences to relevant ICAO Annexes and relevant EU regulations.	x		x		x	
2.	**HUMAN PERFORMANCE**						
	Human factors: basic concepts						
	Human factors in aviation						
	Becoming a competent pilot	x		x		x	
	Basic aviation physiology and health maintenance						
	The atmosphere: (a) composition;	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(b) gas laws.						
	Respiratory and circulatory systems: (a) oxygen requirement of tissues; (b) functional anatomy; (c) main forms of hypoxia (hypoxic and anaemic): (1) sources, effects and countermeasures of carbon monoxide; (2) counter measures and hypoxia; (3) symptoms of hypoxia. (d) hyperventilation; (e) the effects of accelerations on the circulatory system; (f) hypertension and coronary heart disease.	x		x		x	
	Man and environment						
	Central, peripheral and autonomic nervous systems	x		x		x	
	Vision: (a) functional anatomy; (b) visual field, foveal and peripheral vision; (c) binocular and monocular vision; (d) monocular vision cues; (e) night vision; (f) visual scanning and detection techniques and importance of 'look-out'; (g) defective vision.	x		x		x	
	Hearing: (a) descriptive and functional anatomy; (b) flight related hazards to hearing; (c) hearing loss.	x		x		x	
	Equilibrium: (a) functional anatomy; (b) motion and acceleration; (c) motion sickness.	x		x		x	
	Integration of sensory inputs: (a) spatial disorientation: forms, recognition and avoidance; (b) illusions: forms, recognition and avoidance: (1) physical origin; (2) physiological origin; (3) psychological origin. (c) approach and landing problems.	x		x		x	
	Health and hygiene						
	Personal hygiene: personal fitness	x		x		x	
	Body rhythm and sleep: (a) rhythm disturbances; (b) symptoms, effects and management.	x		x		x	
	Problem areas for pilots: (a) common minor ailments including cold, influenza and gastro-intestinal upset;	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(b) entrapped gases and barotrauma, (scuba diving); (c) obesity; (d) food hygiene; (e) infectious diseases; (f) nutrition; (g) various toxic gases and materials.						
	Intoxication: (a) prescribed medication; (b) tobacco; (c) alcohol and drugs; (d) caffeine; (e) self-medication.	x		x		x	
	Basic aviation psychology						
	Human information processing						
	Attention and vigilance: (a) selectivity of attention; (b) divided attention.	x		x		x	
	Perception: (a) perceptual illusions; (b) subjectivity of perception; (c) processes of perception.	x		x		x	
	Memory: (a) sensory memory; (b) working or short term memory; (c) long term memory to include motor memory (skills).	x		x		x	
	Human error and reliability						
	Reliability of human behaviour	x		x		x	
	Error generation: social environment (group, organisation)	x		x		x	
	Decision making						
	Decision-making concepts: (a) structure (phases); (b) limits; (c) risk assessment; (d) practical application.	x		x		x	
	Avoiding and managing errors: cockpit management						
	Safety awareness: (a) risk area awareness; (b) situational awareness.	x		x		x	
	Communication: verbal and non-verbal communication	x		x		x	
	Human behaviour						
	Personality and attitudes: (a) development; (b) environmental influences.	x		x		x	
	Identification of hazardous attitudes (error proneness)	x		x		x	
	Human overload and underload						
	Arousal	x		x		x	
	Stress:	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(a) definition(s); (b) anxiety and stress; (c) effects of stress.						
	Fatigue and stress management: (a) types, causes and symptoms of fatigue; (b) effects of fatigue; (c) coping strategies; (d) management techniques; (e) health and fitness programmes;	x		x		x	
3.	**METEOROLOGY**						
	The atmosphere						
	Composition, extent and vertical division						
	Structure of the atmosphere	x		x		x	
	Troposphere	x		x		x	
	Air temperature						
	Definition and units	x		x		x	
	Vertical distribution of temperature	x		x		x	
	Transfer of heat	x		x		x	
	Lapse rates, stability and instability	x		x		x	
	Development of inversions and types of inversions	x		x		x	
	Temperature near the earth’s surface, surface effects, diurnal and seasonal variation, effect of clouds and effect of wind	x		x		x	
	Atmospheric pressure						
	Barometric pressure and isobars	x		x		x	
	Pressure variation with height	x		x		x	
	Reduction of pressure to mean sea level	x		x		x	
	Relationship between surface pressure centres and pressure centres aloft	x		x		x	
	Air density						
	Relationship between pressure, temperature and density	x		x		x	
	ISA						
	ICAO standard atmosphere	x		x		x	
	Altimetry						
	Terminology and definitions	x		x		x	
	Altimeter and altimeter settings	x		x		x	
	Calculations	x		x		x	
	Effect of accelerated airflow due to topography	x		x		x	
	Wind						
	Definition and measurement of wind						
	Definition and measurement	x		x		x	
	Primary cause of wind						
	Primary cause of wind, pressure gradient, coriolis force and gradient wind	x		x		x	
	Variation of wind in the friction layer	x		x		x	
	Effects of convergence and divergence	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	General global circulation						
	General circulation around the globe	x		x		x	
	Local winds						
	Anabatic and katabatic winds, mountain and valley winds, Venturi effects, land and sea breezes	x		x		x	
	Mountain waves (standing waves, lee waves)						
	Origin and characteristics	x		x		x	
	Turbulence						
	Description and types of turbulence	x		x		x	
	Formation and location of turbulence	x		x		x	
	THERMODYNAMICS						
	Humidity						
	Water vapour in the atmosphere	x		x		x	
	Mixing ratio	x		x		x	
	Temperature/dew point, relative humidity	x		x		x	
	Change of state of aggregation						
	Condensation, evaporation, sublimation, freezing and melting, latent heat	x		x		x	
	Adiabatic processes						
	Adiabatic processes, stability of the atmosphere	x		x		x	
	CLOUDS AND FOG						
	Cloud formation and description						
	Cooling by adiabatic expansion and by advection	x		x		x	
	Cloud types and cloud classification	x		x		x	
	Influence of inversions on cloud development	x		x		x	
	Fog, mist, haze						
	General aspects	x		x		x	
	Radiation fog	x		x		x	
	Advection fog	x		x		x	
	Steaming fog	x		x		x	
	Frontal fog	x		x		x	
	Orographic fog (hill fog)	x		x		x	
	PRECIPITATION						
	Development of precipitation						
	Processes of development of precipitation	x		x		x	
	Types of precipitation						
	Types of precipitation, relationship with cloud types	x		x		x	
	AIR MASSES AND FRONTS						
	Air masses						
	Description, classification and source regions of air masses	x		x		x	
	Modifications of air masses	x		x		x	
	Fronts						
	General aspects	x		x		x	
	Warm front, associated clouds and weather	x		x		x	
	Cold front, associated clouds and weather	x		x		x	
	Warm sector, associated clouds and weather	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Weather behind the cold front	x		x		x	
	Occlusions, associated clouds and weather	x		x		x	
	Stationary front, associated clouds and weather	x		x		x	
	Movement of fronts and pressure systems, life cycle	x		x		x	
	Changes of meteorological elements at a frontal wave	x		x		x	
	PRESSURE SYSTEMS						
	Anticyclone						
	Anticyclones, types, general properties, cold and warm anticyclones, ridges and wedges, subsidence	x		x		x	
	Non-frontal depressions						
	Thermal, orographic and polar depressions, troughs	x		x		x	
	CLIMATOLOGY						
	Climatic zones						
	General seasonal circulation in the troposphere	x		x		x	
	Typical weather situations in the mid-latitudes						
	Westerly situation	x		x		x	
	High-pressure area	x		x		x	
	Flat-pressure pattern	x		x		x	
	Local winds and associated weather						
	e.g. Foehn	x		x		x	
	FLIGHT HAZARDS						
	Icing						
	Conditions for ice accretion	x		x		x	
	Types of ice accretion	x		x		x	
	Hazards of ice accretion, avoidance	x		x		x	
	Turbulence						
	Effects on flight, avoidance	x		x		x	
	Wind shear						
	Definition of wind shear	x		x		x	
	Weather conditions for wind shear	x		x		x	
	Effects on flight, avoidance	x		x		x	
	Thunderstorms						
	Conditions for and process of development, forecast, location, type specification	x		x		x	
	Structure of thunderstorms, life history, squall lines, electricity in the atmosphere, static charges	x		x		x	
	Electrical discharges	x		x		x	
	Development and effects of downbursts	x		x		x	
	Thunderstorm avoidance	x		x		x	
	Inversions						
	Influence on aircraft performance	x		x		x	
	Hazards in mountainous areas						
	Influence of terrain on clouds and precipitation, frontal passage	x		x		x	
	Vertical movements, mountain waves, wind shear, turbulence, ice accretion	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Development and effect of valley inversions	x		x		x	
	Visibility-reducing phenomena						
	Reduction of visibility caused by precipitation and obscuration	x		x		x	
	Reduction of visibility caused by other phenomena	x		x		x	
	METEOROLOGICAL INFORMATION						
	Observation						
	Surface observations	x		x		x	
	Radiosonde observations	x		x		x	
	Satellite observations	x		x		x	
	Weather-radar observations	x		x		x	
	Aircraft observations and reporting	x		x		x	
	Weather charts						
	Significant weather charts	x		x		x	
	Surface charts	x		x		x	
	Information for flight planning						
	Aviation-weather messages	x		x		x	
	Meteorological broadcasts for aviation	x		x		x	
	Use of meteorological documents	x		x		x	
	Meteorological warnings	x		x		x	
	Meteorological services						
	World area forecast system and meteorological offices	x		x		x	
4.	**COMMUNICATIONS**						
	VFR COMMUNICATIONS						
	Definitions						
	Meanings and significance of associated terms	x		x		x	
	ATS abbreviations	x		x		x	
	Q-code groups commonly used in RTF airground communications	x		x		x	
	Categories of messages	x		x		x	
	General operating procedures						
	Transmission of letters	x		x		x	
	Transmission of numbers (including level information)	x		x		x	
	Transmission of time	x		x		x	
	Transmission technique	x		x		x	
	Standard words and phrases (relevant RTF phraseology included)	x		x		x	
	R/T call signs for aeronautical stations including use of abbreviated call signs	x		x		x	
	R/T call signs for aircraft including use of abbreviated call signs	x		x		x	
	Transfer of communication	x		x		x	
	Test procedures including readability scale	x		x		x	
	Read back and acknowledgement requirements	x		x		x	
	Relevant weather information terms (VFR)						
	Aerodrome weather	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Weather broadcast	x		x		x	
	Action required to be taken in case of communication failure	x		x		x	
	Distress and urgency procedures						
	Distress (definition, frequencies, watch of distress frequencies, distress signal and distress message)	x		x		x	
	Urgency (definition, frequencies, urgency signal and urgency message)	x		x		x	
	General principles of VHF propagation and allocation of frequencies	x		x		x	
5.	**PRINCIPLES OF FLIGHT**						
5.1.	**PRINCIPLES OF FLIGHT: AEROPLANE**						
	Subsonic aerodynamics						
	Basics concepts, laws and definitions						
	Laws and definitions: (a) conversion of units; (b) Newton´s laws; (c) Bernoulli’s equation and venture; (d) static pressure, dynamic pressure and total pressure; (e) density; (f) IAS and TAS.	x	x				
	Basics about airflow: (a) streamline; (b) two-dimensional airflow; (c) three-dimensional airflow.	x	x				
	Aerodynamic forces on surfaces: (a) resulting airforce; (b) lift; (c) drag; (d) angle of attack.	x	x				
	Shape of an aerofoil section: (a) thickness to chord ratio; (b) chord line; (c) camber line; (d) camber; (e) angle of attack.	x	x				
	The wing shape: (a) aspect ratio; (b) root chord; (c) tip chord; (d) tapered wings; (e) wing planform.	x	x				
	The two-dimensional airflow about an aerofoil						
	Streamline pattern	x	x				
	Stagnation point	x	x				

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Pressure distribution	x	x				
	Centre of pressure	x	x				
	Influence of angle of attack	x	x				
	Flow separation at high angles of attack	x	x				
	The lift – α graph	x	x				
	The coefficients						
	The lift coefficient C_l: the lift formula	x	x				
	The drag coefficient C_d: the drag formula	x	x				
	The three-dimensional airflow round a wing and a fuselage						
	Streamline pattern: (a) span-wise flow and causes; (b) tip vortices and angle of attack; (c) upwash and downwash due to tip vortices; (d) wake turbulence behind an aeroplane (causes, distribution and duration of the phenomenon).	x	x				
	Induced drag: (a) influence of tip vortices on the angle of attack; (b) the induced local α; (c) influence of induced angle of attack on the direction of the lift vector; (d) induced drag and angle of attack.	x	x				
	Drag						
	The parasite drag: (a) pressure drag; (b) interference drag; (c) friction drag.	x	x				
	The parasite drag and speed	x	x				
	The induced drag and speed	x	x				
	The total drag	x	x				
	The ground effect						
	Effect on take-off and landing characteristics of an aeroplane	x	x				
	The stall						
	Flow separation at increasing angles of attack: (a) the boundary layer: (1) laminar layer; (2) turbulent layer; (3) transition. (b) separation point; (c) influence of angle of attack; (d) influence on: (1) pressure distribution; (2) location of centre of pressure; (3) CL; (4) CD; (5) pitch moments. (e) buffet;	x	x				

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(f) use of controls.						
	The stall speed: (a) in the lift formula; (b) 1g stall speed; (c) influence of: (1) the centre of gravity; (2) power setting; (3) altitude (IAS); (4) wing loading; (5) load factor n: (i) definition; (ii) turns; (iii) forces.	x	x				
	The initial stall in span-wise direction: (a) influence of planform; (b) geometric twist (wash out); (c) use of ailerons.	x	x				
	Stall warning: (a) importance of stall warning; (b) speed margin; (c) buffet; (d) stall strip; (e) flapper switch; (f) recovery from stall.	x	x				
	Special phenomena of stall: (a) the power-on stall; (b) climbing and descending turns; (c) t-tailed aeroplane; (d) avoidance of spins: (1) spin development; (2) spin recognition; (3) spin recovery. (e) ice (in stagnation point and on surface): (1) absence of stall warning; (2) abnormal behaviour of the aircraft during stall.	x	x				
	CL augmentation						
	Trailing edge flaps and the reasons for use in take-off and landing: (a) influence on C_L - α-graph; (b) different types of flaps; (c) flap asymmetry; (d) influence on pitch movement.	x	x				
	Leading edge devices and the reasons for use in take-off and landing	x	x				
	The boundary layer						
	Different types: (a) laminar;	x	x				

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(b) turbulent.						
	Special circumstances						
	Ice and other contamination: (a) ice in stagnation point; (b) ice on the surface (frost, snow and clear ice); (c) rain; (d) contamination of the leading edge; (e) effects on stall; (f) effects on loss of controllability; (g) effects on control surface moment; (h) influence on high lift devices during takeoff, landing and low speeds.	x	x				
	Stability						
	Condition of equilibrium in steady horizontal flight						
	Precondition for static stability	x	x				
	Equilibrium: (a) lift and weight; (b) drag and thrust.	x	x				
	Methods of achieving balance						
	Wing and empennage (tail and canard)	x	x				
	Control surfaces	x	x				
	Ballast or weight trim	x	x				
	Static and dynamic longitudinal stability						
	Basics and definitions: (a) static stability, positive, neutral and negative; (b) precondition for dynamic stability; (c) dynamic stability, positive, neutral and negative.	x	x				
	Location of centre of gravity: (a) aft limit and minimum stability margin; (b) forward position; (c) effects on static and dynamic stability.	x	x				
	Dynamic lateral or directional stability						
	Spiral dive and corrective actions	x	x				
	Control						
	General						
	Basics, the three planes and three axis	x	x				
	Angle of attack change	x	x				
	Pitch control						
	Elevator	x	x				
	Downwash effects	x	x				
	Location of centre of gravity	x	x				
	Yaw control						
	Pedal or rudder	x	x			x	x
	Roll control						
	Ailerons: function in different phases of flight	x	x				
	Adverse yaw	x	x				

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Means to avoid adverse yaw: (a) frise ailerons; (b) differential ailerons deflection.	x	x				
	Means to reduce control forces						
	Aerodynamic balance: (a) balance tab and anti-balance tab; (b) servo tab.	x	x				
	Mass balance						
	Reasons to balance: means	x	x				
	Trimming						
	Reasons to trim	x	x				
	Trim tabs	x	x				
	Limitations						
	Operating limitations						
	Flutter	x	x				
	v_{fe}	x	x				
	v_{no}, v_{ne}	x	x				
	Manoeuvring envelope						
	Manoeuvring load diagram: (a) load factor; (b) accelerated stall speed; (c) $v_{a;}$ (d) manoeuvring limit load factor or certification category.	x	x				
	Contribution of mass	x	x				
	Gust envelope						
	Gust load diagram	x	x				
	Factors contributing to gust loads	x	x				
	Propellers						
	Conversion of engine torque to thrust						
	Meaning of pitch	x	x				
	Blade twist	x	x				
	Effects of ice on propeller	x	x				
	Engine failure or engine stop						
	Windmilling drag	x	x				
	Moments due to propeller operation						
	Torque reaction	x	x				
	Asymmetric slipstream effect	x	x				
	Asymmetric blade effect	x	x				
	Flight mechanics						
	Forces acting on an aeroplane						
	Straight horizontal steady flight	x	x				
	Straight steady climb	x	x				
	Straight steady descent	x	x				
	Straight steady glide	x	x				

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Steady coordinated turn: (a) bank angle; (b) load factor; (c) turn radius; (d) rate one turn.	x	x				
5.2.	**PRINCIPLES OF FLIGHT: HELICOPTER**						
	Subsonic aerodynamics						
	Basic concepts, laws and definitions			x	x	x	x
	Conversion of units			x	x	x	x
	Definitions and basic concepts about air: (a) the atmosphere and International Standard Atmosphere; (b) density; (c) influence of pressure and temperature on density.			x	x	x	x
	Newton's laws: (a) Newton's second law: Momentum equation; (b) Newton's third law: action and reaction.			x	x	x	x
	Basic concepts about airflow: (a) steady airflow and unsteady airflow; (b) Bernoulli's equation; (c) static pressure, dynamic pressure, total pressure and stagnation point; (d) TAS and IAS; (e) two-dimensional airflow and three-dimensional airflow; (f) viscosity and boundary layer.			x	x	x	x
	Two-dimensional airflow			x	x	x	x
	Aerofoil section geometry: (a) aerofoil section; (b) chord line, thickness and thickness to chord ratio of a section; (c) camber line and camber; (d) symmetrical and asymmetrical aerofoils sections.			x	x	x	x
	Aerodynamic forces on aerofoil elements: (a) angle of attack; (b) pressure distribution; (c) lift and lift coefficient (d) relation lift coefficient: angle of attack; (e) profile drag and drag coefficient; (f) relation drag coefficient: angle of attack; (g) resulting force, centre of pressure and pitching moment.			x	x	x	x
	Stall: (a) boundary layer and reasons for stalling; (b) variation of lift and drag as a function of angle of attack;			x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(c) displacement of the centre of pressure and pitching moment.						
	Disturbances due to profile contamination: (a) ice contamination; (b) ice on the surface (frost, snow and clear ice).			x	x	x	x
	The three-dimensional airflow round a wing and a fuselage			x	x	x	x
	The wing: (a) planform, rectangular and tapered wings; (b) wing twist.			x	x	x	x
	Airflow pattern and influence on lift: (a) span wise flow on upper and lower surface; (b) tip vortices; (c) span-wise lift distribution.			x	x	x	x
	Induced drag: causes and vortices			x	x	x	x
	The airflow round a fuselage: (a) components of a fuselage; (b) parasite drag; (c) variation with speed.			x	x	x	x
	Transonic aerodynamics and compressibility effects						
	Airflow velocities			x	x	x	x
	Airflow speeds: (a) speed of sound; (b) subsonic, high subsonic and supersonic flows.			x	x	x	x
	Shock waves: (a) compressibility and shock waves; (b) the reasons for their formation at upstream high subsonic airflow; (c) their effect on lift and drag.			x	x	x	x
	Influence of wing planform: sweep-angle			x	x	x	x
	Rotorcraft types			x	x	x	x
	Rotorcraft			x	x	x	x
	Rotorcraft types: (a) autogyro; (b) helicopter.			x	x	x	x
	Helicopters			x	x		
	Helicopters configurations: the single main rotor helicopter			x	x		

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	The helicopter, characteristics and associated terminology: (a) general lay-out, fuselage, engine and gearbox; (b) tail rotor, fenestron and NOTAR; (c) engines (reciprocating and turbo shaft engines); (d) power transmission; (e) rotor shaft axis, rotor hub and rotor blades; (f) rotor disc and rotor disc area; (g) teetering rotor (two blades) and rotors with more than two blades; (h) skids and wheels; (i) helicopter axes and fuselage centre line; (j) roll axis, pitch axis and normal or yaw axis; (k) gross mass, gross weight and disc loading.			x	x		
	Main rotor aerodynamics			x	x	x	x
	Hover flight outside ground effect			x	x		
	Airflow through the rotor discs and round the blades: (a) circumferential velocity of the blade sections; (b) induced airflow, through the disc and downstream; (c) downward fuselage drag; (d) equilibrium of rotor thrust, weight and fuselage drag; (e) rotor disc induced power; (f) relative airflow to the blade; (g) pitch angle and angle of attack of a blade section; (h) lift and profile drag on the blade element; (i) resulting lift and thrust on the blade and rotor thrust; (j) collective pitch angle changes and necessity of blade feathering; (k) required total main rotor-torque and rotor-power; (l) influence of the air density.			x	x	x	x
	Anti-torque force and tail rotor: (a) force of tail rotor as a function of main rotor-torque; (b) anti-torque rotor power; (c) necessity of blade feathering of tail rotor blades and yaw pedals.			x	x		
	Maximum hover altitude OGE: (a) total power required and power available; (b) maximum hover altitude as a function of pressure altitude and OAT.			x	x		
	Vertical climb			x	x	x	x
	Relative airflow and angles of attack:			x	x	x	x
	(a) climb velocity V_C, induced and relative velocity and angle of attack; (b) collective pitch angle and blade feathering.						

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Power and vertical speed: (a) induced power, climb power and profile power; (b) total main rotor power and main rotor torque; (c) tail rotor power; (d) total power requirement in vertical flight.			x	x	x	x
	Forward flight			x	x	x	x
	Airflow and forces in uniform inflow distribution: (a) assumption of uniform inflow distribution on rotor disc; (b) advancing blade (90°) and retreating blade (270°); (c) airflow velocity relative to the blade sections, area of reverse flow; (d) lift on the advancing and retreating blades at constant pitch angles; (e) necessity of cyclic pitch changes; (f) compressibility effects on the advancing blade tip and speed limitations; (g) high angle of attack on the retreating blade, blade stall and speed limitations; (h) thrust on rotor disc and tilt of thrust vector; (i) vertical component of the thrust vector and gross weight equilibrium; (j) horizontal component of the thrust vector and drag equilibrium.			x	x	x	x
	The flare (power flight): (a) thrust reversal and increase in rotor thrust; (b) increase of rotor RPM on non-governed rotor.			x	x	x	x
	Power and maximum speed: (a) induced power as a function of helicopter speed; (b) rotor profile power as a function of helicopter speed; (c) fuselage drag and parasite power as a function of forward speed; (d) tail rotor power and power ancillary equipment; (e) total power requirement as a function of forward speed; (f) influence of helicopter mass, air density and drag of additional external equipment; (g) translational lift and influence on power required.			x	x	x	x
	Hover and forward flight in ground effect			x	x		
	Airflow in ground effect and downwash: rotor power decrease as a function of rotor height above the ground at constant helicopter mass			x	x		
	Vertical descent			x	x	x	x
	Vertical descent, power on:			x	x	x	x
	(a) airflow through the rotor, low and moderate descent speeds;						

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(b) vortex ring state, settling with power and consequences.						
	Autorotation: (a) collective lever position after failure; (b) up flow through the rotor, auto-rotation and anti-autorotation rings; (c) tail rotor thrust and yaw control; (d) control of rotor RPM with collective lever; (e) landing after increase of rotor thrust by pulling collective and reduction in vertical speed.			x	x	x	x
	Forward flight: Autorotation			x	x	x	x
	Airflow through the rotor disc: (a) descent speed and up flow through the disc; (b) the flare, increase in rotor thrust, reduction of vertical speed and ground speed.			x	x	x	x
	Flight and landing:			x	x	x	x
	(a) turning; (b) flare; (c) autorotative landing; (d) height or velocity avoidance graph and dead man’s curve.						
	Main rotor mechanics			x	x	x	x
	Flapping of the blade in hover			x	x		
	Forces and stresses on the blade: (a) centrifugal force on the blade and attachments; (b) limits of rotor RPM; (c) lift on the blade and bending stresses on a rigid attachment; (d) the flapping hinge of the articulated rotor and flapping hinge offset; (e) the flapping of the hinge less rotor and flexible element.			x	x	x	x
	Coning angle in hover: (a) lift and centrifugal force in hover and blade weight negligible (b) flapping, tip path plane and disc area.			x	x		
	Flapping angles of the blade in forward flight			x	x	x	x
	Forces on the blade in forward flight without cyclic feathering: (a) aerodynamic forces on the advancing and retreating blades without cyclic feathering; (b) periodic forces and stresses, fatigue and flapping hinge; (c) phase lag between the force and the flapping angle (about 90°); (d) flapping motion of the hinged blades and tilting of the cone and flap back of rotor;			x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(e) rotor disc attitude and thrust vector tilt.						
	Cyclic pitch (feathering) in helicopter mode, forward flight: (a) necessity of forward rotor disc tilt and thrust vector tilt; (b) flapping and tip path plane, virtual rotation axis or no flapping axis and plane of rotation; (c) shaft axis and hub plane; (d) cyclic pitch change (feathering) and rotor thrust vector tilt; (e) collective pitch change, collective lever, swash plate, pitch link and pitch horn; (f) cyclic stick, rotating swash plate and pitch link movement and phase angle.			x	x	x	x
	Blade lag motion			x	x	x	x
	Forces on the blade in the disc plane (tip path plane) in forward flight: (a) forces due to the Coriolis effect because of the flapping; (b) alternating stresses and the need of the drag or lag hinge.			x	x	x	x
	The drag or lag hinge: (a) the drag hinge in the fully articulated rotor; (b) the lag flexure in the hinge less rotor; (c) drag dampers.			x	x		
	Ground resonance: (a) blade lag motion and movement of the centre of gravity of the blades and the rotor; (b) oscillating force on the fuselage; (c) fuselage, undercarriage and resonance.			x	x	x	x
	Rotor systems			x	x	x	x
	See-saw or teetering rotor			x	x	x	x
	Fully articulated rotor: (a) three hinges arrangement; (b) bearings and elastomeric hinges.			x	x		
	Hinge less rotor and bearing less rotor			x	x	x	x
	Blade sailing: (a) low rotor RPM and effect of adverse wind; (b) minimising the danger; (c) droop stops.			x	x	x	x
	Vibrations due to main rotor: (a) origins of the vibrations: in plane and vertical; (b) blade tracking and balancing.			x	x	x	x
	Tail rotors			x	x		
	Conventional tail rotor			x	x		
	Rotor description: (a) two-blades tail rotors with teetering hinge; (b) rotors with more than two blades;			x	x		

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	(c) feathering bearings and flapping hinges; (d) dangers to people and to the tail rotor, rotor height and safety.						
	Aerodynamics: (a) induced airflow and tail rotor thrust; (b) thrust control by feathering, tail rotor drift and roll; (c) effect of tail rotor failure and vortex ring.			x	x		
	The fenestron: technical lay-out			x	x		
	The NOTAR: technical lay-out			x	x		
	Vibrations: high frequency vibrations due to the tail rotors			x	x		
	Equilibrium, stability and control			x	x	x	x
	Equilibrium and helicopter attitudes			x	x	x	x
	Hover: (a) forces and equilibrium conditions; (b) helicopter pitching moment and pitch angle; (c) helicopter rolling moment and roll angle.			x	x		
	Forward flight: (a) forces and equilibrium conditions; (b) helicopter moments and angles; (c) effect of speed on fuselage attitude.			x	x	x	x
	Control			x	x	x	x
	Control power			x	x		
	(a) fully articulated rotor; (b) hinge less rotor;						
	(c) teetering rotor.					x	x
	Static and dynamic roll over			x	x	x	x
	Helicopter performances Engine performances			x	x	x	x
	Piston engines:			x	x	x	x
	(a) power available; (b) effects of density altitude.						
	Turbine engines: (a) power available; (b) effects of ambient pressure and temperature.			x	x		
	Helicopter performances			x	x		
	Hover and vertical flight: (a) power required and power available; (b) OGE and IGE maximum hover height; (c) influence of AUM, pressure, temperature and density.			x	x		
	Forward flight: (a) maximum speed; (b) maximum rate of climb speed; (c) maximum angle of climb speed; (d) range and endurance; (e) influence of AUM, pressure, temperature and density.			x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Manoeuvring: (a) load factor; (b) bank angle and number of g's; (c) manoeuvring limit load factor.			x	x	x	x
	Special conditions: (a) operating with limited power; (b) over pitch and over torque.			x	x	x	x
5.3.	**PRINCIPLES OF FLIGHT: GYROPLANES**						
	Rotor system (a) Hub bar (b) Teeter tower, blok, bolt and stops (c) Roll bolt (d) Pitch bolt (e) Mast (f) Trim mechanism					x	X
	Horizontal and vertical stabiliser					x	x
	Nacelle					x	x
	Pre-rotator mechanism					x	x
	Stability (a) function of the empennage (b) propeller wash and yaw stability (c) Engine torque (d) the centre of gravity considerations (e) propeller thrust and stability (f) rotor thrust and stability					x	x
6.	**OPERATIONAL PROCEDURES**						
	General						
	Operation of aircraft: ICAO Annex 6, General requirements						
	Definitions	x	x	x	x	x	x
	Applicability	x	x	x	x	x	x
	Special operational procedures and hazards (general aspects)	x	x	x	x	x	x
	Noise abatement						
	Noise abatement procedures	x	x	x	x	x	x
	Influence of the flight procedure (departure, cruise and approach)	x	x	x	x	x	x
	Runway incursion awareness (meaning of surface markings and signals)	x	x	x	x	x	x
	Fire or smoke						
	Carburettor fire	x	x	x	x	x	x
	Engine fire	x	x	x	x	x	x
	Fire in the cabin and cockpit, (choice of extinguishing agents according to fire classification and use of the extinguishers)	x	x	x	x	x	x

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Smoke in the cockpit and (effects and action to be taken) and smoke in the cockpit and cabin (effects and actions taken)	x	x	x	x	x	x
	Windshear and microburst						
	Effects and recognition during departure and approach	x	x	x	x	x	x
	Actions to avoid and actions taken during encounter	x	x	x	x	x	x
	Wake turbulence						
	Cause	x	x	x	x	x	x
	List of relevant parameters	x	x	x	x	x	x
	Actions taken when crossing traffic, during take-off and landing	x	x	x	x	x	x
	Emergency and precautionary landings						
	Definition	x	x	x	x	x	x
	Cause	x	x	x	x	x	x
	Passenger information	x	x	x	x	x	x
	Evacuation	x	x	x	x	x	x
	Action after landing	x	x	x	x	x	x
	Contaminated runways						
	Kinds of contamination	x	x			x	x
	Estimated surface friction and friction coefficient	x	x			x	x
	Rotor downwash			x	x	x	x
	Operation influence by meteorological conditions (helicopter)						
	White out, sand or dust			x	x	x	x
	Strong winds			x	x	x	x
	Mountain environment			x	x	x	x
	Emergency procedures						
	Influence by technical problems						
	Engine failure			x	x	x	x
	Fire in cabin, cockpit or engine			x	x	x	x
	Tail, rotor or directional control failure			x	x		
	Ground resonance			x	x	x	x
	Blade stall			x	x	x	x
	Settling with power (vortex ring)			x	x		
	Overpitch			x	x	x	x
	Overspeed: rotor or engine			x	x	x	x
	Dynamic rollover			x	x	x	x
	Mast bumping			x	x	x	x
7.	**FLIGHT PERFORMANCE AND PLANNING**						
7.1.	**MASS AND BALANCE: AEROPLANES OR HELICOPTERS**						
	Purpose of mass and balance considerations						
	Mass limitations						
	Importance in regard to structural limitations	x	x	x	x	x	x
	Importance in regard to performance limitations	x	x	x	x	x	x
	CG limitations						

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Importance in regard to stability and controllability	x	x	x	x	x	x
	Importance in regard to performance	x	x	x	x	x	x
	Loading						
	Terminology						
	Mass terms	x	x	x	x	x	x
	Load terms (including fuel terms)	x	x	x	x	x	x
	Mass limits						
	Structural limitations	x	x	x	x	x	x
	Performance limitations	x	x	x	x	x	x
	Baggage compartment limitations	x	x	x	x	x	x
	Mass calculations						
	Maximum masses for take-off and landing	x	x	x	x	x	x
	Use of standard masses for passengers, baggage and crew	x	x	x	x	x	x
	Fundamentals of CG calculations						
	Definition of centre of gravity	x	x	x	x	x	x
	Conditions of equilibrium (balance of forces and balance of moments)	x	x	x	x	x	x
	Basic calculations of CG	x	x	x	x	x	x
	Mass and balance details of aircraft						
	Contents of mass and balance documentation						
	Datum and moment arm	x	x	x	x	x	x
	CG position as distance from datum	x	x	x	x	x	x
	Extraction of basic mass and balance data from aircraft documentation						
	BEM	x	x	x	x	x	x
	CG position or moment at BEM	x	x	x	x	x	x
	Deviations from standard configuration	x	x	x	x	x	x
	Determination of CG position						
	Methods						
	Arithmetic method	x	x	x	x	x	x
	Graphic method	x	x	x	x	x	x
	Load and trim sheet						
	General considerations	x	x	x	x	x	x
	Load sheet and CG envelope for light aeroplanes and for helicopters	x	x	x	x	x	x
7.2.	**PERFORMANCE: AEROPLANES**						
	Introduction						
	Performance classes	x	x				
	Stages of flight	x	x				
	Effect of aeroplane mass, wind, altitude, runway slope and runway conditions	x	x			x	x
	Gradients	x	x				
	SE aeroplanes						
	Definitions of terms and speeds	x	x				
	Take-off and landing performance						

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Use of aeroplane flight manual data	x	x				
	Climb and cruise performance						
	Use of aeroplane flight data	x	x				
	Effect of density altitude and aeroplane mass	x	x				
	Endurance and the effects of the different recommended power or thrust settings	x	x				
	Still air range with various power or thrust settings	x	x				
7.3.	**FLIGHT PLANNING AND FLIGHT MONITORING**						
	Flight planning for VFR flights						
	VFR navigation plan						
	Routes, airfields, heights and altitudes from VFR charts	x	x	x	x	x	x
	Courses and distances from VFR charts	x	x	x	x	x	x
	Aerodrome charts and aerodrome directory	x	x	x	x	x	x
	Communications and radio navigation planning data	x	x	x	x	x	x
	Completion of navigation plan	x	x	x	x	x	x
	Fuel planning						
	General knowledge	x	x	x	x	x	x
	Pre-flight calculation of fuel required						
	Calculation of extra fuel	x	x	x	x	x	x
	Completion of the fuel section of the navigation plan (fuel log) and calculation of total fuel	x	x	x	x	x	x
	Pre-flight preparation						
	AIP and NOTAM briefing						
	Ground facilities and services	x	x	x	x	x	x
	Departure, destination and alternate aerodromes	x	x	x	x	x	x
	Airway routings and airspace structure	x	x	x	x	x	x
	Meteorological briefing						
	Extraction and analysis of relevant data from meteorological documents	x	x	x	x	x	x
	ICAO flight plan (ATS flight plan)						
	Individual flight plan						
	Format of flight plan	x	x	x	x	x	x
	Completion of the flight plan	x	x	x	x	x	x
	Submission of the flight plan	x	x	x	x	x	x
	Flight monitoring and in-flight replanning						
	Flight monitoring						
	Monitoring of track and time	x	x	x	x	x	x
	In-flight fuel management	x	x	x	x	x	x
	In-flight re-planning in case of deviation from planned data	x	x	x	x	x	x
7.4.	**PERFORMANCE: HELICOPTERS; GYROPLANES**						
	General						
	Introduction						
	Stages of flight			x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Effect on performance of atmospheric, airport or heliport and helicopter conditions			x	x	x	x
	Applicability of airworthiness requirements			x	x	x	x
	Definitions and terminology			x	x	x	x
	Performance: SE helicopters						
	Definitions of terms (a) masses; (b) velocities: v_x, v_y; (c) velocity of best range and of maximum endurance; (d) power limitations; (e) altitudes.			x	x	x	x
	Take-off, cruise and landing performance **Use and interpretation of diagrams and tables:** (a) Take-off: (1) take-off run and distance available; (2) take-off and initial climb; (3) effects of mass, wind and density altitude; (4) effects of ground surface and gradient. (b) Landing: (1) effects of mass, wind, density altitude and approach speed; (2) effects of ground surface and gradient. (c) In-flight: (1) relationship between power required and power available; (2) performance diagram; (3) effects of configuration, mass, temperature and altitude; (4) reduction of performance during climbing turns; (5) autorotation; (6) adverse effects (icing, rain and condition of the airframe).			x	x	x	x
8.	**AIRCRAFT GENERAL KNOWLEDGE**						
8.1.	**AIRFRAME AND SYSTEMS, ELECTRICS, POWERPLANT AND EMERGENCY EQUIPMENT**						
	System design, loads, stresses, maintenance						
	Loads and combination loadings applied to an aircraft’s structure	x	x	x	x	x	x
	Airframe						
	Wings, tail surfaces and control surfaces						
	Design and constructions	x	x			x	x
	Structural components and materials	x	x			x	x
	Stresses	x	x			x	x
	Structural limitations	x	x			x	x
	Fuselage, doors, floor, wind-screen and windows						
	Design and constructions	x	x	x	x	x	x

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Structural components and materials	x	x	x	x	x	x
	Stresses	x	x	x	x	x	x
	Structural limitations	x	x	x	x	x	x
	Flight and control surfaces						
	Design and constructions			x	x	x	x
	Structural components and materials			x	x	x	x
	Stresses and aero elastic vibrations			x	x	x	x
	Structural limitations			x	x	x	x
	Hydraulics						
	Hydromechanics: basic principles	x	x	x	x	x	x
	Hydraulic systems	x	x	x	x	x	x
	Hydraulic fluids: types and characteristics, limitations	x	x	x	x	x	x
	System components: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Landing gear, wheels, tyres and brakes						
	Landing gear						
	Types and materials	x	x	x	x	x	x
	Nose wheel steering: design and operation	x	x			x	x
	Brakes						
	Types and materials	x	x	x	x	x	x
	System components: design, operation, indications and warnings	x	x	x	x	x	x
	Wheels and tyres						
	Types and operational limitations	x	x	x	x	x	x
	Helicopter equipments			x	x		
	Flight controls						
	Mechanical or powered	x	x	x	x	x	x
	Control systems and mechanical	x	x	x	x	x	x
	System components: design, operation, indications and warnings, degraded modes of operation and jamming	x	x	x	x	x	x
	Secondary flight controls						
	System components: design, operation, degraded modes of operation, indications and warnings	x	x				
	Anti-icing systems						
	Types and operation (pitot and windshield)	x	x	x	x	x	x
	Fuel system						
	Piston engine						
	System components: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Turbine engine						
	System components: design, operation, degraded modes of operation, indications and warnings			x	x		
	Electrics						
	Electrics: general and definitions						
	Direct current: voltage, current, resistance, conductivity, Ohm’s law, power and work	x	x	x	x	x	x

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Alternating current: voltage, current, amplitude, phase, frequency and resistance	x	x	x	x	x	x
	Circuits: series and parallel	x	x	x	x	x	x
	Magnetic field: effects in an electrical circuit	x	x	x	x	x	x
	Batteries						
	Types, characteristics and limitations	x	x	x	x	x	x
	Battery chargers, characteristics and limitations	x	x	x	x	x	x
	Static electricity: general						
	Basic principles	x	x	x	x	x	x
	Static dischargers	x	x	x	x	x	x
	Protection against interference	x	x	x	x	x	x
	Lightning effects	x	x	x	x	x	x
	Generation: production, distribution and use						
	DC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	AC generation: types, design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Electric components						
	Basic elements: basic principles of switches, circuit-breakers and relays	x	x	x	x	x	x
	Distribution						
	General: (a) bus bar, common earth and priority; (b) AC and DC comparison.	x	x	x	x	x	x
	Piston engines						
	General						
	Types of internal combustion engine: basic principles and definitions	x	x	x	x	x	x
	Engine: design, operation, components and materials	x	x	x	x	x	x
	Fuel						
	Types, grades, characteristics and limitations	x	x	x	x	x	x
	Alternate fuel: characteristics and limitations	x	x	x	x	x	x
	Carburettor or injection system						
	Carburettor: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Injection: design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Icing	x	x	x	x	x	x
	Air cooling systems						
	Design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Lubrication systems						
	Lubricants: types, characteristics and limitations	x	x	x	x	x	x
	Design, operation, degraded modes of operation, indications and warnings	x	x	x	x	x	x
	Ignition circuits						

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Design, operation, degraded modes of operation	x	x	x	x	x	x
	Mixture						
	Definition, characteristic mixtures, control instruments, associated control levers and indications	x	x	x	x	x	x
	Propellers						
	Definitions and general: (a) aerodynamic parameters; (b) types; (c) operating modes.	x	x			x	x
	Constant speed propeller: design, operation and system components	x	x			x	x
	Propeller handling: associated control levers, degraded modes of operation, indications and warnings	x	x			x	x
	Performance and engine handling						
	Performance: influence of engine parameters, influence of atmospheric conditions, limitations and power augmentation systems	x	x	x	x	x	x
	Engine handling: power and mixture settings during various flight phases and operational limitations	x	x	x	x	x	x
	Turbine engines						
	Definitions			x	x		
	Coupled turbine engine: design, operation, components and materials			x	x		
	Free turbine engine: design, operation, components and materials			x	x		
	Fuel						
	Types, characteristics and limitations			x	x		
	Main engine components						
	Compressor: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) stall, surge and means of prevention.			x	x		
	Combustion chamber: (a) types, design, operation, components and materials; (b) stresses and limitations; (c) emission problems.			x	x		
	Turbine: (a) types, design, operation, components and materials; (b) stresses, creep and limitations.			x	x		
	Exhaust: (a) design, operation and materials; (b) noise reduction.			x	x		
	Fuel control units: types, operation and sensors			x	x		

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Helicopter air intake: different types, design, operation, materials and optional equipments			x	x		
	Additional components and systems						
	Helicopter additional components and systems: lubrication system, ignition circuit, starter, accessory gearbox, free wheel units: design, operation and components			x	x		
	Performance aspects						
	Torque, performance aspects, engine handling and limitations: (a) engine ratings; (b) engine performance and limitations; (c) engine handling.			x	x	x	x
	Protection and detection systems						
	Fire detection systems						
	Operation and indications			x	x	x	x
	Miscellaneous systems						
	Rotor design			x	x	x	x
	Rotor heads						
	Main rotor						
	Types			x	x	x	x
	Structural components and materials, stresses and structural limitations			x	x	x	x
	Design and construction			x	x	x	x
	Adjustment			x	x	x	x
	Tail rotor						
	Types			x	x		
	Structural components and materials, stresses and structural limitations			x	x		
	Design and construction			x	x		
	Adjustment			x	x		
	Transmission						
	Main gear box						
	Different types, design, operation and limitations			x	x		
	Rotor brake						
	Different types, design, operation and limitations			x	x	x	x
	Auxiliary systems			x	x		
	Drive shaft and associated installation			x	x		
	Intermediate and tail gear box						
	Different types, design, operation and limitations			x	x		
	Blades						
	Main rotor blade						
	Design and construction			x	x	x	x
	Structural components and materials			x	x	x	x
	Stresses			x	x	x	x
	Structural limitations			x	x	x	x
	Adjustment			x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Tip shape			x	x	x	x
	Tail rotor blade						
	Design and construction			x	x		
	Structural components and materials			x	x		
	Stresses			x	x		
	Structural limitations			x	x		
	Adjustment			x	x		
8.2.	**INSTRUMENTATION**						
	Instrument and indication systems						
	Pressure gauge						
	Different types, design, operation, characteristics and accuracy	x	x	x	x	x	x
	Temperature sensing						
	Different types, design, operation, characteristics and accuracy	x	x	x	x	x	x
	Fuel gauge						
	Different types, design, operation, characteristics and accuracy	x	x	x	x	x	x
	Flow meter						
	Different types, design, operation, characteristics and accuracy	x	x	x	x	x	x
	Position transmitter						
	Different types, design, operation, characteristics and accuracy	x	x	x	x	x	x
	Torque meter						
	Design, operation, characteristics and accuracy			x	x	x	x
	Tachometer						
	Design, operation, characteristics and accuracy	x	x	x	x	x	x
	Measurement of aerodynamic parameters						
	Pressure measurement						
	Static pressure, dynamic pressure, density and definitions	x	x	x	x	x	x
	Design, operation, errors and accuracy	x	x	x	x	x	x
	Temperature measurement: aeroplane						
	Design, operation, errors and accuracy	x	x				
	Displays	x	x				
	Temperature measurement: helicopter						
	Design, operation, errors and accuracy			x	x	x	x
	Displays			x	x	x	x
	Altimeter						
	Standard atmosphere	x	x	x	x	x	x
	The different barometric references (QNH, QFE and 1013.25)	x	x	x	x	x	x
	Height, indicated altitude, true altitude, pressure altitude and density altitude	x	x	x	x	x	x
	Design, operation, errors and accuracy	x	x	x	x	x	x

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Displays	x	x	x	x	x	x
	Vertical speed indicator						
	Design, operation, errors and accuracy	x	x	x	x	x	x
	Displays	x	x	x	x	x	x
	Air speed indicator						
	The different speeds IAS, CAS, TAS: definition, usage and relationships	x	x	x	x	x	x
	Design, operation, errors and accuracy	x	x	x	x	x	x
	Displays	x	x	x	x	x	x
	Magnetism: direct reading compass						
	Earth magnetic field	x	x	x	x	x	x
	Direct reading compass						
	Design, operation, data processing, accuracy and deviation	x	x	x	x	x	x
	Turning and acceleration errors	x	x	x	x	x	x
	Gyroscopic instruments						
	Gyroscope: basic principles						
	Definitions and design	x	x	x	x	x	x
	Fundamental properties	x	x	x	x	x	x
	Drifts	x	x	x	x	x	x
	Turn and bank indicator						
	Design, operation and errors	x	x	x	x	x	x
	Attitude indicator						
	Design, operation, errors and accuracy	x	x	x	x	x	x
	Directional gyroscope						
	Design, operation, errors and accuracy	x	x	x	x	x	x
	Communication systems						
	Transmission modes: VHF, HF and SATCOM						
	Principles, bandwidth, operational limitations and use	x	x	x	x	x	x
	Voice communication						
	Definitions, general and applications	x	x	x	x	x	x
	Alerting systems and proximity systems						
	Flight warning systems						
	Design, operation, indications and alarms	x	x	x	x	x	x
	Stall warning						
	Design, operation, indications and alarms	x	x				
	Radio-altimeter						
	Design, operation, errors, accuracy and indications			x	x	x	x
	Rotor or engine over speed alert system						
	Design, operation, displays and alarms			x	x	x	x
	Integrated instruments: electronic displays						
	Display units						
	Design, different technologies and limitations	x	x	x	x	x	x
9.	**NAVIGATION**						
9.1.	**GENERAL NAVIGATION**						

Best Intervention Strategy for “Road/Gyroplane”

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Basics of navigation						
	The solar system						
	Seasonal and apparent movements of the sun	x		x		x	
	The earth						
	Great circle, small circle and rhumb line	x		x		x	
	Latitude and difference of latitude	x		x		x	
	Longitude and difference of longitude	x		x		x	
	Use of latitude and longitude co-ordinates to locate any specific position	x		x		x	
	Time and time conversions						
	Apparent time	x		x		x	
	UTC	x		x		x	
	LMT	x		x		x	
	Standard times	x		x		x	
	Dateline	x		x		x	
	Definition of sunrise, sunset and civil twilight	x		x		x	
	Directions						
	True north, magnetic north and compass north	x		x		x	
	Compass deviation	x		x		x	
	Magnetic poles, isogonals, relationship between true and magnetic	x		x		x	
	Distance						
	Units of distance and height used in navigation: nautical miles, statute miles, kilometres, metres and ft	x		x		x	
	Conversion from one unit to another	x		x		x	
	Relationship between nautical miles and minutes of latitude and minutes of longitude	x		x		x	
	Magnetism and compasses						
	General principles						
	Terrestrial magnetism	x		x		x	
	Resolution of the earth’s total magnetic force into vertical and horizontal components	x		x		x	
	Variation-annual change	x		x		x	
	Aircraft magnetism						
	The resulting magnetic fields	x		x		x	
	Keeping magnetic materials clear of the compass	x		x		x	
	Charts						
	General properties of miscellaneous types of projections						
	Direct Mercator	x		x		x	
	Lambert conformal conic	x		x		x	
	The representation of meridians, parallels, great circles and rhumb lines						
	Direct Mercator	x		x		x	
	Lambert conformal conic	x		x		x	
	The use of current aeronautical charts						
	Plotting positions	x		x		x	

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Methods of indicating scale and relief (ICAO topographical chart)	x		x		x	
	Conventional signs	x		x		x	
	Measuring tracks and distances	x		x		x	
	Plotting bearings and distances	x		x		x	
	DR navigation						
	Basis of DR						
	Track	x		x		x	
	Heading (compass, magnetic and true)	x		x		x	
	Wind velocity	x		x		x	
	Air speed (IAS, CAS and TAS)	x		x		x	
	Groundspeed	x		x		x	
	ETA	x		x		x	
	Drift and wind correction angle	x		x		x	
	DR position fix	x		x		x	
	Use of the navigational computer						
	Speed	x		x		x	
	Time	x		x		x	
	Distance	x		x		x	
	Fuel consumption	x		x		x	
	Conversions	x		x		x	
	Air speed	x		x		x	
	Wind velocity	x		x		x	
	True altitude	x		x		x	
	The triangle of velocities						
	Heading	x		x		x	
	Ground speed	x		x		x	
	Wind velocity	x		x		x	
	Track and drift angle	x		x		x	
	Measurement of DR elements						
	Calculation of altitude	x		x		x	
	Determination of appropriate speed	x		x		x	
	In-flight navigation						
	Use of visual observations and application to in-flight navigation	x		x		x	
	Navigation in cruising flight, use of fixes to revise navigation data						
	Ground speed revision	x		x		x	
	Off-track corrections	x		x		x	
	Calculation of wind speed and direction	x		x		x	
	ETA revisions	x		x		x	
	Flight log	x		x		x	
9.2.	**RADIO NAVIGATION**						
	Basic radio propagation theory						
	Antennas						

Best Intervention Strategy for "Road/Gyroplane"

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Characteristics	x		x		x	
	Wave propagation						
	Propagation with the frequency bands	x		x		x	
	Radio aids						
	Ground DF						
	Principles	x		x		x	
	Presentation and interpretation	x		x		x	
	Coverage	x		x		x	
	Range	x		x		x	
	Errors and accuracy	x		x		x	
	Factors affecting range and accuracy	x		x		x	
	NDB/ADF						
	Principles	x		x		x	
	Presentation and interpretation	x		x		x	
	Coverage	x		x		x	
	Range	x		x		x	
	Errors and accuracy	x		x		x	
	Factors affecting range and accuracy	x		x		x	
	VOR						
	Principles	x		x		x	
	Presentation and interpretation	x		x		x	
	Coverage	x		x		x	
	Range	x		x		x	
	Errors and accuracy	x		x		x	
	Factors affecting range and accuracy	x		x		x	
	DME						
	Principles	x		x		x	
	Presentation and interpretation	x		x		x	
	Coverage	x		x		x	
	Range	x		x		x	
	Errors and accuracy	x		x		x	
	Factors affecting range and accuracy	x		x		x	
	Radar						
	Ground radar						
	Principles	x		x		x	
	Presentation and interpretation	x		x		x	
	Coverage	x		x		x	
	Range	x		x		x	
	Errors and accuracy	x		x		x	
	Factors affecting range and accuracy	x		x		x	
	Secondary surveillance radar and transponder						
	Principles	x		x			
	Presentation and interpretation	x		x			
	Modes and codes	x		x			
	GNSS						
	GPS, GLONASS OR GALILEO						

		Aeroplane		Helicopter		Gyroplane	
		PPL	Bridge course	PPL	Bridge course	GPL	Bridge course
	Principles	x		x			
	Operation	x		x			
	Errors and accuracy	x		x			
	Factors affecting accuracy	x		x			

(3) In AMC1 FCL.215; FCL.235, the title is replaced by the following:
'THEORETICAL KNOWLEDGE EXAMINATION AND SKILL TEST FOR THE PPL AND THE GPL';

(4) After AMC3 FCL.235, a new AMC4 FCL.235 is inserted as follows:
'**AMC4 FCL.235 Skill test**
SKILL TEST FOR THE GPL

GENERAL

(a) The route to be flown for the skill test should be chosen by the FE. The route should end at the aerodrome of departure or at another aerodrome. The applicant should be responsible for the flight planning and should ensure that all equipment and documentation for the execution of the flight are on board. The navigation section of the test should have a duration that allows the pilot to demonstrate his/her ability to complete a route with at least three identified waypoints and may, as agreed between the applicant and FE, be flown as a separate test.

(b) An applicant should indicate to the FE the checks and duties carried out, including the identification of radio facilities. Checks should be completed in accordance with the flight manual or the authorised checklist for the gyroplane on which the test is being taken. During pre-flight preparation for the test the applicant should be required to determine power settings and speeds. Performance data for take-off, approach and landing should be calculated by the applicant in compliance with the operations manual or flight manual for the gyroplane used.

FLIGHT TEST TOLERANCE

(c) The applicant should demonstrate the ability to:
  (1) operate the gyroplane within its limitations;
  (2) complete all manoeuvres with smoothness and accuracy;
  (3) exercise good judgment and airmanship;
  (4) apply aeronautical knowledge;
  (5) maintain control of the gyroplane at all times in such a manner that the successful outcome of a procedure or manoeuvre is never seriously in doubt.

(d) The following limits are for general guidance. The FE should make allowance for turbulent conditions and the handling qualities and performance of the gyroplane used:

(1) height (normal flight): ± 150 ft
(2) heading or tracking of radio aids (normal flight): + 10 dgrs
(3) speed:
  (i) take-off and approach +15/-5 knots
  (ii) all other flight regimes ± 15 knots

CONTENT OF THE SKILL TEST

(e) The skill test contents and sections set out in point (f) of this AMC should be used for the skill test for the issue of a GPL. In all sections, all of the following should be included:
  (1) RT, as appropriate for the airfield and classification of airspace;
  (2) critical assessment of active rotor handling, whenever the blades are turning at less than flying speed;
  (3) use of checklists, airmanship, control of gyroplane by external visual reference, anti/de-icing procedures, etc.

(f) Contents and sections of the skill test for the issue of a GPL:

SECTION 1 PRE-FLIGHT OPERATIONS	
a	Pre-flight preparation: pilot and passenger Documentation; fitness to fly
b	Pre-flight preparation: gyroplane Documentation; pre-flight inspection; servicing;
c	Pre-flight preparation: weather Forecast; interpretation of actual; personal limits
d	Pre-flight preparation: flight planning NOTAM; route plan; destination plan; fuel; mass and balance; performance
e	External factors and the pressure to fly
SECTION 2: TAKE-OFF AND LANDING	
a	Start-up and taxi
b	Take-off and climb into the circuit pattern, approach and land. Touch and go or full stop.
c	Take-off with land ahead (abort or simulated engine failure) during the take-off

d	Approach to land, make a decision to go-around due to a baulked landing or runway not clear
e	Approach to land, land in a designated area of 100m (simulated 1m fence at each end)
f	Approach to land on a glide approach from above 500ft, land in a designated area of 200m (simulated 1m fence at each end)
SECTION 3: GENERAL HANDLING	
a	Depart the circuit pattern and fly to a designated area, level out at a given height and airspeed, maintain this height and airspeed
b	Fly, whilst maintaining the original height and speed turn to the left and to the right to a given compass heading
c	Fly, whilst maintaining the original height and speed, 360 degree turns to the left and to the right
d	Climb and descend to given heights onto given compass headings
e	Increase speed to a sensible fast cruise speed and maintain this airspeed. The height should be constant throughout
f	Decrease speed to the slowest sensible speed achievable whilst maintaining height
g	Fly stationary, if possible, whilst maintaining positive airflow in relation to a given point on the ground, maintain height throughout
h	Descend on idle power, at a slow airspeed whilst maintaining a positive airflow, recover with minimum height loss
i	Descend on idle power, at a slow airspeed whilst maintaining a positive airflow, recover to a safe glide speed for landing
j	Turn around fixed point on the ground at a constant radius. Change direction turning the turn. Turns can be 180 degree or 360 degree.
SECTION 4: EMERGENCIES	
a	Simulated emergency actions/scenarios that could occur during flight, not related to the engine (that can also be done by oral questions)
b	Simulate a precautionary landing, select a landing area and fly a suitable approach

c	Simulate an engine failure select a landing area and fly a suitable approach
d	Simulate unusual attitudes and recover Distracted: Rapid pitch up or fast descent; Fixated on ground: slow or fast spiral descent
SECTION 5: POST-FLIGHT	
a	Return to the airfield, join the circuit pattern appropriately, land
b	Return to the apron, shutdown and exit
c	Perform the post-flight actions

';

(5) After AMC1 FCL.210.As, a new AMC1 FCL.210.G and new AMC1 FCL.240.G are inserted as follows:

'**AMC1 FCL.210.G EXPERIENCE REQUIREMENTS AND CREDITING**
FLIGHT INSTRUCTION FOR THE GPL

(a) Entry to training
Before being accepted for training, an applicant should be informed that the appropriate medical certificate must be obtained before solo flying is permitted.

(b) Flight Instruction
(1) The GPL flight instruction syllabus should take into account the principles of threat and error management and also cover:
(i) pre-flight operations, including mass and balance determination, gyroplane inspection and servicing;
(ii) ground manoeuvring, rotor handling;
(iii) aerodrome and traffic pattern operations, collision avoidance precautions and procedures;
(iv) control of the gyroplane by external visual reference;
(v) flight at altitude, at slow airspeeds, maintaining altitude;
(vi) flight on idle power, at very slow airspeeds, maintaining rudder authority;
(vii) normal and crosswind take-offs and landings;
(viii) maximum performance (short field and obstacle clearance) take-offs, short-field landings;
(ix) flight by sole reference to the instruments, including the completion of a level 180-degree turn;

(x) cross-country flying using visual reference and dead reckoning ;

(xi) emergency operations, including simulated gyroplane equipment malfunctions;

(xii) operations to, from and transiting controlled aerodromes, compliance with air traffic service procedures, communication procedures and phraseology.

(2) Before allowing the applicant for a GPL to undertake his/her first solo flight, the FI should ensure that the applicant can use R/T communication.

(c) Syllabus of flight instruction

(1) The numbering of exercises should be used primarily as an exercise reference list and as a broad instructional sequence guide; therefore the demonstrations and practices need not necessarily be given in the order listed. The actual order and content will depend upon the following interrelated factors:

(i) the applicant's progress and ability;

(ii) the weather conditions affecting the flight;

(iii) the flight time available;

(iv) instructional technique considerations;

(v) the local operating environment;

(vi) applicability of the exercise to the gyroplane.

(2) Each of the exercises involves the need for the applicant to be aware of the needs of good airmanship and look-out, which should be emphasised at all times.

(3) Syllabus and list of exercises:

Exercise 1a: Familiarisation with the gyroplane	
a	Characteristics of the gyroplane
b	Cockpit layout
c	Systems
d	Checklists, drills and controls
Exercise 1b: Emergency drills	
a	Action in case of fire on the ground and in the air
b	Engine cabin and electrical system fire
c	Systems failure

d	Location and use of emergency equipment
Exercise 1c: Air experience flight	
a	Introduction to rotary wing flight in a gyroplane
b	Air exercise
Exercise 2: Basic skills (1)	
Turning left and right to follow features at a constant speed	
a	Look-out
b	Control handover
c	Use of the stick – speed and direction
Exercise 3: Basic skills (2)	
Flying in trim, maintaining height and flying in balance	
a	Trim (pitch and roll as applicable), avoiding PIO (Pilot-Induced Oscillation)
b	Use of the throttle – height
c	Use of the pedals – balance
Exercise 4: Basic skills (3)	
Ground handling and introduction to pre-flight planning	
a	Pre-flight planning – pilot/passenger, aircraft, weather, flight content, risk mitigation
b	Handling the gyroplane prior to start
c	Pre-start and start-up procedure
d	Taxiing (rotor stationary)
e	Power and pre-runway checks
f	After landing checks and procedures
g	Shutdown
Exercise 5: Developing muscle memory	

Coordinating stick and pedal with power changes	
a	Counteracting engine torque roll
b	Counteracting yaw from propeller slipstream
c	Counteracting unwanted pitch changes
d	Transitioning to the climb, descents and level-out at constant speed and balance throughout
Exercise 6: Coordinating throttle and pedal to maintain height, speed and balance when turning	
a	Medium level turns
b	Power requirements during a turn
c	Maintaining balance during turns in different directions
Exercise 7: The effect of wind when flying in a straight line	
a	Wind terminology
b	The technique for flying in a straight line with a string crosswind
c	Determining the wind direction during flight
Exercise 8: Fine tuning accuracy when maintaining height and speed	
a	Technique for fine-tuning height
Exercise 9: Exercise 9 : Climbing and descending to pre-determined levels	
a	Effect of power on the rate of climb and descent
b	Effect of speed on the rate of climb and descent
c	Full power climbs, idle power descents
Exercise 10: Climbing and descending while turning	
a	Effect of angle of bank on the rate of climb and descent
b	Maintaining balance during full power climbing turns, and difference between left and right turns

c	Maintaining balance during idle power descending turns, and difference between left and right turns
Exercise 11: Purposeful increase and decrease speed below slow cruise and fast cruise	
a	Rapid acceleration and rapid deceleration to given speeds
b	Fast flight
Exercise 12: Flying the circuit pattern and going around	
a	Terminology in the circuit pattern
b	Pre-landing checks
c	Flying an accurate circuit pattern
d	Maintaining appropriate spacing for other traffic in the circuit pattern
e	Technique for going around
Exercise 13: Take-offs 1 – Rotor management	
Rotor management	
a	Active rotor management, taxi with rotor turning
b	Building rotor speed during the early take-off phase
c	Smooth transition to the wheel balance attitude, prior to take-off
d	Stopping the gyroplane
Exercise 14: Take-offs (2)	
Wind close to the runway heading, landing ahead	
a	Lifting the gyroplane off the surface
b	Building airspeed, transitioning to climb airspeed
c	Understanding the Height/Velocity avoid curve
d	Aborting take-offs, landing ahead
e	Trimming during take-off

f	Climbing through 300ft checks
Exercise 15: Take-offs (3)	
Different weather conditions and ground surfaces	
a	Crosswinds from left and right
b	Strong winds
c	No wind
d	Considerations for take-off performance
e	Determining an appropriate abort point
f	Rough ground take-offs – differences
g	Smooth surface take-offs – differences
h	Immediate departure take-offs, pre-rotating at the holding point
Exercise 16: Landings (1)	
Wind close to the runway heading	
a	Flying an accurate approach
b	Descending through 300ft - checks
c	Recovering from a balloon when landing
Exercise 17: Landings (2)	
Different wind conditions and ground surfaces	
a	Crosswinds – left and right
b	Strong winds
c	Light winds
d	Rough / soft ground
Exercise 18: Landings (3)	
Landing close to a designated point with power available	
a	Precision landings

Best Intervention Strategy for “Road/Gyroplane”

Exercise 19: Landings (4)	
Landing close to a designated point when power is at idle	
a	Importance of maintaining airspeed
b	Technique for making a precision landing when power is not available
Exercise 20: Departing and arriving at airfields	
Landing close to a designated point when power is at idle	
a	Departing from the airfield
b	Arriving at the airfield
Exercise 21: Slow flight at level altitude and flying stationary in relation to a ground reference (helicopter mode)	
a	HASEL – checks (Height, Area, Secure, Engine, Look-out) before unusual manoeuvres
b	Flying on the back side of the power curve
c	Avoiding flying behind the power curve
Exercise 22: Descending at slow airspeed on idle power (parachute mode)	
a	Importance of maintaining rudder authority to avoid loss of control
b	Establishing slow flight on idle power
c	Recovering speed when power is available
d	Recovering speed when power is not available
Exercise 23: High bank angle turns and turning in relation to ground reference features	
a	High bank angle turns
b	Turning in relation to a ground reference (with significant wind)
Exercise 24: Avoiding, recognizing and recovery from unusual attitudes	
a	Hazards of distraction and fixation

b	Recognising unusual attitudes
c	Recovery techniques
Exercise 25: Dangers associated with low flying	
a	Legal issues relating to low flying
b	Reduction of safety margin when flying low
Exercise 26: Consolidation of general handling, pre-flight preparation and en-route airmanship	
a	Advanced pre-flight preparation and post-flight responsibilities
b	En-route airmanship
NOTE: This exercise is a continuation to exercise 4 and the combination of these exercises are taught and consolidated in parallel with all the previous exercises.	
Exercise 27: Emergencies (1)	
Coping with in-flight issues	
a	Possible emergency scenarios
b	standard emergency procedures
c	mitigating catastrophic failure
Exercise 28: Emergencies (2)	
Making a precautionary landing	
a	Selecting appropriate fields
b	Technique for surveying fields prior to landing
Exercise 29: Emergencies (3)	
Landing safely in case of engine failure during the flight	
a	Restart procedure
b	Distress/urgency radio calls
c	Technique for positioning prior to the approach
Exercise 30: Emergencies (4)	
Being prepared, should the engine stop when flying in the circuit pattern	

a	Preparation prior to taking off
Exercise 31: Checking readiness for first solo flight	
a	Difference in flying characteristics
b	Checking all pre-requisites have been completed
Exercise 32: First solo flight	
Exercise 33: Consolidating solo flying skills	
a	Flying according to the instructor's briefing
b	Decision to fly – decision making
Exercise 34: Navigation and flying a route without getting lost	
a	Navigation pre-flight planning
b	Navigation technique – dead reckoning
c	Navigation technique – GPS assisted
d	Lost procedure
Exercise 35: Landing at airfields other than the home airfield	
a	Destination pre-flight planning
Exercise 36: Consolidating navigation skills – flying solo	
Exercise 37: Flying the navigation flights required prior to licence issue	
Exercise 38: Preparation for the skills test	

AMC1 FCL.240.G Recency requirements

[AMC on the conditions for crediting experience on gyroplanes falling under Annex I to Regulation (EU) 2018/1139 to be inserted, based on the final version of AMC1 FCL.140.A & FCL.740.A(b)(1)(ii) – RMT.0188 (NPA 2014-29(B) / Opinion No 05/2017)]';

(6) AMC1 FCL.810(a) is amended as follows:

(a) The title of the AMC is amended as follows:

'AEROPLANE AND GYROPLANE NIGHT RATING TRAINING COURSE';

(b) Paragraph (a) is amended as follows:

‘(a) The aim of the course is to qualify aeroplane or gyroplane licence holders to exercise the privileges of the licence at night.’;

(7) In paragraph (a) of GM1 FCL.900, paragraph (1) is amended as follows:

‘(a) FI certificate: aeroplane (FI(A)), helicopter (FI(H)) ~~and~~, airship (FI(As)) and gyroplane (FI(G));’;

(8) In AMC5 FCL.935, a new paragraph (b) is added as follows:

‘(b) Assessment of competence form for the FI for gyroplanes

APPLICATION AND REPORT FORM FOR THE FI(G) ASSESSMENT OF COMPETENCE			
1 Applicants personal particulars:			
Applicant’s last name(s):		First name(s):	
Date of birth:		Tel (home):	Tel (work):
Address:		Country:	
2 Licence details			
GPL number:		Exp. Date:	
Privileges (point FCL.235.G of Part-FCL) for the following gyroplane variants:	1.		
	2.		
	3.		
	4.		
	5.		
Night rating included:	☐ Yes ☐ No		
3 Pre-course flying experience			
Total flying hours		PIC	
4 Pre-entry flight test			
I recommend ....for the FI(G) course.			
Name of ATO/DTO:		Date of flight test:	
Name(s) of FI conducting the test (capital letters):			
Licence number:			
Signature:			
5 Declaration by the applicant			

I have received a course of training in accordance with the syllabus for the FI(G) certificate:			
Applicant’s name(s): (capital letters)		Signature:	
6	**Declaration by the HT of the ATO/DTO**		
I certify that .... has satisfactorily completed a training course for the FI(G) certificate in accordance with the FI(G) training syllabus.			
Flying hours during the course:			
Aircraft or FSTDs used :			
Name(s) of HT:			
Signature:			
Name of ATO/DTO:			
7	**Flight instructor examiner’s certificate**		
I have tested the applicant according to Part-FCL			
A. GYROPLANE FLIGHT INSTRUCTOR EXAMINER’S ASSESSMENT (in case of partial pass):			
Theoretical oral examination:		Skill test:	
Passed	***Failed***	***Passed***	***Failed***
	I recommend further flight or ground training with an instructor before re-test		
	I do not consider further flight or theoretical instruction necessary before re-test (tick as applicable)		
B. GYROPLANE FLIGHT INSTRUCTOR EXAMINER’S ASSESSMENT:			
Name(s) of FIE (capital letters):			
Signature:			
Licence number:		Date:	

(9) AMC1 FCL.930.FI is amended as follows:

(a) The headline is amended as follows:

‘FI(A), FI(H), ~~AND~~ FI(AS) AND FI(G) TRAINING COURSE’;

(b) After Section C, a new Section D is added as follows:

‘D. Gyroplanes

Part 2

AIR EXERCISES

(a) The air exercises are similar to those used for the training of the GPL but with additional items designed to cover the needs of an FI.

(b) The numbering of exercises should be used primarily as an exercise reference list and as a broad instructional sequence guide; therefore the demonstrations and practices need not necessarily be given in the order listed. The actual order and content will depend upon the following interrelated factors:
  (1) the applicant’s progress and ability;
  (2) the weather conditions affecting the flight;
  (3) the flight time available;
  (4) instructional technique considerations;
  (5) the local operating environment;

(c) It follows that student instructors will eventually be faced with similar interrelated factors. They should be shown and taught how to construct flight lesson plans, taking these factors into account, so as to make the best use of each flight lesson, combining parts of the set exercises as necessary.

GENERAL

(d) The briefing normally includes a statement of the aim and a brief allusion to principles of flight only if relevant. An explanation is to be given of exactly what air exercises are to be taught by the instructor and practised by the student during the flight. It should include information on how the flight will be conducted, who is to fly the gyroplane and what airmanship, weather and flight safety aspects currently apply. The nature of the lesson will govern the order in which the constituent parts are to be taught.

(e) The four basic components of the briefing will be:
  (1) the aim;
  (2) principles of flight (briefest reference only);
  (3) the air exercise(s) (what, and how and by whom);
  (4) airmanship (weather, flight safety etc).

PLANNING OF FLIGHT LESSONS

(f) The preparation of lesson plans is an essential prerequisite of good instruction and the student instructor is to be given supervised practice in the planning and practical application of flight lesson plans.

GENERAL CONSIDERATIONS

(g) The student instructor should complete flight training to practice the principles of basic instructor at the GPL level.

(h) During this training, expect when acting as a student pilot for mutual flights, the student instructor occupies the seat normally occupied by the FI(G).

(i) It is to be noted that airmanship and look-out is a vital ingredient of all flight operations. Therefore, in the following air exercises the relevant aspects of airmanship are to be stressed at all times.

(j) The student instructor should learn how to identify common errors and how to correct them properly, which should be emphasised at all times.

(k) The student instructor should attain flying skills that allows them to recover from student errors and land safely in the event of an actual engine failure during training. These include:

- (1) precision forced landings above the landing spot when flying into wind (360 degree turn) and downwind (180 degree turn);
- (2) precision powered approaches at a slower than normal approach speed to land with very little ground roll in a small area;
- (3) take-off and hover taxi at the slowest speed possible (accurate control at the slow end of the flight envelope of the gyroplane);
- (4) flying and landing dead stick;
- (5) taking off and flying in strong winds and crosswinds close to the approved limits for the model of the gyroplane;
- (6) advanced rotor handling on the ground to include building up rotor rpm from a slow rotor speed using airflow and slowing down a rotor in relatively strong winds without the aid of a rotor brake;
- (7) safely entering each of the unusual attitudes and knowing the limits of the safe flight envelope in each attitude;
- (8) rounding out significantly high with low airspeed and being able to safely recover to land;
- (9) taking off and climbing with insufficient airspeed approaching the edges of the ‘do not fly’ region of the height/velocity curve and recovering to land.
- (10) taking off with limited power to demonstrate to a student what limited power take-offs will fee like.

SYLLABUS OF FLIGHT INSTRUCTION CONTENTS

LONG BRIEFINGS AND AIR EXERCISES

IMPORTANT: Where the student instructor holds an instructor certificate for fixed wing/delta wing aircraft or helicopters, there should be sufficient time allocated and significant emphasis given to highlight the differences between a gyroplane and the other type(s) of aircraft. This applies to the flight envelope, the coordination of controls and instructional techniques as often the differences can appear similar but are actually subtly different. It is imperative that aeroplane or helicopter pilot/instructor knowledge and skills cannot be automatically transferred to flying/instructing in a gyroplane.

EXERCISE 1: INTRODUCTION TO THE GYROPLANE

(a) Long briefing objectives:
- (1) safety considerations around an airfield;
- (2) introduction to the gyroplane;
- (3) key differences between a gyroplane and a helicopter;
- (4) key differences between a gyroplane and a fixed-wing aircraft;
- (5) key differences between a gyroplane and a delta-wing aircraft;
- (6) initial preparation for the introductory flight:
  - (i) fitness of pilot/passenger to fly;
  - (ii) importance of look-out;
  - (iii) in-cockpit communication (standby, traffic, repeat instructions);
  - (iv) explanation of the cockpit layout;
  - (v) internal and external checks before flight;
  - (vi) suitability of weather for introductory flights;
  - (vii) the flight content (handover of controls);
- (7) passenger safety brief and emergency routines;
- (8) differences when occupying the instructor's seat

NOTE: Items (a) 3-5 are particularly important as a significant number of student pilots will have fixed-wing and/or helicopter experience. Due consideration must be given to differences.

(b) Air exercise:
- (1) Appropriate demonstrations and hands-on control related to the previous experience and expectations of the student pilot.

EXERCISE 2: BASIC SKILLS (1) – TURNING LEFT AND RIGHT TO FOLLOW FEATURES AT A CONSTANT SPEED

(a) Long briefing objectives:
- (1) the six basic skills of flying: look-out; speed; direction; trim; height; balance;
- (2) the primary controls, instruments and the gyroplane cockpit;
- (3) straight and level cruise flight: attitude; visual references;
- (4) the look-out technique;
- (5) the stick and the axes of rotation: pitch; roll;

(6) maintaining a correct and constant airspeed, use of the airspeed indicator;
(7) changing direction, limited angle of bank;
(8) recap in-cockpit communication: who has control; standby; repeat instructions.

(b) Air exercise:
(1) look-out technique and what to say when traffic is seen;
(2) straight and level flight, determining the attitude of the gyroplane;
(3) handover of control - procedure;
(4) sensitivity of the stick and boundaries for pitch up/down roll left/right in early exercises;
(5) technique for glancing at instruments during look-out; interpret ASI;
(6) the procedure for holding a constant chosen speed (limited speed ranges suitable for early training exercises);
(7) gentle turns to follow features (no requirement for additional power);
(8) the importance of being relaxed when flying and building situational awareness.

EXERCISE 3: BASIC SKILLS (2) – FLYING IN TRIM, MAINTAINING HEIGHT AND FLYING IN BALANCE

(a) Long briefing objectives:
(1) pitch and roll trim; principles and how it works (as applicable to model of gyroplane);
(2) use of the throttle for adjusting height; terminology idle/max/cruise power;
(3) use of the pedals for adjusting balance; explanation of flying in balance; yaw;
(4) the danger of over controlling; avoiding pilot induced oscillation (PIO);
(5) reinforcing where a student should be looking when flying.

(b) Air exercise:
(1) trimming the gyroplane;
(2) interpret altimeter and vertical speed indicator;
(3) gentle adjustments of height using the throttle;
(4) interpret the balance indicator;
(5) use of the pedals to keep the gyroplane in balance.

EXERCISE 4: BASIC SKILLS (3) GROUND HANDLING AND INTRODUCTION TO PRE-FLIGHT PLANNING

(a) Long briefing objectives:

Best Intervention Strategy for “Road/Gyroplane”

(1) introduction to risk mitigation using threat and error management;
(2) pre-flight planning:
  (i) pilot and passenger preparation;
    (A) IMSAFE (Illness, Medication, Stress, Alcohol, Fatigue, Eating)
  (ii) aircraft preparation;
    (A) check of maintenance status;
    (B) daily inspection in accordance with the AFM;
    (C) checks before every flight in accordance with the AFM;
  (iii) weather preparation;
    (A) interpreting weather forecasts;
    (B) interpreting the weather by looking from the airfield;
    (C) personal weather limits;
  (iv) flight content preparation;
    (A) NOTAMS;
    (B) Fuel planning;
    (C) Mass and balance;
  (v) external factors and pressures that add risks to the flight.
(3) terminology relating to an airfield;
(4) ground handling of a gyroplane;
(5) pre-start checks and starting the engine;
(6) taxi procedure and additional checks on initial taxi;
(7) warming the engine and engine checks before flight;
(8) pre-runway procedure;
(9) post-runway procedure;
(10) engine shutdown procedure;
(11) after flight actions;
(12) end of day actions;

(b) Air exercise:
(1) emergency actions should someone approach the gyroplane with the engine running;
(2) pre-start and start-up procedure;
(3) initial taxi and general taxi procedure (rotor stationary);
(4) use of RT when the gyroplane is on the ground;
(5) engine power checks;
(6) pre-runway actions;
(7) actions after the runway has been vacated;
(8) engine shutdown procedure.

Note: The student instructor should be taught to introduce the content of this exercise in parallel with exercises 5 to 25. Topics should be introduced incrementally in line with the student pilot workload.

EXERCISE 5: DEVELOPING MUSCLE MEMORY – COORDINATING STICK AND PEDAL WITH POWER CHANGES

(a) Long briefing objectives:
  (1) energy management in a gyroplane:
    (i) fuel (engine rpm);
    (ii) airspeed (kinetic);
    (iii) height (potential);
    (iv) rotor energy (stored).
  (2) the effect of mass, weather, rotor/propeller cleanliness on gyroplane performance;
  (3) introduction to the power curve, engine rpm requirements for different cruise speeds;
  (4) the effect of propeller slipstream on yaw/balance;
  (5) the effect of engine torque on roll;
  (6) effect of power change on pitch and the relation to the centre of gravity;
  (7) the need to coordinate stick and pedal with throttle changes to maintain speed, a disc level attitude and balance.

(b) Air exercise:
  (1) establish the datum cruise power for a given speed on a given day;
  (2) build muscle memory:
    (i) setting key throttle positions by sound and feel;
    (ii) maintain balance with power changes;
    (iii) maintain disc level attitude with power changes;
    (iv) trim adjustments with power changes for constant speed.
  (3) transition to the climb at a constant speed, in balance and trim, climb attitude;
  (4) transition to the descent at a constant speed, in balance and trim, descend attitude;
  (5) level out from a climb/descent at a constant speed, in balance and trim;
  (6) increase/decrease speed at a constant altitude, in balance, re-trim (normal range of training speeds)

Note: During these exercises, student pilots should move from reacting to instruments (when controls are moved individually) to pre-empting the consequential reactions in roll/pitch and yaw as power is (significantly) adjusted.

EXERCISE 6: COORDINATING THROTTLE AND PEDAL TO MAINTAIN HEIGHT, SPEED AND BALANCE WHEN TURNING

(a) Long briefing objectives:
  (1) the forces in a turn;
  (2) the procedure for a level turn, maintaining speed and balance;
  (3) the limitations of a compass during a turn;
(b) Air exercise:
  (1) reinforcement of look-out in a turn
  (2) medium level turns left and right at a constant speed, maintaining balance;
  (3) turning to a give compass heading.

EXERCISE 7: THE EFFECT OF WIND WHEN FLYING IN A STRAIGHT LINE

(a) Long briefing objectives:
  (1) wind terminology;
  (2) airspeed and groundspeed;
  (3) drift and wind correction angles;
  (4) the difference between track and heading;
  (5) the technique for flying a straight track in a crosswind;
  (6) determining the direction of the wind during flight.
(b) Air exercise:
  (1) determine the wind signals from visual clues;
  (2) determine an appropriate wind correction angle to fly a straight track, disc level and in balance;

Note: This exercise will almost definitely be briefed/flown out of sequence as it requires appropriate wind conditions.

EXERCISE 8: FINE TUNING ACCURACY WHEN MAINTAINING HEIGHT AND SPEED

(a) Long briefing objectives:
  (1) the relationship between energy, height and speed;
  (2) the technique for fine tuning flying at an accurate height;
  (3) consolidating the coordinated control movements for adjusting speed height and direction.
(b) Air exercise:
  (1) maintaining height in particularly thermic flying conditions;
  (2) making fine adjustments to the controls to achieve accurate flying.

Note: This exercise does not introduce new exercises but reinforces to the student the need for accurate flying (look-out/speed/direction/trim/height/balance) as it will be required in the circuit pattern, particularly coordinating controls and taking into account lift and sink conditions.

EXERCISE 9: CLIMBING AND DESCENDING TO PRE-DETERMINED LEVELS

(a) Long briefing objectives:
  (1) the effect of power on the rate of climb and descent;
  (2) the effect of speed on the rate of climb and descent;
  (3) the procedure for climbing and levelling out;
  (4) the procedure for descending and levelling out;
  (5) the technique for accurately levelling out at a given altitude.

(b) Air exercise:
  (1) full power climbs at a constant speed;
  (2) level out from a full power climb at a given altitude, with accurate level, speed and balance;
  (3) idle power descents at a constant speed;
  (4) level out from an idle power descent at a given altitude, with accurate level, speed and balance;
  (5) smooth transition from a high power climb to a low power descent, maintaining speed and balance throughout;
  (6) smooth transition from a low power descent to a high power climb, maintaining speed and balance throughout.

EXERCISE 10: CLIMBING AND DESCENDING WHILE TURNING

(a) Long briefing objectives:
  (1) reinforce the differences in pedal coordination for balance when turning left and right with high power (climbing turns) and low power (idle power descents);
  (2) the effect of the angle of bank on the rate of climb and descent.

(b) Air exercise:
  (1) level turns, initiate a climbing turn, level out while maintaining the turn;
  (2) level turns, initiate a descending turn, level out while maintain the turn;
  (3) straight high power climb, introduce a turn, continue on initial heading;
  (4) straight idle power descent, introduce a turn, continue of initial heading

Note: Turns should be practiced both to the left and to the right, should be 360 degrees, with constant speed and balance maintained throughout.

EXERCISE 11: PURPOSEFUL INCREASE AND DECREASE SPEED BELOW SLOW CRUISE AND FAST CRUISE

(a) Long briefing objectives:

- (1) the procedure for making speed changes with significant acceleration and deceleration
  - (i) acceleration attitude;
  - (ii) deceleration attitude;
- (2) fast flight
  - (i) consequences of exceeding VNE
  - (ii) differences in control responsiveness
  - (iii) differences in vibration at speed

(b) Air exercise:

- (1) significant acceleration from cruise to fast flight, constant height and balance
- (2) significant deceleration from fast flight to cruise, constant height and balance
- (3) gentle turns at fast flight, constant height and speed

Note: Fast flight is considered to be at the speed where a constant altitude can be maintained with the power close to maximum continuous. Care must be taken never to allow the student to exceed VNE.

EXERCISE 12: FLYING THE CIRCUIT PATTERN AND GOING AROUND

(a) Long briefing objectives:

- (1) the terminology associated with the circuit pattern;
- (2) considerations when flying the circuit pattern:
  - (i) high density of other aircraft;
  - (ii) maintaining suitable separation for other aircraft.
- (3) pre-landing checks:
  - (i) pilot/passenger security;
  - (ii) aircraft configuration as per flight manual;
  - (iii) wind check (correct runway, type of landing);
  - (iv) flight situational awareness.
- (4) final approach and positioning for landing;
- (5) the go-around procedure;
- (6) use of RT in the circuit pattern.

(b) Air exercise:

- (1) flying the circuit pattern, maintaining good situational awareness
- (2) go-around at 300ft above the runway
- (3) pre-landing checks

(4) RT as appropriate for the airfield

Note: This exercise is likely to be flown in parallel with the previous lessons as training flights return to the airfield after the general handling exercises.

EXERCISE 13: TAKE-OFFS 1 – ROTOR MANAGEMENT

(a) Long briefing objectives:
- (1) active rotor handling, taxi with rotor turning;
- (2) starting the rotor prior to take-off – pre-rotation;
- (3) setting off and building rotor speed using airflow;
  - (i) the need for using an initial power setting that is unlikely to be full power;
  - (ii) stick forces during take-off;
  - (iii) importance of stick back before applying significant power
- (4) the wheel balance attitude;
- (5) stopping the rotor after landing;
- (6) what to do when the rotor rpm falls below the critical threshold.

(b) Air exercise:
- (1) recap the lining up procedure;
- (2) pre-rotation and setting off procedure;
- (3) maintaining directional control during rotor speed acceleration;
- (4) understanding how the stick forces change during the take-off;
- (5) understanding the reduction in rotor acceleration with forward stick position;
- (6) the importance of monitoring rotor rpm during this stage of the take-off;
- (7) establishing the wheel balance attitude;
- (8) stopping the gyroplane:
  - (i) using the rotor disc to slow down the gyroplane;
  - (ii) stick position after stopping;
  - (iii) when it is appropriate to use the wheel brake;
- (9) taxiing with rotor turning, stick positioned in relation to the wind.

Note: This exercise requires a smooth take-off surface, it cannot be flown from rough ground due to the potential of blade flap on rough ground.

EXERCISE 14: TAKE-OFFS 2 – WIND CLOSE TO THE RUNWAY HEADING, LANDING AHEAD

(a) Long briefing objectives:
- (1) critical checks immediately prior to commencing the take-off run
  - (i) passenger/pilot ready for take-off;

(ii) aircraft engine final check;

(iii) wind direction still as expected;

(iv) runway clear, crosswind clear.

(2) the gyroplane 'lift' from the runway

(3) the height/velocity curve and the need to remain close to the ground during airspeed build-up

(4) stick forces and the need to trim during airspeed build-up

(5) the low hops flight profile, flying at a height of approximately 1 metre

(6) the high hops flight profile, flying at a height of approximately 50 metres

(7) landing ahead and aborting take-offs

(b) Air exercise:

(1) student lift and airspeed acceleration,

(i) with the instructor transitioning to a landing on the remaining runway;

(ii) with the student transitioning to a landing on the remaining runway;

(iii) low hop on cruise power, student landing on remaining runway;

(iv) high hop, student landing on remaining runwway;

(2) take-off and climb out;

(3) checks when climbing through 300ft.

(i) passenger check (especially tandem gyroplanes);

(ii) aircraft performance check;

(iii) weather check (clear of obstructions);

(iv) flight path and situational awareness.

Note: It is vital that the student learns to remain in control throughout the take-off and is comfortable to land ahead before continuing with the climb-out part of the exercise. Aborting take-offs should be trained until the student is capable of aborting a take-off safely otherwise pilots will favour climbing out in situations that should be aborted for safety reasons.

EXERCISE 15: TAKE-OFFS 3 – DIFFERENT WEATHER CONDITIONS AND GROUND SURFACES

(a) Long briefing objectives:

(1) crosswind considerations;

(2) rough ground considerations;

(3) take-off performance:

(i) factors affecting take-off performance;

(ii) acceptable method for maximising take-off performance;

(A) higher pre-rotation
(B) quicker application of high power
(iii) noting a ground reference feature as an abort point;
(iv) the danger of climbing out with insufficient airspeed to clear an obstacle. ‘fools confidence’, a significant contributing factor to gyroplane accidents;
(v) Noting there is no additional ‘short field’ take-off technique in a gyroplane
(4) strong wind considerations;
(5) slope considerations;
(6) immediate departure take-offs, pre-rotating prior to lining up
(b) Air exercise:
(1) take-off with a crosswind from the left;
(2) take-off with a crosswind from the right;
(3) take-off in a strong wind;
(4) rough ground take-off technique;
(5) immediate departure take-off technique;
(6) emulating take-off with poor performance characteristics (see note 1)

Note 1: This exercise is done to allow the student feel what the gyroplane will do when there is insufficient power to climb out safely. The purpose is to teach the student to recognize the problem and to make the decision to land ahead.

Note 2: This exercise will be flown on different days as it requires different wind conditions that are extremely unlikely to happen on a single day and in sequence. If, in the absence of particular wind conditions, take-offs in these wind conditions cannot be trained, the relevant parts of this exercise should be subject to an extensive briefing between student and instructor during this exercise as well as exercise 38.

EXERCISE 16: LANDINGS 1 – WIND CLOSE TO THE RUNWAY HEADING
(a) Long briefing objectives:
(1) the basics of the approach to landing;
(2) checks when descending through 300ft
(i) passenger standby;
(ii) aircraft settled – constant power and airspeed;
(iii) wind – prepare to anticipate drift;
(iv) runway clear or initiate go-around procedure;
(3) use of the controls during the landing:

(i) throttle – rate of descent and angle of descent;
(ii) fore/aft stick – airspeed;
(iii) left/right stick – position over the ground;
(iv) pedals – aligning the wheels with the runway direction;

(4) extending the touchdown point to be close to a runway exit point;
(5) recovering from an inadvertent gaining of height during the final stages of landing caused by gusting winds or incorrect movement of the controls ;
(6) consideration of the approach profile in relation to other traffic that may not be familiar with the descent profiles available in a gyroplane flight envelope.

(b) Air exercise:

(1) approach to a nominated reference point:
(i) go-around at 300ft, with a constant airspeed;
(ii) descend through 300ft and make appropriate checks;
(A) go-around with a constant airspeed at a height as low as the student is comfortable.
(B) continue practicing until the student is comfortable at flying a few feet above the runway.

(2) when the student is comfortable at flying a few feet above the runway, land ahead;
(3) flying the approach with different power settings, including idle power.

Note: The instructor should avoid asking the student to go-around at specific heights below 300ft so that the student concentrates on judging height above the ground visually and not by reference to the altimeter.

EXERCISE 17: LANDINGS 2 – DIFFERENT WIND CONDITIONS AND GROUND SURFACES

(a) Long briefing objectives:

(1) considerations when landing in a crosswind;
(2) considerations when landing in light winds or no wind;
(3) the significant hazards of attempting to land downwind due to the rotor disc;
(4) considerations when landing in strong winds;
(5) considerations when landing in soft or uneven ground.

(b) Air exercise:

(1) landing in a crosswind from the right;
(2) landing in a crosswind from the left;
(3) landing in no wind or light wind conditions;
(4) landing in strong wind, close to the runway heading;

(5) landing in strong wind, crosswind, opting to land cross runway into wind;
(6) landing on soft or uneven ground.

EXERCISE 18: LANDINGS 3 – TO BE ABLE TO LAND CLOSE TO A DESIGNATED POINT WITH POWER AVAILABLE

(a) Long briefing objectives:
  (1) the technique for a precision landing (power available)
  (2) the importance of maintaining airspeed until immediately prior to touchdown
(b) Air exercise:
  (1) high power approach, shallow approach angle;
  (2) lower power approach, steep approach angle.

EXERCISE 19: LANDINGS 4 – TO BE ABLE TO LAND CLOSE TO A DESIGNATED POINT WHEN POWER IS AT IDLE

(a) Long briefing objectives:
  (1) the technique for a precision landing (idle power or no power available) using a close-in base leg and altering the radius of the final turn to get to the correct landing area;
  (2) the importance of maintaining sufficient airspeed when close to the ground
(b) Air exercise:
  (1) glide approaches to touch down at a given point on the runway
    (i) straight in approach;
    (ii) using a single turn from base leg;
    (iii) using descending turns in a figure of 8 pattern perpendicular to the runway heading. Balance must be maintained throughout.

EXERCISE 20: DEPARTING AND ARRIVING AT AIRFIELDS

(a) Long briefing objectives:
  (1) procedure when departing from the airfield;
  (2) procedure when arriving at an airfield;
  (3) airfield joining techniques;
    (i) overhead join;
    (ii) joining from the dead side of the airfield;
    (iii) joining from the live side of the airfield.
(b) Air exercise:
  (1) departing from the airfield;
  (2) arriving at the airfield.
  (3) joining procedures appropriate to the airfield.

Note: This exercise may be included in parallel with any other exercises that are flown outside the airfield ATZ as student workload permits.

EXERCISE 21: SLOW FLIGHT AT LEVEL ALTITUDE AND FLYING STATIONARY IN RELATION TO A GROUND REFERENCE (HELICOPTER MODE)

(a) Long briefing objectives:
  (1) the backside of the power curve and behind the power curve;
  (2) HASEL checks (Height, Area, Secure, Engine, Look-out) before unusual manoeuvres;
  (3) the technique for slow flight;
  (4) flying stationary, at altitude, in relation to a ground reference (into wind).

(b) Air exercise:
  (1) HASEL checks;
  (2) slow flight into wind;
  (3) slow flight downwind;
  (4) flying stationary in reference to a ground feature.

Note: The term ‘helicopter mode’ is a turn of phrase to indicate that a gyroplane has slow flight characteristics that are consistent with light helicopters and outside the flight envelope of light fixed-wing aircraft. These exercises are all flown at a safe altitude.

EXERCISE 22: DESCENDING AT SLOW AIRSPEED ON IDLE POWER (PARACHUTE MODE)

(a) Long briefing objectives:
  (1) the technique for establishing slow flight on idle power;
  (2) the importance of maintaining airflow over the rudder to avoid loss of control;
  (3) the technique for regaining airspeed with minimum height loss when power is available;
  (4) the technique for regaining airspeed with minimum height loss when power is not available;
  (5) the tendency of a gyroplane to enter a ‘flat turn’ if rudder authority is lost due to dissymmetry of propeller thrust when there is a high rate of descent and the power is idle;
  (6) the recovery technique if the gyroplane starts to enter a ‘flat turn’.

(b) Air exercise:
  (1) initiate a descent on idle power and an airspeed close to the minimum airspeed possible for the model of gyroplane while maintaining rudder authority.

(2) recover from the slow airspeed descent, with minimum height loss:

(i) with power available;

(ii) when no power is available;

(3) instructor demo: inadvertent entry into loss of rudder authority - student recovery.

Note: The term 'parachute mode' is a turn of phrase to indicate that a gyroplane has capability to descend in a controlled manner at very slow airspeed when power is not available. This is not dissimilar to a parachute. This can be a key concept of emergency handling. These exercises are all flown at a safe altitude.

EXERCISE 23: HIGH BANK ANGLE TURNS AND TURNING IN RELATION TO GROUND REFERENCE FEATURES

(a) Long briefing objectives:

(1) reminder of throttle and pedal coordination during turns to maintain height and balance;

(2) high bank angle turns;

(3) the technique for turning around a ground reference feature at a constant radius to counter the effect of wind.

(b) Air exercise:

(1) high bank turns to the left and to the right;

(2) turning around a ground reference feature (with significant wind)

(i) 360 degree turns around the feature;

(ii) changing direction of the turn;

(iii) flying an S shape with constant radius along a line feature (180 degree turns).

EXERCISE 24: AVOIDING, RECOGNIZING AND RECOVERY FROM UNUSUAL ATTITUDES

(a) Long briefing objectives:

(1) why unusual attitudes occur: distraction and fixation;

(2) recognizing unusual attitudes;

(3) the unusual attitude recovery technique;

(4) the unusual attitude recovery exercises.

(b) Air exercise:

(1) reminder of HASEL checks;

(2) distracted, head inside the cockpit:

(i) sudden pull-up in pitch, recover;

(ii) powered descent towards VNE, recover;

(3) fixated, head outside the cockpit, looking at the ground:

(i) slow airspeed spiral descent, turning with the pedals, recover;
(ii) fast airspeed spiral decent, close to VNE, recover.

Note: The unusual attitudes are created by the instructor and recovered by the student.

EXERCISE 25: THE DANGERS ASSOCIATED WITH LOW FLYING

(a) Long briefing objectives:
  (1) the legal requirements relating to low flying;
  (2) the hazards related to low flying;
  (3) the pilot's limitations related to recovering from an emergency related to low flying
(b) Air exercise:
  (1) flying low, with a suitable safety margin, to demonstrate how significantly reduced the margin of error is, with low height.
  (2) analysing:
    (i) the difficulty in seeing wires and masts;
    (ii) loss of line of sight radio communication;
    (iii) lack of time in the event of an engine failure;
    (iv) noise and nuisance implications.

EXERCISE 26: CONSOLIDATION OF GENERAL HANDLING, PRE-FLIGHT PREPARATION AND EN-ROUTE AIRMANSHIP

(a) Long briefing objectives:
  (1) consolidation of the pre-flight planning process;
  (2) en-route checks:
    (i) pilot and passenger:
      (A) stress;
      (B) hunger;
      (C) illness;
      (D) tiredness;
    (ii) aircraft:
      (A) vibrations;
      (B) engine;
      (C) fuel;
    (iii) weather:
      (A) as expected/forecast;
      (B) escape route;
    (iv) flight situational awareness:
      (A) location;

(B) airspace;
(C) radio;

(b) Air exercise:
 (1) en-route checks

Note: The flying element of this exercises is incorporated into other general handling flights as student workload permits. The pre-flight planning aspects of this exercise are likely to be included in parallel with all previous flights. This exercise exists to state that the complete pre-flight planning process should be competently done by a student by this point in the syllabus.

EXERCISE 27: EMERGENCIES 1 – COPING WITH IN-FLIGHT ISSUES

(a) Long briefing objectives:
 (1) preparing for emergencies:
  (i) possible emergency scenarios;
  (ii) categories of emergencies;
  (iii) how threat and error management reduces the likelihood of incidents;
  (iv) standard emergency procedures;
  (v) ensuring that catastrophic failure is mitigated;
  (vi) emergency RT calls.
(b) Air exercise:
 (1) simulated fire in the air;
 (2) simulated fire on the ground;
 (3) simulated bird strike or sudden noise;
 (4) simulated violent shaking of the gyroplane;
 (5) simulated limited engine power (slightly below cruise power);
 (6) simulated trim failure (where applicable):
  (i) excessive rear trim;
  (ii) excessive forward trim;
  (iii) excessive roll trim;
 (7) simulated rudder control failure;
 (8) simulated stick failure;
 (9) simulated throttle stuck on high power.

EXERCISE 28: EMERGENCIES 2 – MAKING A PRECAUTIONARY LANDING

(a) Long briefing objectives:
 (1) awareness that poor inflight planning during precautionary landings increases the risk of accidents;
 (2) reasons for making a precautionary landing;

(3) ideal field selection criteria;
(4) precautionary landing technique;

(b) Air exercise:
(1) surveying of field suitability for precautionary landings;
(2) simulating the reasons for a precautionary landing;
(3) practicing the approach for precautionary landings.

EXERCISE 29: EMERGENCIES 3 – LANDING SAFELY SHOULD THE ENGINE STOP IN FLIGHT

(a) Long briefing objectives:
(1) the phraseology that should be used when simulating forced landings
(2) recap of the necessary skills already learned to make forced landing
(i) exercise 7 : always being aware of the wind direction;
(ii) exercise 10 : descending turns on idle power;
(iii) exercise 19: glide approaches;
(iv) exercise 22 : slow flight on idle power (parachute mode);
(v) exercise 25 : the hazards of low level flying;
(vi) exercise 28 : field selection for landing;
(3) options for positioning for the field, above 300ft AGL;
(4) options for positioning for the field, below 300ft AGL;
(5) defensive flying, thinking ahead of landing areas, in relation to the wind direction

(b) Air exercise:
(1) preselected fields and starting position:
(i) use slower than normal cruise speed to position at a key point on the field;
(ii) fly a path at the correct airspeed for landing to the field;
(iii) go around at an appropriate height;
(2) simulated restart in flight;
(3) simulated emergency RT calls;
(4) simulated forced landings without prior knowledge;
(5) fly routes defensively, verbalizing options in the event of a forced landing.

EXERCISE 30: EMERGENCIES 4 – BEING PREPARED, SHOULD THE ENGINE STOP WHEN FLYING IN THE CIRCUIT PATTERN

(a) Long briefing objectives:
(1) engine failure on take-off
(i) when still on the ground;
(ii) during the airspeed build-up phase;
(iii) during the climb-out;

(2) preparing for engine failures around the circuit pattern:
(i) crosswind;
(ii) downwind;
(iii) base leg;
(iv) final approach.

(b) Air exercise:
(1) recap of the aborted take-off technique;
(2) simulated engine failure:
(i) as the gyroplane is lifting;
(ii) during the airspeed build-up phase;
(iii) during climbout;
(iv) crosswind;
(v) downwind;
(vi) base leg;
(vii) final approach (when it is not possible to reach the runway).

Note: When simulating engine failure in the circuit pattern, the emphasis should be put on proper initial reaction by the student pilot. It is not so important to continue at low level, as this is likely to be restricted due to noise abatement procedures.

EXERCISE 31: CHECKING READINESS FOR FIRST SOLO FLIGHT

(a) Long briefing objectives:
(1) pre-requisites for first solo flight.

(b) Air exercise:
(1) simulated first solo flight (no hands on control from the instructor unless required to save the aircraft from incident).

EXERCISE 32: FIRST SOLO FLIGHT

(a) Long briefing objectives:
(1) differences in power requirements when flying solo;
(2) differences in handling characteristics when flying solo.

(b) Air exercise:
(1) first solo flight.

EXERCISE 33: CONSOLIDATING SOLO FLYING SKILLS

(a) Long briefing objectives:
(1) readiness for first solo flight (decision-making by the student pilot, to be confirmed by the instructor)

(b) Air exercise:

(1) Solo flight in the local area, exercises determined by the instructor

EXERCISE 34: NAVIGATION AND FLYING A ROUTE WITHOUT GETTING LOST

(a) Long briefing objectives:

(1) pre-flight planning for cross-country flights;

(2) considerations when flying a route;

(3) weather deterioration;

(4) procedure when unsure of the position;

(5) dead reckoning;

(6) flying with GPS;

(7) en-route RT.

(b) Air exercise:

(1) flying planned routes at the discretion of the instructor.

EXERCISE 35: LANDING AT AIRFIELDS OTHER THAN THE HOME AIRFIELD

(a) Long briefing objectives:

(1) pre-flight planning when landing at different airfields

(b) Air exercise:

(1) landing at different airfields at the discretion of the instructor.

EXERCISE 36: CONSOLIDATING NAVIGATION SKILLS – FLYING SOLO

(a) Long briefing objectives:

(1) always flying to the plan unless safety is compromised

(b) Air exercise:

(1) flying planned routes solo at the discretion of the instructor.

EXERCISE 37: NAVIGATION FLIGHTS REQUIRED PRIOR TO LICENCE ISSUE

(a) Long briefing objectives:

(1) the requirement for qualifying cross country flights

(b) Air exercise:

(1) flying the qualifying cross country flight(s).

EXERCISE 38: PREPARATION FOR THE FLYING SKILLS TEST

(a) Long briefing objectives:

(1) the content of the skill test

(2) preparation for the skill test

(b) Air exercise:

(1) flying the skill test programme.';

(10) In GM1 FCL.940.FI(a)(2), a new point (d) is added as follows:

‘D. GYROPLANES

INSTRUCTIONAL FLYING EXPERIENCE			
Instructors applying for revalidation of the FI certificate should enter the instructional hours flown during the preceding 36 months.			
Total instructional hours (preceding 36 months):			
Total instructional hours (preceding 12 months):			
FI REFRESHER TRAINING			
1	This is to certify that the applicant completed FI refresher training.		
2	Personal particulars of the applicant:		
Name(s):		Address:	
Licence number:		Expiration date of FI(G) certificate:	
3	Refresher training particulars:		
Date(s) of refresher training:		Place:	
4	Declaration by the responsible ATO/DTO:		
I certify that the above data are correct and that the FI refresher training was carried out.			
Date of approval:		Name(s) of ATO/DTO: (capital letters)	
Date and place:		Signature of the head of training of the ATO/DTO:	
5	Declaration by the applicant:		
I confirm the data under 1 through 3			
Applicant’s signature:			
ASSESSMENT OF COMPETENCE			
(Name(s) of applicant) has given proof of flying instructional ability during an assessment of competence flight. This was done to the required standard.			
Flying time:		Gyroplane used:	
Main exercise:			
Name(s) of FIE:		Licence number:	
Date and place:			
Signature: ______________________________			

’;

(11) GM1 FCL.1015 in amended as follows:

(a) in point (a), paragraph (1) is replaced by the following:

‘(1) three tests or checks relating to PPL, GPL, CPL, IR or class ratings;’;

(b) point (b) is replaced by the following:

‘(b) An examiner should plan at least 2 hours for a LAPL or 3 hours for a PPL, GPL, CPL, IR or class rating test or checks, and at least 4 hours for FI, CPL, IR, MPL, ATPL or MP type rating tests or checks, including preflight briefing and preparation, conduct of the test, check or assessment of competence, de-briefing, evaluation of the applicant and document-tation.’;

(c) in point (c), paragraph (2) is replaced by the following:

‘(2) 90 minutes for LAPL(A) or (H), PPL, GPL and CPL, including navigation section;’;

(12) In AMC1 FCL.1030(b)(3), point (a) is replaced by the following:

‘(a) For skill tests or proficiency checks for issue, revalidation or renewal of LAPL, PPL, GPL, CPL and IR in AMC1 to Appendix 7;’.

AMC1 to Appendix 7 is replaced by the following:

‘AMC1 to Appendix 7

LAPL, PPL, GPL, CPL, IR SKILL TEST AND PROFICIENCY CHECK APPLICATION AND REPORT FORM

APPLICATION AND REPORT FORM **LAPL, PPL, GPL, CPL, IR SKILL TEST AND PROFICIENCY CHECK**		
Applicant’s last name(s):		
Applicant’s first name(s):		
Signature of applicant:		
Type of licence*:	**LAPL** ☐ A ☐ H **PPL** ☐ A ☐ H ☐ As **GPL** ☐ **CPL** ☐ A ☐ H ☐ As **IR** ☐ A ☐ H ☐ As	
Licence number*:		
State:		
1	**Details of the flight**	

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Group, class, type of aircraft:		Registration:	
Aerodrome or site:	Take-off time:	Landing time:	Flight time:
			Total flight time:
2	**Result of the test**		
Skill test details:			
Pass ☐	Fail ☐	Partial pass ☐	
3	**Remarks**		

Location and date:	
Examiner’s certificate number *:	Type and number of licence:
Signature of examiner:	Name(s) in capital letters:

** if applicable*

10.3.2.2 ED Decision 2012/007/R

The Annex to ED Decision 2012/007/R of 19 April 2012 is amended as follows:

(13) In AMC1 ORA.GEN.200(b), paragraph (1) of point (c) is amended as follows:
‘(1) Approved Training Organisations (ATOs) only providing training for the light aircraft pilot licence (LAPL), private pilot licence (PPL), gyroplane pilot licence, sailplane pilot licence (SPL) or balloon pilot licence (BPL) and the associated ratings and certificates;

(14) In AMC1 ORA.GEN.200(c), the title is amended as follows:
‘ATOs PROVIDING TRAINING ONLY FOR THE LAPL, PPL, GPL, SPL AND BPL AND THE ASSOCIATED RATINGS OR CERTIFICATES – ORGANISATIONAL REVIEW’;

(15) In GM1 ORA.GEN.200(c), the title is amended as follows:
‘ATOs PROVIDING TRAINING ONLY FOR THE LAPL, PPL, GPL, SPL OR BPL AND THE ASSOCIATED RATINGS OR CERTIFICATES – ORGANISATIONAL REVIEW PROGRAMME’;

(16) In GM2 ORA.GEN.200(c), the title is amended as follows:
‘ATOs PROVIDING TRAINING ONLY FOR THE LAPL, PPL, GPL, SPL OR BPL AND THE ASSOCIATED RATINGS OR CERTIFICATES – ORGANISATIONAL REVIEW ITEMS’;

(17) In AMC2 ORA.GEN.215, the title is amended as follows:
‘ATOs PROVIDING TRAINING FOR THE LAPL, PPL, GPL, SPL OR BPL AND THE ASSOCIATED RATINGS AND CERTIFICATES’;

(18) In GM1 ORA.ATO.100, point (a) is replaced by the following:
‘(a) the LAPL, PPL, GPL, SPL and BPL and the associated ratings and certificates; and’;

(19) In AMC1 ORA.ATO.120(a);(b), the title is amended as follows:
‘ATOs PROVIDING TRAINING FOR THE LAPL, PPL, GPL, SPL OR BPL AND THE ASSOCIATED RATINGS AND CERTIFICATES;

(20) AMC1 ORA.ATO.145 is amended as follows:
‘**AMC1 ORA.ATO.145 Pre-requisites for training**
ENTRANCE REQUIREMENTS

ATOs providing training for other than the LAPL, PPL, GPL, SPL or BPL and the associated ratings and certificates should establish entrance requirements for students in their procedures. The entrance requirements should ensure that the students have enough knowledge, particularly of physics and mathematics, to be able to follow the courses.’.

Best Intervention Strategy for “Road/Gyroplane”

10.4 Appendix 4 – OPS regulatory proposal (NL initial proposal reviewed by EASA)

10.4.1 OPS Regulation 965/2012

Proposals for amendments to the Operational Regulation 965/2012

The text of the amendment is arranged to show deleted text, new or amended text as shown below:
— deleted text is ~~struck through~~;
— new or amended rule text is in red;
Text is based on the aircrew regulation before the separation of the balloon and glider pilots. The deletion of those is also marked in red.

Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council

Article 1
Subject matter and scope

1. This Regulation lays down detailed rules for air operations with aeroplanes, and ~~helicopters~~rotorcraft,~~ balloons and sailplanes~~, including ramp inspections of aircraft of operators under the safety oversight of another State when landed at aerodromes located in the territory subject to the provisions of the Treaty.

Article 5
Air operations
4. Operators of other-than complex motor-powered aeroplanes and ~~helicopters~~rotorcraft~~, as well as balloons and sailplanes,~~ involved in non-commercial operations, including non-commercial specialised operations, shall operate the aircraft in accordance with the provisions specified in Annex VII.
5. Training organisations having their principal place of business in a Member State and approved in accordance with Regulation (EU) No 1178/2011 when conducting flight training into, within or out of the Union shall operate:
(a) complex motor-powered aeroplanes and helicopters in accordance with the provisions specified in Annex VI;
(b) other aeroplanes and ~~helicopters~~ rotorcraft ~~as well as balloons and sailplanes~~ in accordance with the provisions specified in Annex VII.

Article 6
Derogations
4a. By way of derogation from Article 5(1) and (6), the following operations with other-than complex motor-powered aeroplanes and ~~helicopters~~rotorcraft~~, balloons and sailplanes~~ may be conducted in accordance with Annex VII:
(a) cost-shared flights by private individuals, on the condition that the direct cost is shared by all the occupants of the aircraft, pilot included and the number of persons sharing the direct costs is limited to six;
(b) competition flights or flying displays, on the condition that the remuneration or any valuable consideration given for such flights is limited to recovery of direct costs and a proportionate contribution to annual costs, as well as prizes of no more than a value specified by the competent authority;

(c) introductory flights, parachute dropping, sailplane towing or aerobatic flights performed either by a training organisation having its principal place of business in a Member State and approved in accordance with Regulation (EU) No 1178/2011, or by an organisation created with the aim of promoting aerial sport or leisure aviation, on the condition that the aircraft is operated by the organisation on the basis of ownership or dry lease, that the flight does not generate profits distributed outside of the organisation, and that whenever non-members of the organisation are involved, such flights represent only a marginal activity of the organisation.

Article 10
Entry into force
An appropriate implementation period for this change should be established.

10.4.2 OPS regulation 965/2012 changes to the annexes

Annex I Definitions

“Gyroplane” means a heavier-than-air aircraft supported in flight chiefly by one or more non-engine-driven rotors.

Annex VII Part NCO

NCO.GEN.115 Taxiing of aeroplanes or gyroplanes

An aeroplane or gyroplane shall only be taxied on the movement area of an aerodrome if the person at the controls:

(a) is an appropriately qualified pilot; or

(b) has been designated by the operator and:

(1) is trained to taxi the aeroplane or gyroplane;

(2) is trained to use the radio telephone, if radio communications are required;

(3) has received instruction in respect of aerodrome layout, routes, signs, marking, lights, air traffic control (ATC) signals and instructions, phraseology and procedures; and

(4) is able to conform to the operational standards required for safe aeroplane or gyroplane movement at the aerodrome.

NCO.OP.110 Aerodrome operating minima — aeroplanes and rotorcraft ~~helicopters~~

Only a change to the title because some of the AMC and GM are applicable.

NCO.OP.115 Departure and approach procedures — aeroplanes and rotorcraft ~~helicopters~~

Only a change to the title.

NCO.OP.120 Noise abatement procedures — aeroplanes, rotorcraft ~~helicopters~~ and powered sailplanes

Only a change to the title.

NCO.OP.126 Fuel and oil supply — rotorcraft ~~helicopters~~

(a) The pilot-in-command shall only commence a flight if the rotorcraft ~~helicopter~~ carries sufficient fuel and oil for the following:

(1) for VFR flights, to fly to the aerodrome/operating site of intended landing and thereafter to fly for at least 20 minutes at best-range-speed; and

(2) for IFR flights with helicopters:

NCO.OP.155 Smoking on board — aeroplanes and rotorcraft ~~helicopters~~

Only a change to the title.

NCO.OP.175 Take-off conditions — aeroplanes and rotorcraft ~~helicopters~~

Only a change to the title.

NCO.OP.205 Approach and landing conditions — aeroplanes and rotorcraft ~~helicopters~~

Only a change to the title.

NCO.POL.105 Weighing

(a) The operator shall ensure that the mass and, except for balloons, the CG of the aircraft have been established by actual weighing prior to initial entry into service. The accumulated effects of modifications and repairs on the mass and balance shall be accounted for and properly documented. Such information shall be made available to the pilot-in-command. The aircraft shall be reweighed if the effect of modifications on the mass and balance is not accurately known. ▼M4

(b) The weighing shall be accomplished:

(1) for aeroplanes and rotorcrafts ~~helicopters~~, by the manufacturer of the aircraft or by an approved maintenance organisation; and

~~(2) for sailplanes and balloons, by the manufacturer of the aircraft or in accordance with Commission Regulation (EC) No 2042/2003, as applicable.~~

NCO.SPEC.140 Fuel and oil supply — rotorcraft ~~helicopters~~

Notwithstanding NCO.OP.126(a)(1), the pilot-in-command of a rotorcraft ~~helicopter~~ may only commence a VFR flight by day remaining within 25 NM of the aerodrome/operating site of departure with reserve fuel of not less than 10 minutes at best-range-speed.

NCO.SPEC.171 Performance and operating criteria — gyroplanes

When operating a gyroplane at a height of less than 150 m (500 ft) above a non-congested area, for operations of gyroplanes that are not able to sustain level flight in the event of a critical engine failure, the pilot-in-command shall have:

(c) established operational procedures to minimise the consequences of an engine failure; and

(d) briefed all crew members and task specialists on board on the procedures to be carried out in the event of a forced landing.

10.4.3 OPS Sub-part IDE

Sub-part IDE

SECTION 2

~~Helicopters~~ Rotorcrafts

NCO.IDE.R.100 Instruments and equipment — general

(a) Instruments and equipment required by this Subpart shall be approved in accordance with the applicable airworthiness requirements if they are:

(1) used by the flight crew to control the flight path;

(2) used to comply with NCO.IDE.R.190;

(3) used to comply with NCO.IDE.R.195; or

(4) installed in the ~~helicopter~~ rotorcraft.

(b) The following items, when required by this Subpart, do not need an equipment approval:

(1) independent portable lights;

(2) an accurate time piece;

(3) first-aid kit;

(4) survival and signalling equipment;

(5) sea anchor and equipment for mooring; and

(6) child restraint device.

(c) Instruments and equipment not required by this Subpart, as well as any other equipment that is not required by other applicable Annexes, but is carried on a flight, shall comply with the following:

(1) the information provided by these instruments or equipment shall not be used by the flight crew to comply with Annex I to Regulation (EC) No 216/2008 or NCO.IDE.R.190 and NCO.IDE.R.195; and

(2) the instruments and equipment shall not affect the airworthiness of the ~~helicopter~~ rotorcraft, even in the case of failures or malfunction.

(d) Instruments and equipment shall be readily operable or accessible from the station where the flight crew member that needs to use it is seated.

(e) All required emergency equipment shall be easily accessible for immediate use.

NCO.IDE.R.105 Minimum equipment for flight

A flight shall not be commenced when any of the ~~helicopter~~ rotorcraft’s instruments, items of equipment or functions required for the intended flight are inoperative or missing, unless:

(a) the ~~helicopter~~ rotorcraft is operated in accordance with the MEL, if established; or

(b) the ~~helicopter~~ rotorcraft is subject to a permit to fly issued in accordance with the applicable airworthiness requirements.

NCO.IDE.R.115 Operating lights

~~Helicopter~~ rotorcrafts operated at night shall be equipped with:

(a) an anti-collision light system;

(b) navigation/position lights;

(c) a landing light;

(d) lighting supplied from the ~~helicopter~~ rotorcraft’s electrical system to provide adequate illumination for all instruments and equipment essential to the safe operation of the ~~helicopter~~ rotorcraft;

(e) lighting supplied from the ~~helicopter~~ rotorcraft’s electrical system to provide illumination in all passenger compartments;

(f) an independent portable light for each crew member station; and

(g) lights to conform with the International Regulations for Preventing Collisions at Sea if the ~~helicopter~~ rotorcraft is amphibious.

NCO.IDE.R.120 Operations under VFR — flight and navigational instruments and associated equipment

(a) ~~Helicopter~~ rotorcrafts operated under VFR by day shall be equipped with a means of measuring and displaying the following:

(1) magnetic heading;

(2) time in hours, minutes and seconds;

(3) pressure altitude;

(4) indicated airspeed; and

(5) slip.

(b) ~~Helicopter~~ rotorcrafts operated under VMC at night, or when the visibility is less than 1 500 m, or in conditions where the ~~helicopter~~ rotorcraft cannot be maintained in a desired flight path without reference to one or more additional instruments, shall be, in addition to (a), equipped with:

(1) a means of measuring and displaying the following:

(i) attitude;

(ii) vertical speed; and

(iii) stabilised heading; and

(2) a means of indicating when the supply of power to the gyroscopic instruments is not adequate.

(c) ~~Helicopter~~ rotorcrafts operated when the visibility is less than 1 500 m, or in conditions where the ~~helicopter~~ rotorcraft cannot be maintained in a desired flight path without reference to one or more additional instruments, shall be, in addition to (a) and (b), equipped with a means of preventing malfunction of the airspeed indicating system required in (a)(4) due to condensation or icing.

NCO.IDE.R.125 Operations under IFR — flight and navigational instruments and associated equipment

~~Helicopter~~ rotorcrafts operated under IFR shall be equipped with:

(a) a means of measuring and displaying the following:

(1) magnetic heading;

(2) time in hours, minutes and seconds;

(3) pressure altitude;

(4) indicated airspeed;

(5) vertical speed;

(6) slip;

(7) attitude;

(8) stabilised heading; and

(9) outside air temperature;

(b) a means of indicating when the supply of power to the gyroscopic instruments is not adequate;

(c) a means of preventing malfunction of the airspeed indicating system required by (a)(4) due to condensation or icing; and

(d) an additional means of measuring and displaying attitude as a standby instrument.

NCO.IDE.R.126 Additional equipment for single pilot operations under IFR

~~Helicopters~~ Rotorcraft operated under IFR with a single pilot shall be equipped with an autopilot with at least altitude hold and heading mode.

NCO.IDE.R.135 Flight crew interphone system

~~Helicopter~~ rotorcrafts operated by more than one flight crew member shall be equipped with a flight crew interphone system, including headsets and microphones for use by all flight crew members.

NCO.IDE.R.140 Seats, seat safety belts, restraint systems and child restraint devices

(a) ~~Helicopter~~ rotorcrafts shall be equipped with:

(1) a seat or berth for each person on board who is aged 24 months or more;

(2) a seat belt on each passenger seat and restraining belts for each berth;

(3) for ~~helicopter~~ rotorcrafts first issued with an individual CofA after 31 December 2012, a seat belt with an upper torso restraint system for each passenger who is aged 24 months or more;

(4) a child restraint device for each person on board younger than 24 months; and

(5) for ~~helicopter~~ rotorcrafts, a seat belt with upper torso restraint system incorporating a device that will automatically restrain the occupant's torso in the event of rapid deceleration on each flight crew seat.

(b) A seat belt with upper torso restraint system shall have a single point release.

NCO.IDE.R.145 First-aid kit

(a) ~~Helicopter~~ rotorcrafts shall be equipped with a first-aid kit.

(b) The first-aid kit shall be:

(1) readily accessible for use; and

(2) kept up-to-date.

NCO.IDE.R.155 Supplemental oxygen — non-pressurised ~~helicopter~~ rotorcrafts

Non-pressurised ~~helicopter~~ rotorcrafts operated when an oxygen supply is required in accordance with NCO.OP.190 shall be equipped with oxygen storage and dispensing apparatus capable of storing and dispensing the required oxygen supplies.

NCO.IDE.R.160 Hand fire extinguishers

(a) ~~Helicopter~~ rotorcrafts, except ELA2 ~~helicopter~~ rotorcrafts, shall be equipped with at least one hand fire extinguisher:

(1) in the flight crew compartment; and

(2) in each passenger compartment that is separate from the flight crew compartment, except if the compartment is readily accessible to the flight crew.

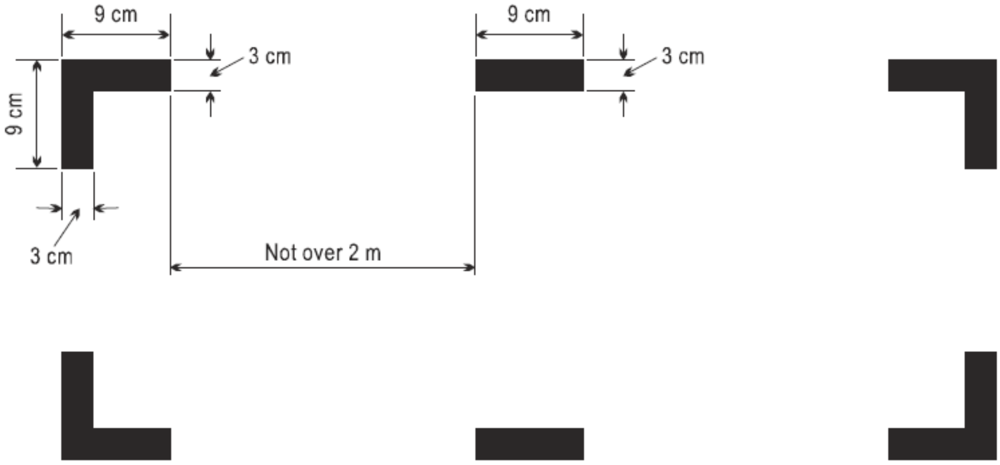
(b) The type and quantity of extinguishing agent for the required fire extinguishers shall be suitable for the type of fire likely to occur in the compartment where the extinguisher is intended to be used and to minimise the hazard of toxic gas concentration in compartments occupied by persons.

NCO.IDE.R.165 Marking of break-in points

If areas of the ~~helicopter~~ rotorcraft's fuselage suitable for break-in by rescue crews in an emergency are marked, such areas shall be marked as shown in Figure 1.

Figure 1

Marking of break-in points



NCO.IDE.R.170 Emergency locator transmitter (ELT)

(a) ~~Helicopter~~ rotorcrafts certified for a maximum passenger seating configuration above six shall be equipped with:

(1) an automatic ELT; and

(2) one survival ELT (ELT(S)) in a life-raft or life-jacket when the ~~helicopter~~ rotorcraft is operated at a distance from land corresponding to more than 3 minutes flying time at normal cruising speed.

(b) ~~Helicopter~~ rotorcrafts certified for a maximum passenger seating configuration of six or less shall be equipped with an ELT(S) or a personal locator beacon (PLB), carried by a crew member or a passenger.

(c) ELTs of any type and PLBs shall be capable of transmitting simultaneously on 121,5 MHz and 406 MHz.

NCO.IDE.R.175 Flight over water

(a) ~~Helicopter~~ rotorcrafts shall be equipped with a life-jacket for each person on board or equivalent individual flotation device for each person on board younger than 24 months, which shall be worn or stowed in a position that is readily accessible from the seat or berth of the person for whose use it is provided, when:

(1) flying over water beyond autorotational distance from land where in case of the critical engine failure, the ~~helicopter~~ rotorcraft is not able to sustain level flight; or

(2) flying over water at a distance of land corresponding to more than 10 minutes flying at normal cruising speed, where in case of the critical engine failure, the ~~helicopter~~ rotorcraft is able to sustain level flight; or

(3) taking off or landing at an aerodrome/operating site where the take-off or approach path is over water.

(b) Each life-jacket or equivalent individual flotation device shall be equipped with a means of electric illumination for the purpose of facilitating the location of persons.

(c) The pilot-in-command of a ~~helicopter~~ rotorcraft operated on a flight over water at a distance from land corresponding to more than 30 minutes flying time at normal cruising speed or 50 NM, whichever is less, shall determine the risks to survival of the occupants of the ~~helicopter~~ rotorcraft in the event of a ditching, based on which he/she shall determine the carriage of:

(1) equipment for making the distress signals;

(2) life-rafts in sufficient numbers to carry all persons on board, stowed so as to facilitate their ready use in emergency; and

(3) life-saving equipment, to provide the means of sustaining life, as appropriate to the flight to be undertaken.

(d) The pilot-in-command shall determine the risks to survival of the occupants of the ~~helicopter~~ rotorcraft in the event of a ditching, when deciding if the life-jackets required in (a) shall be worn by all occupants.

NCO.IDE.R.180 Survival equipment

~~Helicopter~~ Rotorcrafts, operated over areas in which search and rescue would be especially difficult, shall be equipped with such signalling devices and life-saving equipment, including means of sustaining life, as may be appropriate to the area overflown.

NCO.IDE.R.185 All ~~helicopter~~ rotorcrafts on flights over water — ditching

~~Helicopter~~ Rotorcrafts flying over water in a hostile environment beyond a distance of 50 NM from land shall be:

(a) designed for landing on water in accordance with the relevant airworthiness code;

(b) certified for ditching in accordance with the relevant airworthiness code; or

(c) fitted with emergency flotation equipment.

NCO.IDE.R.190 Radio communication equipment

(a) Where required by the airspace being flown ~~helicopter~~ rotorcrafts shall be equipped with radio communication equipment capable of conducting two-way communication with those aeronautical stations and on those frequencies to meet airspace requirements.

(b) Radio communication equipment, if required by (a), shall provide for communication on the aeronautical emergency frequency 121,5 MHz.

(c) When more than one communications equipment unit is required, each shall be independent of the other or others to the extent that a failure in any one will not result in failure of any other.

(d) When a radio communication system is required, and in addition to the flight crew interphone system required in NCO.IDE.R.135, ~~helicopter~~ rotorcrafts shall be equipped with a transmit button on the flight controls for each required pilot and/or crew member at his/her working station.

NCO.IDE.R.195 Navigation equipment

(a) Helicopters Rotorcraft operated over routes that cannot be navigated by reference to visual landmarks shall be equipped with navigation equipment that will enable them to proceed in accordance with:

(1) the ATS flight plan, if applicable; and

(2) the applicable airspace requirements.

(b) Helicopter rotorcrafts shall have sufficient navigation equipment to ensure that, in the event of the failure of one item of equipment at any stage of the flight, the remaining equipment shall allow safe navigation in accordance with (a), or an appropriate contingency action, to be completed safely.

(c) Helicopter rotorcraft operated on flights in which it is intended to land in IMC shall be equipped with navigation equipment capable of providing guidance to a point from which a visual landing can be performed. This equipment shall be capable of providing such guidance for each aerodrome at which is intended to land in IMC and for any designated alternate aerodromes.

(d) For PBN operations the aircraft shall meet the airworthiness certification requirements for the appropriate navigation specification.

NCO.IDE.R.200 Transponder

Where required by the airspace being flown, helicopter rotorcrafts shall be equipped with a secondary surveillance radar (SSR) transponder with all the required capabilities.

NCO.IDE.R.205 Management of aeronautical databases

Applicable from 01 January

(a) Aeronautical databases used on certified aircraft system applications shall meet data quality requirements that are adequate for the intended use of the data.

(b) The pilot-in-command shall ensure the timely distribution and insertion of current and unaltered aeronautical databases to the aircraft that require them.

(c) Notwithstanding any other occurrence reporting requirements as defined in Regulation (EU) No 376/2014, the pilot-in-command shall report to the database provider instances of erroneous, inconsistent or missing data that might be reasonably expected to constitute a hazard to flight.

In such cases, the pilot-in-command shall not use the affected data.

10.4.4 OPS AMC/GM

GM1 NCO.GEN.115 Taxiing of aeroplanes or gyroplanes

SAFETY-CRITICAL ACTIVITY

- Taxiing should be treated as a safety-critical activity due to the risks related to the movement of the aeroplane or gyroplane and the potential for a catastrophic event on the ground.
- Taxiing is a high-workload phase of flight that requires the full attention of the pilot-in-command.

GM1 NCO.GEN.115(b)(4) Taxiing of aeroplanes or gyroplanes

SKILLS AND KNOWLEDGE

The person designated by the operator to taxi an aeroplane or a gyroplane should possess the following skills and knowledge:

(a) positioning of the aeroplane or gyroplane to ensure safety when starting engine;

(b) getting ATIS reports and taxi clearance, where applicable;

(c) interpretation of airfield markings/lights/signals/indicators;

(d) interpretation of marshalling signals, where applicable;

(e) identification of suitable parking area;

(f) maintaining lookout and right-of-way rules and complying with ATC or marshalling instructions when applicable;

(g) avoidance of adverse effect of propeller slipstream or jet wash on other aircraft ~~aeroplanes~~, aerodrome facilities and personnel;

(h) inspection of taxi path when surface conditions are obscured;

(i) communication with others when controlling an aeroplane or gyroplane on the ground;

(j) interpretation of operational instructions;

(k) reporting of any problem that may occur while taxiing an aeroplane or gyroplane; and

(l) adapting the taxi speed in accordance with prevailing aerodrome, traffic, surface and weather conditions.

AMC1 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

TAKE-OFF OPERATIONS – AEROPLANES AND ~~HELICOPTERS~~ROTORCRAFT

(a) General:

(1) Take-off minima should be expressed as visibility (VIS) or runway visual range (RVR) limits, taking into account all relevant factors for each aerodrome planned to be used and aircraft characteristics. Where there is a specific need to see and avoid obstacles on departure and/or for a forced landing, additional conditions, e.g. ceiling, it should be specified.

(2) When the reported meteorological visibility is below that required for take-off and RVR is not reported, a take-off should only be commenced if the pilot-in-command can determine that the visibility along the take-off runway/area is equal to or better than the required minimum.

(3) When no reported meteorological visibility or RVR is available, a take-off should only be commenced if the pilot-in-command can determine that the RVR/VIS along the take-off runway/area is equal to or better than the required minimum.

(b) Visual reference:

(1) The take-off minima should be selected to ensure sufficient guidance to control the aircraft in the event of both a rejected take-off in adverse circumstances and a continued take-off after failure of the critical engine.

(2) For night operations, ground lights should be available to illuminate the runway/final approach and take-off area (FATO) and any obstacles.

AMC2 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

VISUAL APPROACH

For a visual approach operation, the RVR should not be less than 800 m.

AMC3 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

EFFECT ON LANDING MINIMA OF TEMPORARILY FAILED OR DOWNGRADED GROUND EQUIPMENT– AEROPLANES AND ~~HELICOPTERS~~ ROTORCRAFT

(a) Non-precision approaches requiring a final approach fix (FAF) and/or missed approach point (MAPt) should not be conducted where a method of identifying the appropriate fix is not available.

(b) A minimum RVR of 750 m should be used for CAT I approaches in the absence of centreline lines and/or touchdown zone lights.

(c) Where approach lighting is partly unavailable, minima should take account of the serviceable length of approach lighting.

GM1 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrats

COMMERCIALLY AVAILABLE INFORMATION

An acceptable method of selecting aerodrome operating minima is through the use of commercially available information.

GM2 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~~~rotorcraft~~ rotorcrafts

VERTICAL PATH CONTROL– AEROPLANES AND ~~HELICOPTERS~~ROTORCRAFT

Due consideration should be given to the selection of an appropriate technique for vertical path control on non-precision approaches (NPAs). Where appropriate instrumentation and/or facilities are available, a continuous descent final approach technique (CDFA) usually offers increased safety and a lower workload compared to a step-down approach.

GM3 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

CRITERIA FOR ESTABLISHING RVR/CMV– AEROPLANES AND ROTORCRAFT~~HELICOPTERS~~

(a) In order to qualify for the lowest allowable values of RVR/CMV specified in Table 3.A, the instrument approach should meet at least the following facility requirements and associated conditions:

(1) Instrument approaches with designated vertical profile up to and including 4.5° for Category A and B aeroplanes, or 3.77° for Category C and D aeroplanes, where the facilities are:

(i) instrument landing system (ILS)/microwave landing system (MLS)/GBAS landing system (GLS)/precision approach radar (PAR); or

(ii) approach procedure with vertical guidance (APV); and

where the final approach track is offset by not more than 15° for Category A and B aeroplanes or by not more than 5° for Category C and D aeroplanes.

(2) Instrument approach operations flown using the CDFA technique with a nominal vertical profile, up to and including 4.5° for Category A and B aeroplanes, or 3.77° for Category C and D aeroplanes, where the facilities are non-directional beacon (NDB), NDB/distance measuring equipment (DME), VHF omnidirectional radio range (VOR), VOR/DME, localiser (LOC), LOC/DME, VHF direction finder (VDF), surveillance radar approach (SRA) or global navigation satellite system (GNSS)/lateral

navigation (LNAV), with a final approach segment of at least 3 NM, which also fulfil the following criteria:

(i) the final approach track is offset by not more than 15° for Category A and B aeroplanes or by not more than 5° for Category C and D aeroplanes;

(ii) the final approach fix (FAF) or another appropriate fix where descent is initiated is available, or distance to threshold (THR) is available by flight management system (FMS)/area navigation (NDB/DME) or DME; and

(iii) the missed approach point (MAPt) is determined by timing, the distance from FAF to THR is ≤ 8 NM.

(3) Instrument approaches where the facilities are NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA or GNSS/LNAV, not fulfilling the criteria in (a)(2), or with an minimum descent height (MDH) ≥ 1 200 ft.

(b) The missed approach operation, after an approach operation has been flown using the CDFA technique, should be executed when reaching the decision height/altitude (DH/A) or the MAPt, whichever occurs first. The lateral part of the missed approach procedure should be flown via the MAPt unless otherwise stated on the approach chart.

GM4 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

DETERMINATION OF RVR/CMV/VIS MINIMA FOR NPA, APV, CAT I — AEROPLANES

(a) The minimum RVR/CMV/VIS should be the highest of the values specified in Table 2 and Table 3.A but not greater than the maximum values specified in Table 3.A, where applicable.

(b) The values in Table 2 should be derived from the formula below:

required RVR/VIS (m) = [(DH/MDH (ft) x 0.3048) / tanα] – length of approach lights (m);

where α is the calculation angle, being a default value of 3.00° increasing in steps of 0.10° for each line in Table 2 up to 3.77° and then remaining constant.

(c) If the approach is flown with a level flight segment at or above MDA/H, 200 m should be added for Category A and B aeroplanes and 400 m for Category C and D aeroplanes to the minimum RVR/CMV/VIS value resulting from the application of Table 2 and Table 3.A.

(d) An RVR of less than 750 m, as indicated in Table 2, may be used:

(1) for CAT I operations to runways with full approach lighting system (FALS), runway touchdown zone lights (RTZL) and runway centreline lights (RCLL);

(2) for CAT I operations to runways without RTZL and RCLL when using an approved head-up guidance landing system (HUDLS), or equivalent approved system, or when conducting a coupled approach or flight-director-flown approach to a DH. The instrument landing system (ILS) should not be published as a restricted facility; and

(3) for approach procedure with vertical guidance (APV) operations to runways with FALS, RTZL and RCLL when using an approved head-up display (HUD).

(e) Lower values than those specified in Table 2 may be used for HUDLS and auto-land operations if approved in accordance with SPA.LVO.

(f) The visual aids should comprise standard runway day markings and approach and runway lights as specified in Table 1. The competent authority may approve that RVR values relevant to a basic approach lighting system (BALS) are used on runways where the approach lights are restricted in length below 210 m due to terrain or water, but where at least one cross-bar is available.

(g) For night operations or for any operation where credit for runway and approach lights is required, the lights should be on and serviceable, except as provided for in Table 1.

(h) For single-pilot operations, the minimum RVR/VIS should be calculated in accordance with the following additional criteria:

(1) an RVR of less than 800 m, as indicated in Table 2, may be used for CAT I approaches provided any of the following is used at least down to the applicable DH:

(i) a suitable autopilot, coupled to an ILS, microwave landing system (MLS) or GBAS landing system (GLS) that is not published as restricted; or

(ii) an approved HUDLS, including, where appropriate, enhanced vision system (EVS), or equivalent approved system;

(2) where RTZL and/or RCLL are not available, the minimum RVR/CMV should not be less than 600 m; and

(3) an RVR of less than 800 m, as indicated in Table 2, may be used for APV operations to runways with FALS, RTZL and RCLL when using an approved HUDLS, or equivalent approved system, or when conducting a coupled approach to a DH equal to or greater than 250 ft.

Table 1: Approach lighting systems

Class of lighting facility	Length, configuration and intensity of approach lights
FALS	CAT I lighting system (HIALS ≥ 720 m) distance coded centreline, Barrette centreline
IALS	Simple approach lighting system (HIALS 420 – 719 m) single source, Barrette
BALS	Any other approach lighting system (HIALS, MIALS or ALS 210 – 419 m)
NALS	Any other approach lighting system (HIALS, MIALS or ALS < 210 m) or no approach lights

Note: HIALS: high intensity approach lighting system; MIALS: medium intensity approach lighting system; ALS: approach lighting system.

Table 2: RVR/CMV vs. DH/MDH

DH or MDH			Class of lighting facility			
			FALS	**IALS**	**BALS**	**NALS**
			See (d), (e), (h). above for RVR < 750/800 m			
ft			**RVR/CMV (m)**			
200	-	210	550	750	1 000	1 200
211	-	220	550	800	1 000	1 200
221	-	230	550	800	1 000	1 200
231	-	240	550	800	1 000	1 200
241	-	250	550	800	1 000	1 300
251	-	260	600	800	1 100	1 300
261	-	280	600	900	1 100	1 300
281	-	300	650	900	1 200	1 400
301	-	320	700	1 000	1 200	1 400
321	-	340	800	1 100	1 300	1 500

341	-	360	900	1 200	1 400	1 600

DH or MDH			Class of lighting facility			
			FALS	IALS	BALS	NALS
			See (d), (e), (h). above for RVR < 750/800 m			
ft			RVR/CMV (m)			
361	-	380	1 000	1 300	1 500	1 700
381	-	400	1 100	1 400	1 600	1 800
401	-	420	1 200	1 500	1 700	1 900
421	-	440	1 300	1 600	1 800	2 000
441	-	460	1 400	1 700	1 900	2 100
461	-	480	1 500	1 800	2 000	2 200
481		500	1 500	1 800	2 100	2 300
501	-	520	1 600	1 900	2 100	2 400
521	-	540	1 700	2 000	2 200	2 400
541	-	560	1 800	2 100	2 300	2 500
561	-	580	1 900	2 200	2 400	2 600
581	-	600	2 000	2 300	2 500	2 700
601	-	620	2 100	2 400	2 600	2 800
621	-	640	2 200	2 500	2 700	2 900
641	-	660	2 300	2 600	2 800	3 000
661	-	680	2 400	2 700	2 900	3 100
681	-	700	2 500	2 800	3 000	3 200
701	-	720	2 600	2 900	3 100	3 300
721	-	740	2 700	3 000	3 200	3 400
741	-	760	2 700	3 000	3 300	3 500
761	-	800	2 900	3 200	3 400	3 600

801	-	850	3 100	3 400	3 600	3 800

DH or MDH			Class of lighting facility			
			FALS	IALS	BALS	NALS
			See (d), (e), (h). above for RVR < 750/800 m			
ft			RVR/CMV (m)			
851	-	900	3 300	3 600	3 800	4 000
901	-	950	3 600	3 900	4 100	4 300
951	-	1 000	3 800	4 100	4 300	4 500
1 001	-	1 100	4 100	4 400	4 600	4 900
1 101	-	1 200	4 600	4 900	5 000	5 000
1 201 and above			5 000	5 000	5 000	5 000

Table 3.A: CAT I, APV, NPA — aeroplanes
Minimum and maximum applicable RVR/CMV (lower and upper cut-off limits)

Facility/conditions	RVR/CMV (m)	Aeroplane category			
		A	B	C	D
ILS, MLS, GLS, PAR, GNSS/SBAS, GNSS/VNAV	Min	According to Table 2			
	Max	1 500	1 500	2 400	2 400
NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA, GNSS/LNAV with a procedure that fulfils the criteria in GM3 NCO.OP.110 (a)(2)	Min	750	750	750	750
	Max	1 500	1 500	2 400	2 400
For NDB, NDB/DME, VOR, VOR/DME, LOC, LOC/DME, VDF, SRA, GNSS/LNAV: — not fulfilling the criteria in GM3 NCO.OP.110 (a)(2), or — with a DH or MDH ≥ 1 200 ft	Min	1 000	1 000	1 200	1 200
	Max	According to Table 2 if flown using the CDFA technique, otherwise an add-on of 200/400 m applies to the values in Table 2 but not to result in a value exceeding 5 000 m.			

DETERMINATION OF RVR/CMV/VIS MINIMA FOR NPA, CAT I — ROTORCRAFTHELICOPTERS

(a) For non-precision approach (NPA) operations, the minima specified in Table 4.1.H should apply:

(1) where the missed approach point is within ½ NM of the landing threshold, the approach minima specified for FALS may be used regardless of the length of approach lights available. However, FATO/runway edge lights, threshold lights, end lights and FATO/runway markings are still required;

(2) for night operations, ground lights should be available to illuminate the FATO/runway and any obstacles; and

(3) for single-pilot operations, the minimum RVR is 800 m or the minima in Table 2, whichever is higher.

(b) For CAT I operations, the minima specified in Table 4.2.H should apply:

(1) for night operations, ground light should be available to illuminate the FATO/runway and any obstacles;

(2) for single-pilot operations, the minimum RVR/VIS should be calculated in accordance with the following additional criteria:

(i) an RVR of less than 800 m should not be used except when using a suitable autopilot coupled to an ILS, MLS or GLS, in which case normal minima apply; and

(ii) the DH applied should not be less than 1.25 times the minimum use height for the autopilot.

Table 4.1.H: Onshore NPA minima

MDH (ft) *	Facilities vs. RVR/CMV (m) **, ***			
	FALS	IALS	BALS	NALS
250 – 299	600	800	1 000	1 000
300 – 449	800	1 000	1 000	1 000
450 and above	1 000	1 000	1 000	1 000

*: The MDH refers to the initial calculation of MDH. When selecting the associated RVR, there is no need to take account of a rounding up to the nearest 10 ft, which may be done for operational purposes, e.g. conversion to MDA.

**: The tables are only applicable to conventional approaches with a nominal descent slope of not greater than 4°. Greater descent slopes will usually require that visual glide slope guidance (e.g. precision path approach indicator (PAPI)) is also visible at the MDH.

***: FALS comprise FATO/runway markings, 720 m or more of high intensity/medium intensity (HI/MI) approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

IALS comprise FATO/runway markings, 420 – 719 m of HI/MI approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

BALS comprise FATO/runway markings, < 420 m of HI/MI approach lights, any length of low intensity (LI) approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

NALs comprise FATO/runway markings, FATO/runway edge lights, threshold lights, FATO/runway end lights or no lights at all.

Table 4.2.H: Onshore CAT I minima

DH (ft) *	Facilities vs. RVR/CMV (m) **, ***			
	FALS	**IALS**	**BALS**	**NALS**
200	500	600	700	1 000
201 – 250	550	650	750	1 000
251 – 300	600	700	800	1 000
301 and above	750	800	900	1 000

*: The DH refers to the initial calculation of DH. When selecting the associated RVR, there is no need to take account of a rounding up to the nearest 10 ft, which may be done for operational purposes, e.g. conversion to DA.

**: The table is applicable to conventional approaches with a glide slope up to and including 4°.

***: FALS comprise FATO/runway markings, 720 m or more of HI/MI approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

IALS comprise FATO/runway markings, 420 – 719 m of HI/MI approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

BALS comprise FATO/runway markings, < 420 m of HI/MI approach lights, any length of LI approach lights, FATO/runway edge lights, threshold lights and FATO/runway end lights. Lights to be on.

NALS comprise FATO/runway markings, FATO/runway edge lights, threshold lights, FATO/runway end lights or no lights at all.

GM5 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

CONVERSION OF REPORTED METEOROLOGICAL VISIBILITY TO RVR/CMV

(a) A conversion from meteorological visibility to RVR/CMV should not be used:

(1) when reported RVR is available;

(2) for calculating take-off minima; and

(3) for other RVR minima less than 800 m.

(b) If the RVR is reported as being above the maximum value assessed by the aerodrome operator, e.g. ‘RVR more than 1 500 m’, it should not be considered as a reported value.

(c) For all other circumstances, Table 5 should be used.

Table 5: Conversion of reported meteorological visibility to RVR/CMV

Lighting elements in operation	RVR/CMV = reported meteorological visibility x

	Day	Night
High intensity (HI) approach and runway lights	1.5	2.0
Any type of light installation other than above	1.0	1.5
No lights	1.0	not applicable

GM6 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

AIRCRAFT CATEGORIES– AEROPLANES AND ROTORCRAFT~~HELICOPTERS~~

(a) Aircraft categories should be based on the indicated airspeed at threshold (V_{AT}), which is equal to the stalling speed (V_{SO}) multiplied by 1.3 or where published 1-g (gravity) stall speed (V_{S1g}) multiplied by 1.23 in the landing configuration at the maximum certified landing mass. If both V_{SO} and V_{S1g} are available, the higher resulting V_{AT} should be used.

(b) The aircraft categories specified in the Table 6 should be used.

Table 6: Aircraft categories corresponding to VAT values

Aircraft category	**V_{AT}**
A	Less than 91 kt
B	from 91 to 120 kt
C	from 121 to 140 kt
D	from 141 to 165 kt
E	from 166 to 210 kt

GM7 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopters~~rotorcrafts

CONTINUOUS DESCENT FINAL APPROACH (CDFA) — AEROPLANES

(a) Introduction

(1) Controlled flight into terrain (CFIT) is a major hazard in aviation. Most CFIT accidents occur in the final approach segment of non-precision approaches; the use of stabilised- approach criteria on a continuous descent with a constant, predetermined vertical path is seen as a major improvement in safety during the

conduct of such approaches. The following techniques are adopted as widely as possible, for all approaches.

(2) The elimination of level flight segments at MDA close to the ground during approaches, and the avoidance of major changes in attitude and power/thrust close to the runway that can destabilise approaches, are seen as ways to reduce operational risks significantly.

(3) The term CDFA has been selected to cover a flight technique for any type of NPA operation.

(4) The advantages of CDFA are as follows:

(i) the technique enhances safe approach operations by the utilisation of standard operating practices;

(ii) the technique is similar to that used when flying an ILS approach, including when executing the missed approach and the associated missed approach procedure manoeuvre;

(iii) the aeroplane attitude may enable better acquisition of visual cues;

(iv) the technique may reduce pilot workload;

(v) the approach profile is fuel efficient;

(vi) the approach profile affords reduced noise levels; and

(vii) the technique affords procedural integration with APV operations.

(b) CDFA

(1) Continuous descent final approach is defined in Annex I to the Regulation on Air operations.

(2) An approach is only suitable for application of a CDFA technique when it is flown along a nominal vertical profile; a nominal vertical profile is not forming part of the approach procedure design, but can be flown as a continuous descent. The nominal vertical profile information may be published or displayed on the approach chart to the pilot by depicting the nominal slope or range/distance vs. height. Approaches with a nominal vertical profile are considered to be:

(i) NDB, NDB/DME (non-directional beacon/distance measuring equipment);

(ii) VOR (VHF omnidirectional radio range), VOR/DME;

(iii) LOC (localiser), LOC/DME;

(iv) VDF (VHF direction finder), SRA (surveillance radar approach); and

(v) GNSS/LNAV (global navigation satellite system/lateral navigation).

(3) Stabilised approach (SAp) is defined in Annex I to the Regulation on Air operations.

(i) The control of the descent path is not the only consideration when using the CDFA technique. Control of the aeroplane’s configuration and energy is also vital to the safe conduct of an approach.

(ii) The control of the flight path, described above as one of the requirements for conducting an SAp, should not be confused with the path requirements for using the CDFA technique.

(iii) The predetermined approach slope requirements for applying the CDFA technique are established by the following:

(A) the published 'nominal' slope information when the approach has a nominal vertical profile; and

(B) the designated final-approach segment minimum of 3 NM, and maximum, when using timing techniques, of 8 NM.

(iv) An SAp will never have any level segment of flight at DA/H or MDA/H, as applicable. This enhances safety by mandating a prompt missed approach procedure manoeuvre at DA/H or MDA/H.

(v) An approach using the CDFA technique will always be flown as an SAp, since this is a requirement for applying CDFA. However, an SAp does not have to be flown using the CDFA technique, for example a visual approach.

GM8 NCO.OP.110 Aerodrome operating minima — aeroplanes and ~~helicopter~~ rotorcrafts

ONSHORE AERODROME DEPARTURE PROCEDURES — ROTORCRAFT~~HELICOPTERS~~

The cloud base and visibility should be such as to allow the ~~helicopter~~ rotorcraft to be clear of cloud at the take-off decision point (TDP), and for the pilot flying to remain in sight of the surface until reaching the minimum speed for flight in instrument meteorological conditions, as given in the AFM.

AMC1 NCO.OP.205 Approach and landing conditions — aeroplanes and ~~helicopter~~ rotorcrafts

LANDING DISTANCE/FATO SUITABILITY

The in-flight determination of the landing distance/FATO suitability should be based on the latest available meteorological report.

10.5 Appendix 5 - Analysis of UK Gyroplane Accidents and the impact on the EASA Gyroplane Training Syllabus

Analysis provided by IAPGT - Phil Harwood, 6th June 2019

10.5.1 Introduction

This is a report of lessons learned from accidents in factory built gyroplanes. These lessons learned are a key component of the IAPGT Training Syllabus, the foundation of the EASA Gyroplane Training Syllabus.
The analysis is based on gyroplane accidents in the UK between the period of 2006, when the first factory built gyroplane entered the UK and 2018, the latest complete year. This dataset was chosen due to:

- the availability of detailed information on the UK AAIB website in English
- a high proportion of the instructors who were early adopters of the IAPGT collaboration exercise were based in the UK and therefore knew the pilots involved and could help analyse the accidents.

From discussions with instructors in countries outside the UK, the results of this dataset are believed to be consistent with the accidents reported worldwide.
Accidents involving single seat gyroplanes (mostly Benson), RAF2000 and VPM have been **excluded** from this analysis report as these are considered legacy gyroplanes and not indicative of the standards of factory built gyroplanes, the standard closest to the type of gyroplanes that will require an EASA Gyroplane Pilot Licence.

10.5.2 Overview

Fatal Accidents	3
Emergency Landing	5
Other Emergency	1
Low and Slow Flight	2
Takeoff (see below)	28
Go Around	2
Landing (see below)	14
TOTAL	**55**

Takeoff By Stage

Pre-rotation	2
Rotor Acceleration	14
Lift	4
Airspeed Acceleration	8

-> **Rotor Acceleration**

Failed to notice rotor decay	6
Took off with stick forward	6
Training slow rotor buildup	2

Landing By Error

Failed to stop after landing	4
Sideways drift due to crosswind	5
Failed to stop before the end of runway	1

Rounding out too high	2
Over flared during touchdown	2

10.5.3 Fatal Accidents

In the dataset there were 3 fatal accidents:

- A person walked into a spinning propeller when the gyroplane was starting to taxi
- A pilot had a heart attack while flying in the circuit
- A pilot of an enclosed cockpit gyroplane crashed while holding a door that was unlatched and failed to maintain control.

These types of accidents are not isolated to gyroplanes however the syllabus was influenced as follows:

- Lesson 4. As part of the pre-start procedure, as soon as a pilot puts their hand on the magneto key or switch they are taught to always say the following words “if anyone approaches the gyroplane while the engine is running, this is how I will switch off the engine”. This does two things: it reinforces the method for switching off the engine (some models have keys and other models have switches) and it also reinforces to the student to not take any risks when the engine is running.
- Lessons 1, 4 and 26. These are the lessons that incorporate pre-flight planning. The acronym YAWF (You, Aircraft, Weather, Flight) is used in pre-flight planning and throughout the flight. A major part of the Y is to go through the IMSAFE checklist before every flight and to tell any passenger that should they feel unwell at any time during the flight to tell the pilot.
- Lesson 14. The rejected/aborted takeoff is taught **before** the student is taught to climb out, using the term ‘land ahead’. Reinforcing to a pilot that climbing out is a separate decision from becoming airborne is a major part of teaching takeoffs. Ensuring that a student can abort takeoffs easily is vital. We found that if we teach this after teaching climbing out, it is perceived as difficult.

10.5.4 Emergency Landing

In the dataset there were 5 emergency landings:

- Two were initiated by a propeller bird strike at altitude which caused excessive vibration*
- One was initiated by running out of fuel (during final approach)
- One was due to engine stop after takeoff due to contaminated fuel
- One was due to a pilot deciding to make a precautionary landing*.

*The precautionary landing and the two instances of bird strike also involved hitting wires during the final stages of landing.
These types of accident are not isolated to gyroplane however the syllabus was influenced as follows:

- More emphasis was given to handling Emergencies. These are Lessons 27 to 30. Lesson 27 specifically covers actions to be taken after a ‘thump’ is felt possibly due to a bird strike or something coming loose and hitting the propeller. The instance where there is excessive vibration due to a propeller blade breaking is explicitly discussed, with an immediate reaction of shutting down the engine. It is discussed that vibration such as this could cause the engine to shake itself from its mounting in a matter of seconds.

- Lesson 28 is the precautionary landing lesson. The traditional teaching of field selection is based around six items that begin with S (Slope, Size, Surround, Shape, Stock, Surface). This has been enhanced with ensuring the two most critical things to observe are Wires and Wind.

10.5.5 Other Emergency

In the dataset there was one instance of an emergency that did not result in a forced landing.

- A cowling detached after takeoff as it had not been secured before flight.

This type of accident is not isolated to gyroplanes however the syllabus was influenced as follows:

- Lesson 4 emphasises a 360 degree walk around the gyroplane immediately before climbing in as a final check for anything that may not look right or be fastened correctly.

10.5.6 Low and slow flight

In the dataset there were 2 instances where gyroplanes contacted the ground when the pilots were flying behind the power curve.
This type of accident **is** particular to a gyroplane.

- A gyroplane cannot stall, a fixed wing aircraft would stall if flying slowly and the pilot would be warned with the pre-stall warning system, or a stall at low level is likely to be fatal.

- A helicopter can fly low and slow due to its hover capability.

Although gyroplanes can fly slowly this is not without risk. There is a certain airspeed at which, if not maintained with full power, the gyroplane will descend. The descent can initially be quite slow and therefore it is easy for the pilot to be unaware it is happening. In both instances the pilots found themselves distracted by things on the ground.
The syllabus was influenced as follows:

- Lesson 21 is the lesson on Slow Flight while maintaining altitude. This allows the student to practice slow flight to the point where the gyroplane starts to descend. It notes that if the gyroplane starts to descend the only option is to lower the nose to regain airspeed.

- Lesson 22 is the lesson on slow flight in a glide descent. Part of this exercise is about ‘recovering with minimum height loss’ involving rapid application of full power with the correct pitch attitude. This also reminds the student of the significant height loss experienced despite a power recovery.

- Lesson 24 is the lesson on unusual attitudes. This was updated to reinforce how distraction and fixation can be the cause of incidents. The lesson was originally called “Recovery from Unusual Attitudes”, it was revised to “Recognition and Recovery from unusual attitudes”. The present title and content is “Avoiding, Recognising and Recovery from Unusual attitudes” which emphasises the hazards of fixation and distraction.

- In all the above lessons, there is a pre-requisite for the HASEL checks (Height, Area, Security, Engine T&P and Lookout). The objective is to reinforce the hazards to the student when an unusual manoeuver is about to be performed.

10.5.7 Takeoffs

Without question, takeoffs represent the greatest number of accidents in gyroplanes. In this dataset it represents more than 50% of the non-fatal accidents.

About 50% of these accidents involve excessive blade flap (also known as blade sailing) resulting in damage to the rotor blades, the propeller and one or more of the vertical fins. The forces can be so strong that the stick is pulled from the pilot’s hand and may cause the gyroplane to roll on to its side (the left side). Blade sailing is explained later in this section.

It cannot be stressed enough that the technique for taking off in a gyroplane is different from that for fixed wing. A significant number of these accidents involve fixed wing pilots (often ex military or commercial pilots) with a high number of flying hours. When the workload is increased in a takeoff situation, it is likely that the pilots ‘revert to type’ and takeoff as if it were a fixed wing.

The takeoff in a gyroplane has the following stages:

1. **Prerotation**. Start the blades rotating to form the rotor disc (the ‘wing’). This involves some form of drive attached to the rotor system, often using a clutch from the engine. The gyroplane is stationary during this stage.

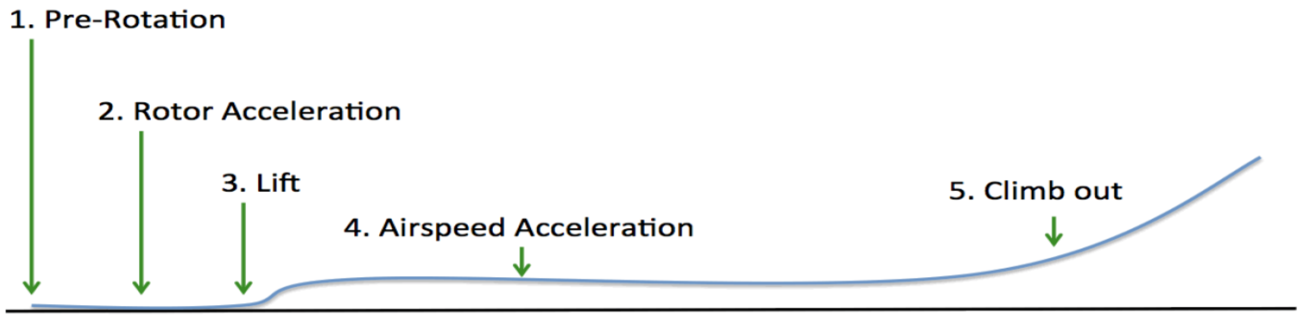
2. **Rotor Acceleration**. The pre-rotator mechanism is released and, with the rotor disc tilted rearward, the headwind and/or forward movement of the gyroplane on the ground (using the propeller) accelerates the rotors. The inertia of the rotor system is a limiting factor in the acceleration of the blades. The gyroplane is moving forward on the ground during this stage.

3. **Lift**. When the rotor rpm is sufficient for takeoff, the disc is set to the takeoff attitude, power is applied and the gyroplane will lift into the air. The gyroplane unsticks from the ground and lifts into the air during this stage.

4. **Airspeed Acceleration**. In order to create enough kinetic energy in the gyroplane to flare on landing, sufficient airspeed must be developed while the gyroplane is low to the ground. There is a Height/Velocity avoid curve for a gyroplane, as there is for a helicopter. The gyroplane is flying at a height of about 1 metre above the ground during this stage.

5. **Climb-Out**. When sufficient airspeed has been developed the gyroplane can climb out.

The height profile of the gyroplane is described by the following diagram.



The errors causing the accidents during takeoff are specific to a gyroplane.

10.5.7.1 Prerotation

In the dataset there were 2 accidents in the prerotation stage:

- One of the accidents involved the pilot taking off in strong winds. At the time the pilot was trained the syllabus did not contain content relating specifically to strong winds. In strong winds, the stick should not be brought as far back as normal otherwise the gyroplane can be lifted a few metres into the air prematurely, without any forward airspeed, in which case it will always fall back to the ground. This will always result in a hard landing, the tail is likely to be damaged by the rotor blades and, as in this case, the gyroplane may roll over.

- The other accident involved a wet grass surface. When the pre-rotation clutch is engaged and power is being applied to the rotorhead to start the blades turning, the propeller is also turning. On wet grass, even though the wheel brakes are engaged, the thrust from the propeller may start to push the gyroplane forward with the wheels skidding on the grass. The nose-wheel is also likely to be ineffective for steering. This is quite a hazardous situation and it takes a skilled pilot to be able to takeoff successfully in this situation.

The syllabus was influenced as follows:

- The lesson for takeoff was split into Lesson 14 and Lesson 15. Lesson 14 covers the basic takeoff technique when the wind is roughly on the runway heading and between 5 and 15kts. These are the wind conditions that are generally used for the initial teaching of takeoffs. Lesson 15 covers all the different takeoff conditions with subsections for: crosswind (left and right have subtle differences); strong winds; nil wind; rough ground (which includes wet grass) and immediate departure, when the gyroplane has to prerotate at the hold.

Note: there is no ‘short field’ takeoff in a gyroplane included in the syllabus as the normal takeoff technique is used for a short field [aside: there have been a number of short field techniques discussed (and taught by some instructors) but these require skilled pilots and not recommended for inexperienced pilots therefore are excluded from the syllabus where the emphasis is always teaching with the greatest margin of error.]

10.5.7.2 Rotor Acceleration

In the dataset there were 14 accidents in the rotor acceleration stage. They fall into three distinct errors:

- Failing to recognize that the rotor rpm is decaying during the ground run (6 accidents)

- Taking off with the stick forward (6 accidents)

- Accidents during training of the exercise to accelerate rotor blades from a low airspeed

The accidents involve a phenomenon known as blade sailing. Blade sailing is when a rotor blade flaps up in excess of the allowable limits, thrashing the stick from side to side, with the blade often striking the rudder other vertical sections of the tail or the ground. It often results in the gyroplane rolling to the left.
Blade sailing is caused by excessive dissymmetry of lift between the blades. Blade sailing can only occur when the gyroplane is on the ground and the rotor blades are turning at less than flying speed. It is most likely during early stages of the takeoff run or when taxiing. <u>It is completely avoidable if the rotor is managed properly by the pilot</u>.
In a two blade rotating “wing”, one blade will be advancing towards the “wind”, the other blade will be retreating from the wind. This creates an imbalance of airflow between each blade. The teetering mechanism automatically compensates for this by allowing the blades to flap up and down therefore adjusting the angle of attack and equalizing the lift.

There is an allowable range of teetering built into the rotorhead. If this range is exceeded, the blades will touch the teeter stops and the blade forces will be both transmitted to, and move, the rotor head. This in turn will move the stick from side to side. The downward blade is likely to hit the tail, or the ground as mentioned previously.
There are 3 factors that affect the dissymmetry of lift:

- The strength of the oncoming airflow caused by the wind or the forward movement of the gyroplane. This is called inflow. The greater the inflow, the greater the dissymmetry of lift.
- The forward/rearward position of the stick. The further rearward, the greater the dissymmetry of lift as the angle of attack on the advancing blade is increased and the angle of attack on the retreating blade is decreased.
- The rotational speed of the rotor (the rotor rpm). The slower the rotor rpm, the greater the dissymmetry of lift.

To accelerate the rotor blades in the most efficient way, the stick needs to be as far back as possible and with as much inflow as possible, without exceeding the dissymmetry of lift limits of the rotorhead.
In most modern gyroplanes the pre-rotators are sufficient to rotate the blades above, say, 200 rpm. This means that in all but the strongest of wind conditions it is safe to bring the stick fully back without fear of dissymmetry of lift. This is the normal takeoff procedure.
There is an additional factor to be considered during this stage of the takeoff. Blades have inertia that regulate the maximum rate at which they can accelerate. The heavier the blades the greater the inertia and the slower the acceleration of the blades. Heavier blades however offer greater stability in flight.

10.5.7.3 Failing to recognize that the rotor rpm is decaying during the ground run

When the prerotator mechanism is disengaged, required before the takeoff run commences, the rotor rpm will decay slightly, this is normal. In a normal takeoff, the delay will last 2-3 seconds and the rotor will decay about 20-30 rpm. The gyroplane starts to move forward and, after a short delay, the airflow will begin to accelerate the rotor.
In 6 of the accidents in the dataset, the pilot encountered delays after releasing the prerotator, mainly due to distraction, with the result that the rotor rpm decayed further than expected. The pilots were unaware of the decay and continued with a normal takeoff, resulting in excessive dissymmetry of lift and damage.
The syllabus was influenced as follows:

- Lesson 13 is dedicated to the understanding of the rotor acceleration stage. It does not involve flight but progresses up to the point where the rotor is able to lift the nose of the gyroplane, ready for the lift stage. This is generally known as the wheel-balance attitude.
- Lesson 13 includes the instruction to the pilot to keep awareness of the rotor rpm by referring to the rotor rpm gauge during this stage. (This is no different to a fixed wing pilot being asked to keep awareness of airspeed during takeoff).
- Lesson 13 includes the instruction to limit the initial application of power in the takeoff, to take into account the inertia of the rotor blades and adjust the power as appropriate during the takeoff process.
- Lesson 13 includes a section called “Active Rotor Handling” that specifies the correct stick position when taxiing, depending upon the direction of the wind and the rotor rpm.

10.5.7.4 Taking off with the stick forward

This is an error that is common more with pilots who have a fixed wing licence, especially pilots with a high number of flying hours.

The normal stick position for the start of the rotor acceleration stage is fully aft (except in strong wind situations) however, in a number of gyroplane, the previous stage (pre-rotation) is performed with the stick fully forward. It is a relatively common error for the pilot to forget to bring the stick fully aft after prerotation.
This has the effect that rotor speed will decay (as there is no angle of attack of the disc to the inflow) while the airspeed (and groundspeed) is increasing. The gyroplane will not takeoff with the stick fully forward. In the event of this happening, the correct recovery is to reduce power to idle and if necessary apply the wheel brake, keeping the stick fully forward.
A common error, when the pilot realizes the stick is still forward, would be to bring the stick back quickly however the rotor speed will be slow, the angle of the disc will be high and the inflow will be high. This is the worst case scenario for blade sailing and it will always occur. In this situation the gyroplane is likely to lift about 1 metre into the air and roll over on its left hand side.
The syllabus was influenced as follows:

- Lesson 14, the lesson on takeoffs has an explicit technique which helps ensure the correct sequence of events for takeoff. This is done, prefixing each instruction with numbers. The order is:
    - One, release the prerotator
    - Two, bring the stick full back
    - Three, release the wheel brake
    - Four, apply power to the initial power setting (usually cruise power)

    Using the numbers every time helps the pilot get into the habit of doing things in the correct order and it also helps to slow down the process into a controlled methodical sequence. Pilots are taught to say this out loud while they are doing it.
    The process continues with the commands: steer with the pedals and call out the rotor rpm, this helps ensure the pilot is aware of the rotor rpm.

10.5.7.5 Accidents during training of the exercise to accelerate rotor blades from a low airspeed

Some models of gyroplane have prerotators that do not always accelerate the rotor to say, 200 rpm (the value where dissymmetry of lift is extremely unlikely). In factory built gyroplanes this should not happen due to design however it can happen when there is excessive wear and tear in the system. It is possible to accelerate the rotor using airflow from a rotor rpm as low as (say) 50 rpm but this requires additional care and skill.

- This is very common in the old gyroplane designed eg Benson
- It is not a skill that is commonly taught to modern-day gyroplane pilots.

There is a lot of debate in the gyroplane industry about whether this is a skill that should be taught to students of modern factory built gyroplanes.

- For: It teaches students a significantly better understanding of how a rotor system works, and this greater knowledge reinforces the correct takeoff technique (this is generally the view of the ‘old boy’ instructor community)

- Against: If the design of the pre-rotator is to accelerate to (say) 200 rpm and it does not achieve this number then the flight should be abandoned due to malfunction (this is generally the view of the ‘new generation’ instructor community).

Both arguments are equally strong. The IAPGT recommendation is that, with some additional training, it is a skill that a gyroplane pilot at PPL level should develop, perhaps with a limitation that if the rotor rpm cannot reach (say) 150rpm, the flight should be abandoned. This is covered in Lesson 13 of the syllabus.
Whether this is taught at standard pilot level or not, it is definitely a skill that an experienced pilot, an instructor or a commercial pilot should be able to perform.

10.5.7.6 Lift

In the dataset there were 4 accidents that occurred in the lift stage:

- The accidents are caused by the nose of the gyroplane becoming excessively high during the unsticking process.

- The primary error made is that the stick is not moved forward into the takeoff position when the lift from the rotor system is able to support some of the weight of the gyroplane.

- This error is often the result of the inexperienced pilot applying too much power, too quickly, during the takeoff process.

- This error is most likely during early solo flight due to the significant relative difference in weight when the instructor is no longer in the gyroplane. It can be partly mitigated using ballast in the passenger seat, but it can be completely mitigated using appropriate power during takeoff.

- The gyroplane will generally rollover to the right due to the engine torque.

The syllabus was influenced as follows:

- Lesson 13 and Lesson 14, the lessons on takeoffs require the pilot to think about two power settings. An initial power setting (usually around cruise power) and a takeoff power setting (which may be full power). The initial power setting is used during the rotor acceleration stage, the takeoff power setting is used to initiate the lift stage.

- Lesson 15. There is no ‘one size fits all’ power setting for takeoff and it depends upon the wind, the runway surface and the weight of the gyroplane (solo is very different from dual). The knowledge relating to the effect of different power settings is an important aspect of the training.

One of the causes of this type of accident is the misunderstanding that there is a ‘short field’ takeoff technique that involves immediate full power. Due to the inertia of the blades, this **may** not be the appropriate setting. This is made clear in the training syllabus.
This problem is likely to become more prevalent in the future as the power to weight ratio of gyroplanes increases, especially with the introduction of higher power engines.

10.5.7.7 Airspeed Acceleration

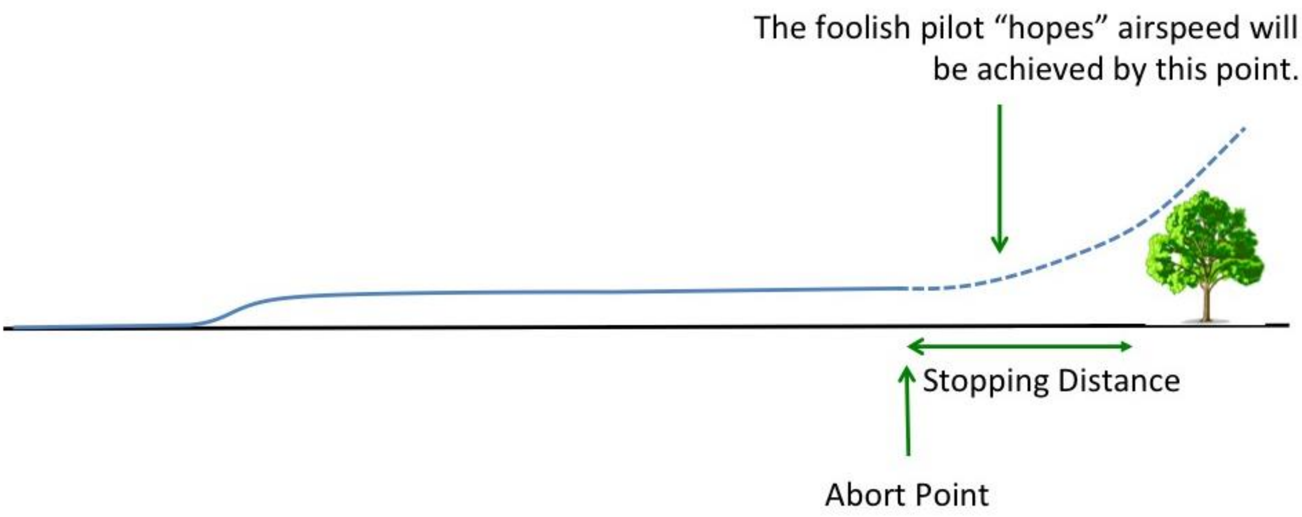
In the dataset there were 8 accidents in the airspeed acceleration stage:

- In each accident, the pilot failed to achieve the safe climb-out speed before initiating the climb.
- The pilot would reach the end of the runway, or an obstacle at the end of the clearway and, in their mind, be "forced" to climb over the obstacle to avoid hitting it.
- If a safe climb speed has not been achieved, raising the nose, which will initiate a climb will also seriously reduce the airspeed and, if the airspeed is behind the power curve, the gyroplane will always descend.
- In each instance, the pilot had failed to take into account the factors adversely affecting air density (hot temperature, high humidity or low air pressure*), and/or was flying the aircraft at or above max all up weight and/or was taking off in nil wind, tailwind, or 90 degree crosswind.
- * Note: Low air pressure is normally associated with high altitude. In the dataset (UK) high attitude is not an issue. This type of incident is more prevalent in countries with runways at high altitude.

The injuries from this type of error can be substantial, fortunately in this dataset there were no fatalities that resulted from this error. Fatalities due to this error are known to have happened in other countries.
The syllabus was influenced as follows:

- Lesson 14. As discussed previously in the fatal accidents section, the rejected/aborted takeoff is taught **before** the student is taught to climb out using the term 'land ahead'. Reinforcing to a pilot that climbing out is a separate decision from getting airborne is a major part of teaching takeoffs. Ensuring that a student can abort takeoffs easily is vital. We found that if we do it after teaching climbing out it is perceived as difficult.
- Lesson 14 includes the concept of a ground reference "abort point". The abort point is chosen as the distance required to stop the gyroplane safely. Note: a gyroplane can stop in a very short distance so this is likely to be, say 50-100 from the end of the run. <u>This is significantly different (shorter) from the abort point distance that is required for a fixed wing aircraft</u>.
- Lesson 15 includes a specific section on Taking off in "poor performance" conditions. This includes a flying exercise that emulates these conditions by limiting the power on takeoff.
- Part of the recommended instructor course flying skills test includes this exercise to ensure that instructors are competent at both teaching it and flying the emulation exercise.

The key message in the teaching is summarized in the following diagram:



The training teaches: *even though you may believe that you will be able to clear the obstacle by reaching flying speed before the tree you must reject the take off if you are not at the required airspeed by the abort point otherwise the only thing you have to rely on is "hope"*

The focus on the teaching is **providing a safe margin for error**.

10.5.8 Go Around

In the dataset there were two instances of accidents due to a go-around situation.

- Accident 1 was due to a late decision to go-around. There was insufficient airspeed before the obstacle at the end of the runway, the result was the same as the error described in Airspeed Acceleration above.
- Accident 2 was the result of an incorrect go-around procedure where the pilot pitched the aircraft too high, such that even though full power was applied, the gyroplane was flying behind the power curve and unable to climb.

The syllabus was influenced as follows:

- Lesson 16 is the first lesson on landings. The lesson concentrates on flying an accurate approach and being able to fly along the length of the runway maintaining a height of approximately 1 metre and then climbing out. The wheels should not contact the ground throughout the exercise. Concentrating on this and not on the actual touchdown has both significantly reduced the overall training time, but also increased the accuracy of landings. As a consequence of teaching in this way, the pilot is automatically taught the go-around procedure early in the training. The standard phraseology for the go-around is "power to cruise, level the attitude, check the airspeed" followed, after a pause by, "lookout above, power to climb power, climb".
- Lesson 16 also teaches a set of checks as the gyroplane descends through 300ft. These checks involve ensuring the runway is completely clear of aircraft/birds/obstacles, and if it is not clear, to immediately initiate a go-around. [Aside: Although not reported in this dataset, a number of 'near miss' incidents have been witnessed at airfields, in different types of aircraft not specifically gyroplanes, involving very late decisions to go-around.]

It is a common misconception that the go-around means “full power and lift the nose to climb”. Application of full power generally involves significant roll to the right* caused by engine torque and yaw to the left* caused by the propeller slipstream on the tail section. It may also involve significant pitch movements, depending the relationship between the propeller thrust line, the centre of gravity and the design of the horizontal stabiliser. Adding full power very close to the ground can result in a pilot over-controlling and/or excessive speed very close to the ground, not an ideal situation.
* the direction depends upon the direction that the propeller turns. The directions given above apply to all factory built models of gyroplane that exist at the date of writing this document, anti-clockwise when viewed from the rear of the gyroplane. If the propeller direction is reversed, the direction of the roll and yaw will be reversed.

10.5.9 Landings

Landings represent the second largest number of accidents in gyroplanes. They broadly fall into five categories:

- Rounding out too high, resulting in a hard landing (2 accidents)
- Rolling over during excessive sideways drift during the final stages of the float, usually in a crosswind (5 accidents)
- Failing to stop before the end of the runway (1 accident)
- Over-flaring on touchdown, resulting in the blades touching the ground at the rear of the gyroplane (2 accidents)
- Rolling over immediately after landing (4 accidents)

One of the key features of a gyroplane is the extremely short landing roll. It is usual for a gyroplane to be able to stop within 30 metres from the initial point where the main wheels touch the ground. With a headwind component of, say, 15kts, it is possible for the ground distance to be zero. This is significantly different from the ground element of a fixed wing landing.
A gyroplane is extremely stable when flying in the air, but it is relatively unstable when on the ground. This is due to a combination of:

- A close coupled triangular wheel system consisting of a nosewheel and a relatively narrow distance between the main wheels.
- A high centre of gravity due to the heavy rotor blades installed at the top of the gyroplane.
- When the rotor blades are turning above, say, 120 rpm there is some element of lift opposing the weight of the gyroplane.

Emphasis must be made by the pilot to taxi slowly, especially when turning whilst taxiing on the ground to reduce the likelihood of a rollover.

10.5.9.1 Rounding out too high, resulting in a hard landing

This error is not specific to gyroplanes, it is a judgement made by pilots of all aircraft. However, the consequences are potentially more severe in a gyroplane compared with a fixed wing aircraft due to the greater rate of deceleration in the final stages of the landing.

- The forward airspeed of a gyroplane could be reduced to almost zero while still airborne, this will always result in a near vertical drop to the ground. It is therefore vital that a pilot does not attempt to stop a gyroplane at a height of more than a few centimetres above the ground otherwise a hard landing will occur and damage to the gyroplane (and possibly the occupants) will result.

- One of the main reasons for a pilot rounding out high and attempting to stop the gyroplane while airborne is during an attempt to make a precision landing. A common error is for a pilot to approach the landing position with excessive airspeed, and, when the gyroplane is obviously going to land past the required position the gyroplane pilot incorrectly brings the stick rearward to reduce the airspeed. Whilst rearward stick movement does reduce the airspeed, it also has the consequence that the gyroplane will climb. The end result is very slow airspeed, at a height usually of more than one metre.

The syllabus was influenced as follows:

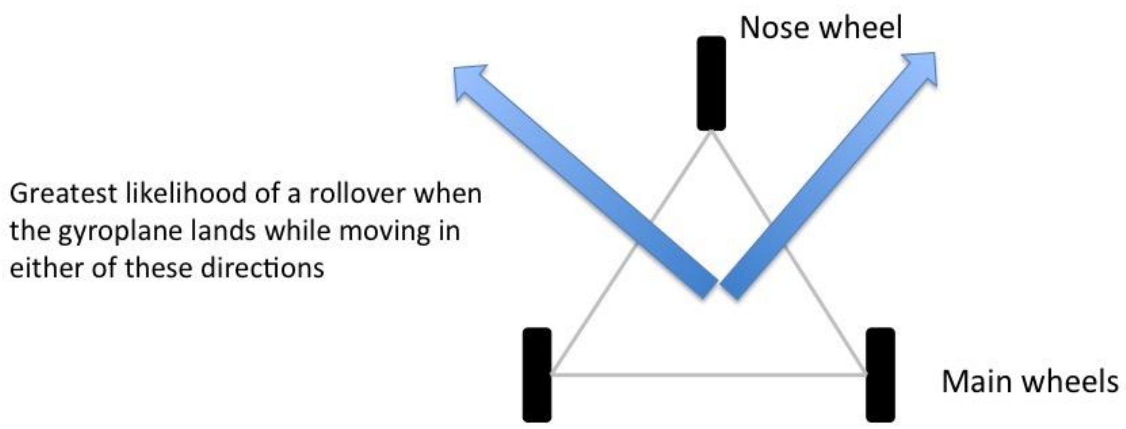
- Lesson 14, is the lesson where student pilots are taught to takeoff. As discussed previously the emphasis is in three areas: the lift section of the takeoff; level flight just above the runway; followed by an instruction to land ahead. This involves a landing. A key part of this lesson is being able to correctly judge, and safely adjust, the height above the runway surface. It also involves the use of power to avoid a heavy landing.

- Lesson 18 is explicitly about making a precision landing. Having a separate lesson provides an emphasis on the appropriate techniques, the common errors and how to avoid them. A note is made that a common reason for the errors is the pilot’s ego, when there is more focus on ‘hitting the target’ than ‘ensuring a safe landing’.

10.5.9.2 Rolling over during excessive sideways drift during the final stages of the float, usually in a crosswind

These accidents involve sideways drift, most often in the final stages of the float just prior to touchdown. Excessive drift will result in a rollover.

- A triangular structure is very stable if forces are towards the points of the triangle. When related to an undercarriage, an aircraft has most stability if the direction of travel is towards the nose wheel (ie the gyroplane is moving forward). A triangular structure is most unstable if the forces are towards the edges of the triangle. When related to an undercarriage, a landing aircraft is least stable when moving in the direction shown below.



- The “relative wind” affecting an aircraft on landing is a combination of the movement of the aircraft over the ground and the actual wind. A 90degree crosswind with a strength of 20kts is more significant on an aircraft landing at 60kts than an aircraft landing at 120kts. A gyroplane decelerates quickly during the float, before the touchdown. A gyroplane can still be airborne at (say) 20kts immediately prior to touchdown. The crosswind component at this time is very significant.

- The common error is for a pilot to ‘fix’ the crosswind control movements (stick towards the wind, opposite rudder) throughout the crosswind landing float. The pilot fails to increase the control movements during the deceleration part of the float to offset the greater significance of the crosswind with the slower airspeed at the end of the float. This results in excessive sideways drift just prior to touchdown.

- This is significantly different from a fixed wing aircraft that touches down at flying speed and then decelerates comparatively slowly versus a gyroplane. By the time the relative wind becomes significant, the weight of the fixed wing aircraft is transmitted to the wheels and the friction will tend to keep the fixed wing aircraft travelling in a straight line.

The syllabus was influenced as follows:

- Lesson 17 is dedicated to landing in different wind and ground surface conditions. This includes strong winds, nil wind and rough ground as well as crosswinds. Separating each of the different scenarios makes it clearer to the student pilot what must be done differently in each of the scenarios, highlights the common errors and teaches how to avoid them.

10.5.9.3 Failing to stop before the end of the runway

One of the accidents in the dataset involved a gyroplane failing to stop before the end of the runway. This is due to an error of judgement, with the pilot being too high at the threshold of the runway and not initiating a go-around. This type of error is common on all types of aircraft.
The syllabus was influenced as follows:

- As mentioned earlier in this document, Lesson 16, the first lesson on landings include a 300ft check that includes a decision to go-around if the approach is not set up as expected.

10.5.9.4 Over-flaring on touchdown, resulting in the blades touching the ground at the rear of the gyroplane

Two of the accidents in the dataset involved inexperienced pilots lifting the nose excessively high just before touchdown. This resulted in the tips of the rotor blades contacting the ground at the rear of the gyroplane. These accidents were attributed to inexperience of the pilots and brain workload.

10.5.9.5 Rolling over immediately after landing

These accidents were caused by the pilots failing to bring the gyroplane to a complete stop (or at least a very slow forward speed) before initiating the taxi to clear the runway.

- After touchdown, a gyroplane is primarily slowed by the rearward direction of the rotor thrust (stick back). It acts in a similar way to a parachute used to help slow a fast military jet. The wheel brake is not normally required to slow a gyroplane after landing.

- If the stick is put forward while there is still forward speed, the gyroplane will no longer decelerate and will travel with a high groundspeed. As discussed earlier in this document, "a gyroplane is very stable in the air but relatively unstable on the ground". A fast taxi, especially with the rotor turning above 120rpm is likely to end with a rollover, especially if a turn is initiated.

The syllabus was influenced as follows:

- Lesson 13, the lesson on rotor handling, taught before takeoffs and landings includes the standard phraseology to be repeated by a student after landing.

  > *"Keep the stick backward until the gyroplane comes to a complete stop. When stopped, stick fully forward and central, trim fully forward. Pause to let the excessive rotor energy dissipate [2-3 seconds] then taxi off the runway by the shortest route. Monitor the rotor rpm and when it is below 120, stick [fully forward] left or right as appropriate for the wind."*

- Lesson 16 includes various factors relating to the approach profile of a gyroplane and the point on the runway where a gyroplane should touchdown. Although not directly related to accidents in the dataset, these factors are an important part of the training of a gyroplane pilot, and are significantly different to the profile of a fixed wing aircraft.

10.5.10 Conclusion

This document has presented the main factors that contribute to accidents in gyroplanes. The statistical elements relate to a dataset that is felt to be representative of the worldwide gyroplane community. Where elements are known to create accidents that are not in the dataset, these have been included in [aside] comments.
The training syllabus that is presented by IAPGT is based upon the feedback and comments from instructors around the world who opt-in to the project. The content of the syllabus, both the pilot training syllabus and the instructor training syllabus is the result of a continuous improvement program that started in 2013. It is an ongoing program, designed to incorporate changes that will result from new models of gyroplane in the future.