



Appendix

to ED Decision 2018/001/R

Subject 021 — AIRCRAFT GENERAL KNOWLEDGE: AIRFRAME, SYSTEMS AND POWER PLANT

RELATED NPA: 2016-03(B) — RMT.0595 — 6.2.2018

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1. Summary of the outcome of the consultation

Please refer to the Explanatory Note to Decision 2018/001/R.



2. Individual comments and responses

In responding to comments, a standard terminology has been applied to attest EASA's position. This terminology is as follows:

- (a) **Accepted** — EASA agrees with the comment and any proposed amendment is wholly transferred to the revised text.
- (b) **Partially accepted** — EASA either agrees partially with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.
- (c) **Noted** — EASA acknowledges the comment but no change to the existing text is considered necessary.
- (d) **Not accepted** — The comment or proposed amendment is not shared by EASA.

comment	6-B 021 01 01 02 - about time too! We are training pilots, not aircraft designers.	comment by: <i>Bristol Groundschool</i>
response	Noted. Thank you for providing this comment referring to Subject 021 01 01 02. EASA acknowledges your comment.	

comment	7-B 021 02 04 00 (08). There are more than two types of 'double-bubble' fuselage. Specify which two are to be taught.	comment by: <i>Bristol Groundschool</i>
response	Accepted. Thank you for providing this comment referring to LO 021 02 04 00 (08). EASA agrees that this LO is unclear and the reference to 'two types' will be deleted. The text will be amended as follows: Explain the advantages and disadvantages of the following fuselage cross sections: <ul style="list-style-type: none"> — circular; — double bubble (two types); — oval; — rectangular. 	

comment	8-B 021 03 02 01 (04). Disagree. An awareness - at the very least - of the non-miscibility of hydraulic fluids is essential, as crews could find themselves topping up fluids when working away from fixed bases, especially helicopter crews.	comment by: <i>Bristol Groundschool</i>
response	Accepted. Thank you for providing this comment referring to LO 021 03 02 01 (04). EASA agrees that this LO is relevant and will be retained.	

comment	9-B	comment by: <i>Bristol Groundschool</i>
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	021 03 02 02 (07). Add the caveat 'or higher' (A380 and B787, for example, are at 5000 psi), so 'normal' is too subjective a statement for an LO.
response	Partially accepted.
	Thank you for providing this comment referring to LO 021 03 02 02 (07).
	EASA agrees to reword this LO, but slightly differently from your proposal.
	The text will be amended as follows:
	State that the normal hydraulic pressure of most large transport aircraft is 3 000 psi.
	State that a high-pressure hydraulic system is typically operating at 3 000 psi but on some aircraft a hydraulic pressure of 4 000 to 5 000 psi may also be used.
	In comment 266-B, the same issue was raised regarding this LO (07).
comment	10-B comment by: Bristol Groundschool
	021 04 01 01 (02). What about four-poster type (Kamov etc)?
response	Noted.
	Thank you for providing this comment referring to LO 021 04 01 01 (02).
	EASA is of the opinion that the four-poster type is too type-specific. Most common modern types of design is adequate.
comment	11-B comment by: Bristol Groundschool
	021 04 01 02 (03). Should include helicopters in the tagging. Apart from bogie beam, the content of (01) and (02) are identical, so why shouldn't the (H) licence include it?
response	Accepted.
	Thank you for providing this comment referring to LO 021 04 01 02 (03).
	EASA agrees that this LO also is applicable for helicopters and will add an 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.
	In comment 261-B, the same issue was raised regarding this LO (03).
comment	12-B comment by: Bristol Groundschool
	021 04 01 02 (07). Include helicopters. Those with retractable gear do have VLO/VLE limits (140 kts on the A109 if I recall correctly).
response	Accepted.
	Thank you for providing this comment referring to LO 021 04 01 02 (07).
	EASA agrees that this LO (07) also is applicable for helicopters and will add an 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.
	In comment 261-B, the same issue was raised regarding this LO (07).
comment	13-B comment by: Bristol Groundschool
	021 04 03 01 (01) and (03) 'disk' should be 'disc' (it is spelt correctly in (02)).
response	Accepted.
	Thank you for providing this comment referring to LOs 021 04 03 01 (01) and (03).
	EASA agrees to correct this typo.

The text will be amended as follows:
 Describe the basic operating principle of a disk disc brake.
~~Describe their characteristics, advantages and disadvantages such as:~~
 Describe the characteristics, advantages and disadvantages of steel or carbon brake discs with regard to:
 [...]

comment 14-B comment by: Bristol Groundschool
 021 06 01 01 (01). Which means do you mean? Pump? Vacuum? Supercharger upstream of the carburettor? Needs to be specific.

response Accepted.
 Thank you for providing this comment referring to LO 021 06 01 01 (01).
 EASA agrees to reword this LO.
 The text will be amended as follows:
 State the method Describe the following means of supplying air for the pneumatic systems for piston-engine aircraft:
 - compressor;
 - vacuum pomp.

comment 15-B comment by: Bristol Groundschool
 021 08 02 02 (02). Do you mean 'baffles' instead of 'bafflers'? 'Cos I'm baffled!

response Accepted.
 Thank you for providing this comment referring to LO 021 08 02 02 (02).
 EASA wishes to state that both terms are acceptable
 The text will be amended as follows
 [...]
 — bafflers/baffles;
 [...]

comment 16-B comment by: Bristol Groundschool
 021 08 02 02 (09). Some helicopters do have jettison facilities (OEI, SAR pickup etc) - and indeed many modern large transport fixed wing aircraft do not. As you have already mentioned jettison systems in 021 08 02 02 (02) for all licences, I see no reason why (09) should not include helicopters as well.

response Accepted.
 Thank you for providing this comment referring to LO 021 08 02 02 (09).
 EASA agrees that this LO also is applicable for helicopters and will retain the 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.

comment 17-B comment by: Bristol Groundschool
 021 09 05 01 (02) introduces a new LO for starter/generator. However, 021 09 03 00 already mentioned them.

response Noted.
 Thank you for providing this comment referring to LO 021 09 05 01 (02).
 LO 021 09 03 00 is purely stating the approved terms for the different designs.
 LO 021 09 05 01 (02) is an LO for the starter generator.

comment 18-B comment by: Bristol Groundschool
 021 09 05 02 (03) talks of rotor seizure/runaway, but rotors are not introduced until the next LO, 021 09 05 03 (01). Suggest changing the running order.

response Not accepted.
 Thank you for providing this comment referring to LO 021 09 05 02 (03).
 EASA will not change the running order. This is a result of the operating principle being set out before the components. The LOs do not have to be in perfect order and training courses can be structured to cover the LOs in a more logical order if appropriate.

comment 19-B comment by: Bristol Groundschool
 021 10 02 01 (01). Mentions AVGAS and 'its colour'. There are currently 4 different colours for Avgas:

- 80 Red
- 82UL Purple
- 100 Green
- 100LL Blue

So do we mean 'colours', or are we going to specify a grade of Avgas for this LO?

response Accepted.
 Thank you for providing this comment referring to LO 021 10 02 01 (01).
 EASA agrees to reword this LO.
 The text will be amended as follows:
 Name the type of fuel used for petrol engines including its colour (AVGAS);
 – 100 (green);
 – 100LL (blue).

comment 20-B comment by: Bristol Groundschool
 021 11 04 01 (13) to (18) exclude CPL (H), but include CPL (A). Is this an error of omission? Otherwise it seems illogical.

response Accepted.
 Thank you for providing this comment referring to LOs 021 11 04 01 (13) to (18).
 EASA agrees that this is an omission and this LO is also applicable for helicopters CPL and

will add the 'X' in the column Helicopter 'CPL'.

comment 21-B comment by: Bristol Groundschool
 021 12 01 01 (01) and (02). These are also fitted to some helicopters, so the tagging should include them.

response Accepted.
 Thank you for providing this comment referring to LOs 021 12 01 01 (01) and (02).
 EASA agrees that this LO also is applicable for helicopters and will retain the 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.
 In comment 261-B, the same issue was raised regarding this LO.

comment 22-B comment by: Bristol Groundschool
 021 15 02 01 (08). Not just on Fenestron types. The upper fin of the AS350, for example, is an aerofoil shape to produce a side thrust, thereby offloading the tail rotor. (The lower fin is symmetrical, as it is primarily used for stabilisation in autorotation). Suggest changing to **'vertical fin on some types reduces the power demand of the tail rotor.'**

response Accepted.
 Thank you for providing this comment referring to LO 021 15 02 01 (08).
 EASA agrees to reword this LO.
 The text will be amended as follows:
 Describe how the vertical fin ~~on some types on some helicopters~~ reduces the power demand of the Fenestron tail rotor.

comment 42-B comment by: Bristol Groundschool
 Overall this NPA represents, in the personal opinion of the writer, a welcome move away from unnecessary depth of technical knowledge and towards better understanding of the pilot/aircraft interface. Notwithstanding the comments made by me above, I heartily endorse the proposals.

response Noted.
 Thank you for providing this general statement.

comment 43-B comment by: UK CAA
 The UK CAA has no comments on Part B.

response Noted.
 Thank you for providing this comment.

comment 261-B comment by: European Cockpit Association

Attachment #1

NPA 2016-03 (B)	Page nb	European Cockpit Association - Comments
SUBJECT 020 — AIRCRAFT GENERAL KNOWLEDGE		
SUBJECT 021 — Airframe and systems, electrics, power plant and emergency equipment:		
021 01 05 01 - Maintenance methods: hard time and on condition	7 & 8	The proposed provision lacks the knowledge of fix intervals and contents of maintenance checks (A,B,C,D,IL,R- Check)
021 02 05 00 - Helicopter: Flight controls structural aspects	15	Keep the LO's (02) and (03) which are removed because "No practical use". In fact, the type of rotors designs are very important to understand the use and capabilities of each helicopter. Not totally addressed in 021 15 02 01 (01)
021 04 01 02 (01), (02) and (03)	24 and 25	Identify clearly that are different LO's for aeroplanes and helicopters. In the caso of LO (3) is also applicable to helicopters.
021 04 01 02 (07) - System components, design, operation, indications and warnings, on ground/in-light protections, emergency extension systems	26	This LO is also applicable to helicopters
021 04 02 00 (04) - Nose-wheel steering	27	This LO is also applicable to helicopters
021 04 02 00 (05) - Nose-wheel steering	27	The term and consequences of "shimmy" do not apply to helicopters so this LO should be removed
021 04 04 01 - Wheels, rims and tyres; Types, structural components and materials, operational limitations, thermal plugs	30	Add Learning Objective: Identify cuts and damages (outside check) and know the limits. Describe how damages arise (e.g. flat spots)
021 04 05 00 (01) - Helicopter equipment	31	Add: And its limitations
021 05 04 06 Aeroplane: fly-by-wire (FBW) control systems	39	Add to the Learning Objective 021 05 04 06 the following: Describe solutions or actions to regain control.
021 07 01 00 ANTI-ICING AND DE-ICING SYSTEMS Types, design, operation, indications and warnings,	46	Add Learning Objective: Know the certification requirements for de- and anti-icing components and state that real life condition can be much

operational limitations		worse.
021 12 01 01 (01) and (02) - Smoke detection	110	This LO is also applicable to helicopters
021 16 03 00 (01) - Auxiliary systems hoist	118	Remove LO's. Justification: modern hoist/which systems are not longer driven by the aux gearbox. Are normally electrically driven.
SUBJECT 022 — INSTRUMENTATION		General remark: Good update of the Learning Objectives in the field of instrumentation, removing irrelevant topics and adding useful new ones. In particular addition of FMA's, fly-by-wire, general improved automation knowledge and unreliable airspeed are excellent. At the same time, what is still missing is the implementation of HUD displays on more next-gen aircraft as the B787/737Max/A350/etc.
022 01 01 00 (04) - Pressure gauge	127	Maintain both LO's. We consider important to understand the operating principles of sensors and therefore the understanding of the measurement and instrument errors
022 01 02 00 (04) and (05) - Temperatur sensing	129	Maintain both LO's. We consider important to understand the operating principles of sensors and therefore the understanding of the measurement and instrument errors
022 01 09 02 operating principle of a vibration-monitoring system	136	No practical use for this LO: <i>Describe the operating principle of a vibration-monitoring system using the following two types of sensors: — piezoelectric crystal, — magnet.</i>
022 02 03 05 Angle-of-attack (AoA) measurement	141	It is unclear what is desired from the student with the wording: <i>Give examples of different types of AoA displays.</i>
022 02 04 07 Altimeter	142	To the existing text " <i>Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale</i> " add Digital (in HUD displays)
022 02 06 00 Airspeed indicator	145	022 02 06 00 (2): Undo rewording and include Groundspeed as well in the list of speeds. 022 02 06 00 (5): Include the HUD Display. 022 02 06 00 (7): Include the lower amber band.
022 02 06 00 (07) - Airspeed indicator	146	Include this LO's for helicopters but with "as appropriate to aeroplanes or helicopters". ASI in helicopters also has colour codes but with different meaning. IE barber's pole is used for VNE in autorotation.
022 02 06 00 (09) - Airspeed indicator	146	Introduce a new bullet for unreliable speed: "Aircraft attitude". This is important when a very low speed (<30 KIAS) or hover in helicopters
022 02 07 00 - Machmeter	147	Machmeter and LSS are of no use for helicopters,

	148	but if the LO is included for IR courses it will affect also to helicopters IR modular courses which is of no sense.
022 02 08 00 Air Data Computer / Air Data Reference System	148	Do not remove Learning Objective 022 02 08 00 (10). Students should be able to tell the difference between raw data and an ADC/ADRS system, and the advantage of having ADC's/ADRS
022 02 08 00 (02)(03)- Air Data Computer / Air Data Reference System	149	Bullets like AoA and "Flaps" should include a phrase like : "as appropriate for airplanes or helicopters". Flaps bullet and landing gear positions should be separated.
022 06 00 07 Aeroplane Automatic Flight Control Systems	167	Explain how a state of self-induced oscillations may be detected, describe the effects of self-induced oscillations and technique to stop the oscillations and maintain positive control of the aircraft.
022 06 02 00 Autopilot system: design and operation	169	In connection to the LO 022 06 02 00 (13): <i>Describe the purpose of the synchronization function when engaging the autopilot and explain why the autopilot should be engaged when the aircraft is in trim</i> - insert a new LO: Explain why using trim with the autopilot engaged is not allowed, and possible consequences, e.g. A/P Disconnect /aircraft out of trim. Also, Add Learning Objective: Describe FPA (Flight Path Angle). FPA-Mode is missing in the enumeration.
022 06 03 00 Flight director: design and operation	178	Comment on LO 022 06 03 00 (5): If the FD is showing unwanted commands, it should be switched off. Add new LO 022 06 03 00 (9): Explain the importance of checking the FMC data and/or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed thus turned off.
022 08 00 00 - Trims - Yaw damper - FEP	191	Many helicopters use already such systems, including FEP, FBW, etc. So the introduction of this LO for helicopters will be a matter of time. A question remains, whether it should be added at this stage.
022 09 00 00 AUTOTHURST – AUTOMATIC THRUST CONTROL SYSTEM	196	In LO 022 09 00 00 (5) amend the wording: <i>Explain how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed.</i> Also, add in addition: <i>indications/trend vectors are correct, but the</i>

		reaction should not be too aggressive.
022 09 00 00 (06):	196	Amend the wording LO 022 09 00 00 (06): Explain the threats associated with the use of autothrust resulting in the pilot losing the sense of energy (e.g. thrust, speed) awareness.
022 10 00 00 - Communications systems	197	This LO should be included also for helicopters. Besides ACARS, ATSU or FANS - helicopters use the same systems.
022 12 10 00 ACAS/TCAS principles and operations	221 & 222	In LO 022 12 10 00 (19): add bullet point: - bellow 1100 feet above ground no descent RA can be generated In LO 022 12 10 00 (21) take into consideration that the green area not displayed in most aircraft. (at least not on Boeing aircraft)
022 13 03 01 Electronic Flight Instrument Systems (EFIS), design & operation	225	Do not delete LO 022 13 03 00 (3) ; also see LO 022 13 03 00 (6). General knowledge about the function of a Symbol Generator is required
022 13 03 02 Primary Flight Display (PFD), Electronic Attitude Direction Indicator (EADI)	226	Remark on the LO 022 13 03 02 (8) - not common on most PFD displays, usually shown on ND.
022 13 04 00 Engine parameters, crew warnings, aircraft systems, procedure and mission display systems	236	Remark on the LO 022 13 04 00 (1) Electronic checklist (display unit) not common on all airplanes, e.g. 737 does not have such a system. Rephrase so it doesn't appear that any crew alerting system is connected with electronic checklists. Not all aircraft have system displays with system diagrams/schematics. Rephrase to "An aircraft display unit"
022 14 01 00 - CVR	240	This LO is also applicable to helicopters
022 15 01 00 Digital circuits and computers: general, definitions and design	247	Remark on 022 15 01 00 (5) - clarify the wording (unclear what knowledge is expected from the student): <i>Define and explain the terms 'multitasking' and 'multiprocessing'.</i>
022 15 01 00 (08)	247	No practical use for this LO.
Missing topics in Subject 022:	X	Head Up Display (HUD) LO 1: State the components used in a HUD system. LO 2: Explain the possible advantage of having a HUD. LO 3: Name the data shown on a typical HUD (Altitude/Heading/Speed/Trends/Flight Path Vector (FPV)/TCAS Advisory/FMA. LO 4: Name the data NOT shown on a typical HUD (Wx information/Navigation information/TCAS map display.

	<p>LO 5: Explain the principle of the FPV</p> <p style="text-align: right;">LO 6: State display modes on a HUD. (Full display/decluttered)</p> <p>Synthetic Vision System (SVS)/Enhanced Vision Systems (EVS)</p> <p>LO 1: Explain the working principle of a SVS/EVS system.</p> <p>LO 2: Explain the possible advantage of having a SVS/EVS.</p>
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response

Thank you for your extensive feedback, which has been greatly appreciated.

EASA has carefully assessed all the comments received.

Each comment has been dealt with on a one-by-one basis. Comments on LOs as indicated by LO number.

Regarding your comment referring to Subject 021 01 05 01: Not accepted.

Pilots are not responsible for the maintenance programme nor the content of any of the checks. Suggestion too detailed.

Regarding your comment referring to Subject 021 02 05 00: Not accepted.

These LOs are duplicates of the LOs describing main and tail rotors in detail separately.

Regarding your comment referring to LOs 021 04 01 02 (01), (02) and (03): Accepted.

EASA agrees that this LO (03) also is applicable for helicopters and will add an 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.

In comment 11-B, the same issue was raised regarding this LO (03).

Regarding your comment referring to LO 021 04 01 02 (07): Accepted.

EASA agrees that this LO (07) also is applicable for helicopters and will add an 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.

In comment 12-B, the same issue was raised regarding this LO (07).

Regarding your comment referring to LO 021 04 02 00 (04): Accepted.

EASA agrees that this LO (04) also is applicable for helicopters and will add an 'X' in the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.

Regarding your comment referring to LO 021 04 02 00 (05): Accepted.

EASA agrees that this LO (05) is not applicable for helicopters and will delete the 'X' from the column Helicopter under 'ATPL/IR', 'ATPL' and 'CPL'.

Regarding your comment referring to Subject 021 04 04 01: Partially accepted.

EASA agrees to insert a new LO regarding tyre damage not describing or knowing limits as it is consider to be too specific. This new LO will replace the deleted LO (06).

The following new LO will be inserted:

(06) Describe the following tyre checks a pilot will perform during the pre-flight inspection and identify probable causes:

- cuts and damages;
- flat spots.

Regarding your comment referring to LO 021 04 05 00 (01): Accepted.

EASA agrees to add the wording ‘and its limitations’ to this LO.

The text will be amended as follows:

Explain flotation devices, ~~and~~ how they are operated ~~and their limitations~~. Regarding your comment referring to LO 021 05 04 06: Accepted.

EASA agrees to insert a new LO (08) to include disabling system to force a downgrade.

The following new LO will be inserted:

Describe solutions or actions to regain control.

Regarding your comment referring to LO 021 07 01 00: Not accepted.

This belongs in 071 ‘Operational procedures’.

Regarding your comment referring to LO 021 12 01 01 (01) and (02): Accepted.

EASA agrees that this LO also is applicable for helicopters and will retain the ‘X’ in the column Helicopter under ‘ATPL/IR’, ‘ATPL’ and ‘CPL’.

In comment 21-B, the same issue was raised regarding this LO.

Regarding your comment referring to LO 021 16 03 00 (01): Accepted.

EASA agrees to delete this LO (01): ‘modern hoist/which systems’ are no longer driven by the auxiliary gearbox, are normally electrically driven.

NOTE: All comments on 022 are addressed in the relevant 022 CRD file.

comment 287-B comment by: *Luftfahrt-Bundesamt*

The LBA has no comments on NPA 2016-03 (B).

response Noted.

Thank you for providing this comment.

comment 288-B comment by: *European Cockpit Association*

- Overall, ECA acknowledges there has been reorganization of the way some Learning Objectives (LOs) are presented. The splits / moves are visible, and it seems to add clarity and make logical sense.

- At the same time, the review shows a **misunderstanding of the concept of Competency-based-training (CBT)**, and therefore puts an almost exclusive focus on checking/assessment provision, **with very few**, if not no, provision on area 100 KSA **training**. In particular, no provision is proposed to develop the trainee's relevant *Core Competencies* through the relevant de-briefings.
- Moreover, as CBT is to be the new standard for training and licensing purposes, it is essential that there is a **common and coordinated logic sustaining the relevant EASA Rulemaking activities** to avoid duplication, overlaps, and conflicting provisions. In that respect, there should be only one basis for the definition and implementation of Competencies Frameworks throughout the whole Part FCL, and potentially all Aviation Personnel Licensing and Training provisions.
- Furthermore, with the introduction of CBT, Learning Objectives should emphasize - with regard to e.g. operational procedures - on the importance of the policy update of certain documents and procedures. New students should be able to keep up with the continuous development of new documents or updates of old ones. Therefore, it is not only necessary to know certain information (e.g. which documents to keep on board) but also to know the sources of amendments and future developments. Especially concerning long-range operations, pilots are usually further down the career path and the time of flight school is much in the past.
- We agree with the need to establish the **minimum amount/percentage of classroom instruction**. However, it is not clear how we can define *the minimum* percentage of classroom instruction. This issue is of particular importance as the classroom instruction, in general, is necessary to check the competencies of the student.
- We further fear that the lack of **consistency between the Competencies developed by an ATO and an airline** will create not only extra cost, but also a potential mismatch between the pilot profile required by the airline and the one provided by the ATO. This may cause some pilots being hired and subsequently dismissed by the airline due to their competency level being inappropriate. This will create not only an extra financial burden, but also a significant social cost for pilots-to-be.
- We **welcome the improvements in certain fields**, e.g. **subject Instrumentation (022)** where we see a good update of the learning objectives, removing irrelevant topics and adding useful new ones. In particular addition of FMA's, Fly by Wire, general **improved automation knowledge** and unreliable airspeed are a positive change. At the same time, we are missing knowledge requirements on the implementation of HUD displays on more next-gen aircraft as the B787/737Max/A350/etc.
- The introduction of **Threat and Error Management (TEM) is welcomed**. It does add a physical/operational dimension to a subject that some find not very practical. If performed properly it helps the student to think in terms of *understanding => recognition => prevention/recovery*, as per UPRT.
- We further **welcome the introduction of the Fatigue and stress management chapter**. However, ECA is surprised not to find a new Learning Objective demanding explanation of the **components of FRMS**, given the emphasis put on this subject in the foreword. The student should be able to describe FRMS and explain the main components of it.

- Similar refers to the **Peer Support Programs (PSP)**. It is for the benefit of both ATPL and CPL holder to know of the existence of PSP programs and their importance for the safety-culture of an operator.
- Finally, there seems to be a global search for clarification of theoretical notions, which can only be welcomed if it is in addition to the explanation of the notion itself (and not just vulgarization with less resulting knowledge / understanding).

response Noted.

Thank you for providing this comment.

comment 312-B

comment by: *Rogério Pinheiro*

Dear Sirs,

APTTA – Associação Portuguesa de Transporte e Trabalho Aéreo is pleased to submit its comments regarding NPA 2016-03 (B).

1) 021 09 01 07 - Circuit breakers

- Explain a short circuit in practical terms using Ohm’s Law, power and energy expressions highlighting the risk of fire due to power transfer and extreme energy dissipation;
- Explain the risk of fire resulting from excessive heat in a circuit subject to overcurrent;
- Refer that overcurrent situations may be transient;
- Explain the hazards of multiple resets of a Circuit Breaker or the use of incorrect fuse rating when replacing blown fuses,

2) 021 09 01 08 - Semiconductors and logic circuits

- Refer the use of a digital Flip-Flop to memorize a transient situation like reaching an altitude or to sequence events that ultimately result in an important action like the deployment of Ground Spoilers only after a specific criteria is meet (conditions and sequence);
- Refer that simple Flip-Flops may be created using NAND and NOR gates.

Kind regards,
 APTTA

response Thank you for your multiple comments.

Regarding your comment referring to LO 021 09 01 07: Accepted.

EASA agrees to introduce new LOs to include the essence of the points.

The following four new LOs will be inserted:

Explain a short circuit in practical terms using Ohm’s Law, power and energy expressions highlighting the risk of fire due to power transfer and extreme energy dissipation.

Explain the risk of fire resulting from excessive heat in a circuit subject to overcurrent.

Refer that overcurrent situations may be transient.

Explain the hazards of multiple resets of a circuit breaker or the use of incorrect fuse rating when replacing blown fuses.

Regarding your comment referring to LO 021 09 01 08: Not accepted.

EASA is of the opinion that pilots are not designing logic circuits and knowledge of how to make flip-flop logics is not required.

Notice of Proposed Amendment 2016-03(B) — General and specific comments. NOTE: Due to technical issues, the FlashPaper version of this sub-NPA does not contain segments for each Subject. Therefore, when placing comments on this sub-NPA, you are kindly requested to indicate clearly the Subject, topic, subtopic, paragraph and LO number you are commenting on. Example: ‘Comment on 021 08 02 02 (01)’. p. 1

comment *1-B* comment by: René Vreeken

With respect to section 21-09 (Electrics), the following remarks:

page 54:
 021-09-01-04 contains a section about capacitors which is deleted due to the fact it has "no practical use".
 In my experience this deletion is justified.
 When deleting 021-09-01-04 I feel that the capacitor section in 021-09-01-02 (10) should be considered as "no practical use" and should be deleted as well.

page 57:
 The topics about semiconductors (transistors, diodes) have been considered as "no practical use" which I feel is justified.
 Therefore, it is strange that in 021-09-01-08 (01) a topic about temperature effect on semiconductors is introduced.
 My suggestion would be to delete all items referring to semiconductors and to cover only the section about logical circuits.

page 67:
 The explanation about real and reactive loads has been reworded to another subject in 021-09-04-03 (05).
 When real and reactive loads doesn't need to be explained, it is strange that in the next topic 021-09-04-03 (06) compensation of real and reactive loads must be explained.
 I feel that real and reactive loads can be deleted from the learning objectives. This is also supported by the deletion of electromagnetic induction throughout several parts of the learning objectives.
 When electromagnetic induction doesn't need to be explained, it doesn't make sense to talk about reactive loads, which have a link with induction.

response Thank you for your multiple comments.

Regarding your comment referring to LO 021 09 01 02 (10): Accepted.
 EASA agrees that this LO is not relevant and will be deleted.
 The text will be deleted as follows:
~~(10) Explain the term ‘capacitance’, and explain the use of a capacitor as a storage device.~~

Regarding your comment referring to LO 021 09 08 01 (01): Not accepted.
 EASA does not agree to delete all items referring to semiconductors. These items will remain as is in order to highlight the importance of the avionics cooling system and possible implications of switching it off.

Regarding your comment referring to LO 021 09 04 03 (06): Accepted.

EASA agrees that this LO is not relevant and will be deleted.

comment 5-B

comment by: Lufthansa Flight Training

PISTON ENGINES

021 10 01 00

021 10 01 01 Types of internal-combustion engines: basic principles, definitions

(01) Define the following terms and expressions:

- RPM;
- torque;
- mManifold aAbsolute pPressure (MAP);
- power output;
- ~~specific fuel consumption~~; no practical use
- ~~mechanical efficiency, thermal efficiency, volumetric efficiency~~; ; no practical use
- compression ratio, clearance volume, swept (displaced) volume, total volume.

021 10 01 02 Engine: design, operation, components and materials no practical use

(03) Name and identify the various types of engine design with regard to cylinder arrangement and their advantages/disadvantages, such as:

- horizontal opposed,
- in line,
- radial,
- ~~and working cycle (four stroke: petrol and diesel)~~ no practical use

(06) Describe the differences between petrol engines and diesel engines with respect to:

- means of ignition;
- maximum compression ratio;
- regulating air or mixture supply to the cylinder;
- ~~specific power output (kW/kg)~~; no practical use
- ~~thermal efficiency~~; no practical use
- pollution from the exhaust.

021 10 07 01 Design, operation

(01) Describe the working principle of a magneto-ignition system and the functions of the following components:

- magneto,
- ~~contact breaker points~~; no practical use
- ~~capacitor (condenser)~~; no practical use
- ~~coils or windings~~; no practical use
- ignition switches,
- ~~distributor~~; no practical use
- spark plug,
- ~~high tension (HT) cable~~ no practical use

021 10 10 00 Performance and engine handling

(05) Describe the function and the principle of operation of the following main components of a turbocharger:

- turbine,

- compressor,
- waste gate,
- waste-gate actuator,
- ~~absolute pressure controller~~, the description of the function of the different controllers is not of practical use
- ~~density controller~~,
- ~~differential pressure controller~~.

Turbine engine

021 11 02 02 Compressor and diffuser

(05) Describe the gas-parameter changes in a compressor stage. no practical use

(20) Describe a compressor map (surge envelope) with RPM lines, stall limit, steady state line and acceleration line no practical use

021 11 03 05 Engine ignition

(02) Name the following main components of the ignition system and state their function.:

- ~~trembler mechanism (vibrator)~~, no practical use
- ~~transformer~~, no practical use
- ~~diodes~~, no practical use
- ~~capacitors~~, no practical use
- ~~discharge gap (high tension tube)~~, no practical use
- igniters.
- power sources

response Thank you for your multiple comments.

EASA has carefully assessed all the comments received.

Regarding your comment referring to LO 021 10 01 01 (01): Partially accepted.

EASA agrees that the items 'mechanical efficiency, thermal efficiency, volumetric efficiency' are not relevant and will be deleted. Specific fuel consumption (SFC) will be retained.

The text will be amended as follows:

Define the following terms and expressions:

- rpm;
- torque;
- ~~m~~Manifold ~~a~~Absolute ~~p~~Pressure (MAP);
- power output;
- specific fuel consumption;
- ~~mechanical efficiency, thermal efficiency, volumetric efficiency~~;
- compression ratio, clearance volume, swept (displaced) volume, total volume.

Regarding your comment referring to Subject 021 10 01 02 (heading): Accepted.

EASA agrees that the wording 'and materials' is not relevant and will be deleted.

The text will be amended as follows:

021 10 01 02 Engine: design, operation, components ~~and materials~~

Regarding your comment referring to LO 021 10 01 02 (03): Not accepted.

EASA does not agree to delete the wording 'and working cycle (four stroke: petrol and diesel).' Working cycle is the basic working principle of a piston engine.

Regarding your comment referring to LO 021 10 01 02 (06): Accepted.

EASA agrees that the items 'specific power output (kW/kg)' and 'thermal efficiency' are not relevant and will be deleted.

The text will be amended as follows:

Describe the differences between petrol engines and diesel engines with respect to:

- means of ignition;
- maximum compression ratio;
- ~~regulating~~ air or mixture supply to the cylinder;
- ~~specific power output (kW/kg);~~
- ~~thermal efficiency;~~
- pollution from the exhaust.

Regarding your comment referring to LO 021 10 07 01 (01): Not accepted.

EASA does not agree to delete all the items proposed. If it is a requirement to check the magneto, an understanding of its operation is needed.

Regarding your comment referring to LO 021 10 10 01 (05): Accepted.

EASA agrees with your proposal to delete the last 3 items because they are not relevant.

The text will be amended as follows:

Describe the function and the principle of operation of the following main components of a turbocharger:

- turbine₇₇;
- compressor₇₇;
- waste gate₇₇;
- waste-gate actuator.
- ~~absolute pressure controller;~~
- ~~density controller;~~
- ~~differential pressure controller.~~

Regarding your comment referring to LOs 021 11 02 02 (05) and (20): Not accepted.

EASA does not agree to delete LOs (05) and (20) because they are relevant. Knowledge is required for understanding the operation of a turbine engine.

Regarding your comment referring to LO 021 11 03 05 (02): Accepted.

EASA agrees with your proposal to delete the proposed 5 items because they are not relevant.

The text will be amended as follows:

Name the following main components of the ignition system and state their function:

- power sources,
- trembler mechanism (vibrator),
- transformer,
- diodes,
- capacitors,
- discharge gap (high-tension (HT) tube),
- igniters.

comment 44-B
test

comment by: French DGAC

response Noted.

comment 53-B

comment by: KLM Flight Academy

In general the following remarks can be made:

Subject 021

In the year 2012 the name of the subject 021 has been changed in: 'Airframe and Systems, Electrics and Powerplant'. 'Emergency equipment' has since then been moved to subject 070 'Operational Procedures'. There are no emergency equipment LO's in this subject anymore.

Below is just a summary of all my remarks on the NPA for subject 020. I put many more, detailed remarks in the applicable pdf document. On request I can make this document available to the applicable EASA working group.

Deleted LO's

In many LO's that have a summary, only the first line is crossed-out. It is not clear if the remainder of the LO's remain still valid, see for example 021 02 01 00 01.

Why is 'fuel transfer' deleted?

Which components should be known from a piston engine?

Why is knowledge about pressure and temperature sensors deleted? Not even basic knowledge. I think pilots should have a basic understanding about sensor systems. A pilot must, for instance, know that a thermocouple is for (high) temperature sensing. A pilot must have heard of a (pressure) capsule. Is the sensor mechanical or electronical/digital? Where is the sensor located? Fuel gauges and angular speed sensors are still in the LO's.

Does not seem consistent.

I am not happy with the deletion of so many computer LO's (022 15). Please add at least some basic info. Pilots rely on computers everywhere. They should know more on their behaviour. I am willing to write a text proposal.

Etc.

LO's not clear

From too many (new) LO's, I don't understand what is meant with the objective. Example: "Explain the development of a faulty attachment" (21 02 01 00 04).

One more example: It is not clear what should be learned about 'humidity control'. There are aircraft that have humidifiers but there are also aircraft that have de-humidifiers.

In LO's of other subjects (062 Radio navigation for instance) the LO's state exactly what a candidate must know. In the 020 LO's it is not always clear what is expected. An exception is 021 02 04 00 07. Between brackets is exactly stated what is meant. I strongly propose do this everywhere.

What is meant with the 'aircraft positions error' at the altimeter LO? (022 02 04 00 09).

What is meant with 'GPWS modes of operation' (022 12 09)?

Very confusing and lengthy LO's on ACAS and TCAS (022 12 10). Terms are mixed up, LO's are repeated and too much detail when comparing with other alerting system LO's.

There has always been a difference between the EFIS EADI and PFD. Now it seems both displays are considered the same (022 13).

Etc.

Consistency

It would be nice if the LO's are consistent in wording. Example: 'operating principle' instead of 'working principle' or 'principle'.

Consistency is also required when working with knowledge levels to a certain detail. The construction of a wing and the construction of a fuselage should require the same amount of detail. This remark applies for both aeroplanes and helicopters.

Etc.

Mistakes

It is extremely important there are no mistakes in LO's. Students, text book writers, question writers and question evaluators rely on these LO's. Unfortunately the content of LO's is not always correct. As an example: carbon, glass and Kevlar etc. are not composite materials but are part of a composite material (021 02 02 00 02).

Another example is dynamic pressure; dynamic pressure is not measured (022 02 01 01 01) but calculated.

TAT is no input to an ADC.

I am not happy with the new LO on the FWS (022 12 02). Don't agree with the explanation of the MWL and the MCL for instance.

Etc.

Applicability

Many LO's can also be made available to Helicopters. Sometimes LO's for aeroplanes and helicopters can be combined with a small adaption in text.

It is also difficult to find out if an LO is for small aircraft and/or for large aircraft. Example is the LO on flight controls.

Etc.

Terms

Sometimes the same component has different names. Maybe it is worth to spell-out all these names as a candidate might have heard about a 'ground-flight switch', but never of a 'squat switch' which is exactly the same.

Etc.

Missing

Sometimes important 'items' are missing. Example: the ground flight switches (weight-on/off-wheel switches or squat switches) are not mentioned in the LO's.

I miss important (basic) knowledge about permanent magnets and electromagnets. Such info is important when dealing with generators and compasses.

I think a pilot should know a CSD or an IDG has its own oil system. When oil is found underneath an engine an airline pilot must know there are several oil/fluid systems connected onto the engine. Therefore it is also important the pilot can distinguish between engine oil and hydraulic fluid.

I think a pilot might know electrical fuses can be replaced by the pilot.

When reading the gyroscopic instruments LO's, it seems a pilot no longer has to know which instrument uses a gyroscope. That is strange. I strongly recommend: "Mention the operating principle of a turn and balance indicator, an attitude indicator, and a directional gyro". I also think the pilot must know which of these instruments use 'rigidity' and which one uses 'precession' (without going too much in detail). Furthermore I miss the 'error behaviour' of a gyroscopic instrument (error behaviour is discussed for the air data instruments).

Strongly recommend to keep the LO's on inner and outer loop systems in autoflight (022 06). This perfectly explains the new LO on oscillations.

Etc.

Combined LO's

Many LO's can be combined into one LO with a minor adaption in text.

Double LO's

There are still many 'double' LO's.

The term 'instrument error' is a general term which is applicable to each instrument. Take out the 'instrument error' in the separate instrument LO's (ASI, ALT, VSI etc.) and make a 'general' LO on instrument error.

Consider to do the same for the term 'position error'. It is difficult to describe the position error for each separate instrument.

Etc.

Aircraft type/manufacturer related

Sometimes I see Airbus terms that are not used in Boeings (ATSU for instance at 022 10).

On the other hand do we have to implement Airbus' 'alpha-floor protection' and Boeing's 'thrust latch' or are these term too type specific and possibly outdated already?

Etc.

Typo's & spelling errors

Still a number of typo's and spelling errors need to be corrected.

Moved LO

It is not wise to move the 022 05 Inertial navigation LO's to subject 061 General Navigation. Like magnetic compasses, AHRS, FMS and EFIS, all technical systems that are used in navigation are explained in subject 022 Instrumentation. Within this subject the architecture of these systems and their interrelationship and subsequent possible error behaviour are described. When taking out one system, the relative context (cohesion) is gone. On the other hand it would be wise to leave the operational use of the navigation systems in the subjects 061 General Navigation and 062 Radio navigation. Therefore I think some LO's for FMS (022 11) can stay in or move (back) to subject 061/062).

It is good that the CPDLC messages move to subject 091 Communications. Also recommend to move the LO on the 'log-on phase' (022 10 02 07) to subject 091.

Summarising

It is clear that a lot of good work has been done already. But the job is not finished. This NPA is not ready for publication. It still looks like a working document and we are in the middle of the process of converting the 'old' LO's into a new competency based document.

response Thank you for your multiple comments on Subjects 021 and 022.

EASA has carefully assessed all the comments received.

Due to the layout of this comment (53-B), each paragraph is addressed individually with its own individual paragraphs in the list in this section.

All the comments from both Subject 021 and 022 are addressed here.

Regarding your comment referring to the heading of Subject 021 00 00 00: Accepted.

EASA agrees that 'Emergency equipment' is not relevant and will be removed from the header (021 00 00 00).

The text will be amended as follows:

020 00 00 00 AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME, SYSTEMS, ELECTRICS, AND POWER PLANT, ~~EMERGENCY EQUIPMENT~~

Regarding your comment referring to the deleted LOs in Subject 020 00 00 00: Noted.

The LOs that have been crossed out in the LO column are deleted and should have had all text crossed out. This appears to be an editorial error. The technical detail and construction of systems is of little or no practical use to a line pilot as a pilot is a user and has no authorisation to construct nor repair. If any construction or repair is to be conducted, the pilot has to be properly trained for this task.

Regarding your comment referring to the deletion of many computer LOs in 022 15: Noted.

The pilot is a user and not a designer. Computer design beyond the very basic has no place in this Subject. The remaining LOs cover this basic level to the extent of a computer only being able to perform a task according to its instructions and quality of the data.

Regarding your comment referring to many new LOs where the objective is not clear: Noted.

EASA is of the opinion that these new LOs are clear like they are, but these LOs will be further updated in the future.

Regarding your comment referring to LO 021 02 02 00 (02): Accepted.

LO will be reworded to describe components of composite materials.

Regarding your comment referring to LO 022 02 01 01 01: Not accepted.

EASA does not agree with your example that dynamic pressured be calculated. Dynamic pressure is measured but not directly as it is a result of the difference between total and static pressure.

Regarding your comment referring to the Subject: Not accepted.

TAT is an input to an ADC (e.g. ref.: Airbus A32X series FCOM DSC-34-NAV section

describing probe location and ADIRU supplies).

Regarding your comment referring to the LOs of Subject 022 12 02: Noted.

EASA may review these LOs when the LOs are further updated in the future.

Regarding your comment referring to the fact that many LOs can also be made available for helicopters: Noted.

EASA agrees that this should be considered as the LOs are further updated in the future.

Regarding your comment referring to the fact that the same component has different names: Noted.

EASA agrees that this should be considered as the LOs are further updated in the future. This is an issue with the fact that a lot of commonly used terms have developed from jargon rather than the appropriate name.

Regarding your comment referring to the fact that some important 'items' are missing: Noted.

The main objective of this update to the LOs is to shift focus from the outdated thinking of focusing on in-depth knowledge of random facts rather than using and understanding the systems as a whole. Flying is predominantly a practical skill and not a detailed theoretical exercise. Secondly, a commercial pilot is not an engineer and cannot legally perform any maintenance action without an approved training course provided through an approved training organisation.

Regarding your comment referring to the LOs of Subject 022 06: Not accepted.

EASA does not agree with your argumentation. Inner versus outer loop is of no practical use to a pilot and the oscillations are due to the fact that the system overcompensates to correct an error and not whether inner loop provides control and outer loop provides guidance.

Regarding your comment referring to the fact that many LOs can be combined into one LO with a minor adaption in text: Noted.

EASA agrees that this should be considered as the LOs are further updated in the future.

Regarding your comment referring to the fact that there are still many 'double' LOs: Noted.

EASA agrees that this should be considered as the LOs are further updated in the future.

Regarding your comment referring to the neutral terminology and system functions: Noted.

Effort has been made to make the LOs as neutral as possible when it comes to terminology and system functions.

Regarding your comment referring to the fact that there are still many typos and spelling errors in the text: Noted.

Maximum effort has been made to correct them.

Regarding your comment referring to the move of Subject 022 05 'Inertial navigation' LOs to Subject 061 'General Aviation': Noted.

Please refer to CRD to NPA 2016-03 for Subject 022.

Regarding your summarising comment: Noted.

The document should be published as is although it being a radical change, the integrity of the course will be improved significantly.

comment 54-B comment by: KLM Flight Academy

General remark for all subjects:
 General remark:
 When writing out abbreviations, propose to write out abbreviations starting with capitals.
 For instance: Cockpit Voice Recorder (CVR).

response Noted.

Thank you for providing this general comment referring to abbreviations being written with initial capitals.

EASA would like to state though that according to the basic interinstitutional style guide rule, proper nouns have an initial capital but common nouns do not.

Furthermore, the existence of an acronym or initialism or abbreviation does not mean that initial capitals must be used when the corresponding expression is written out in full, e.g. 'cockpit voice recorder' (CVR), 'commercial air transport' (CAT), but 'European Central Question Bank' (ECQB) (*as this is the official name of the bank*).

comment 55-B comment by: KLM Flight Academy

021 01 01 01 02 Combine this LO with 021 01 01 02 03: "Explain some systems are duplicated or triplicated to enhance the redundancy".
 "Explain the purpose of redundancy in aircraft design."

response Not accepted.

Thank you for providing this comment referring to LO 021 01 01 01 (02).

EASA will not combine LO 021 01 01 01 (02) with LO 021 01 01 01 (30).

LO 021 01 01 01 describes the concept of redundancy while 021 01 01 02 (03) describes the multiplication of systems as required by a certification process.

EASA may consider this as the LOs are further updated in the future.

comment 56-B comment by: KLM Flight Academy

021 01 01 02 03
 Implement and reword in 021 01 01 01: "Explain purpose of redundancy in aircraft design."
 Should be CPLH as well because the term redundancy is also CPLH.

response Thank you for your multiple comments.

Regarding your comment referring to LO 021 01 01 01: Not accepted.

EASA does not see the need to reword this LO.

Regarding your comment referring to LO 021 01 01 02 (03): Accepted.

EASA agrees that this is an omission and this LO is also applicable for helicopters CPL and will add the 'X' in the column Helicopter 'CPL'.

comment 57-B comment by: KLM Flight Academy

021 01 01 02 02 Combine this LO with 021 01 01 02 04 in a weak level "state..."

response Not accepted.

Thank you for providing this comment referring to LO 021 01 01 02 (02).

EASA has deleted this LO in the NPA text and will not retain this LO and will not combine it with (04).

comment 58-B comment by: KLM Flight Academy

021 01 01 02 04 (new)

Rewrite + inclusion of #02:

Explain that all aircraft are certified according to certification specifications determined by the authority, and that these specifications cover aspects such as design, material quality, build quality and failure probability related to failure effects.

response Not accepted.

Thank you for providing this comment referring to LO 021 01 01 02 04 (new).

EASA does not agree to rewrite this LO. The factors already specified cover the reason as to why these aspects are defined (e.g. the effect of a failure).

comment 59-B comment by: KLM Flight Academy

021 01 01 02 05 Why not like rotorcraft: "Small Aeroplanes"? The Fokker 50 is a commuter aircraft in excess over 5700 kg which is CS-25.

response Noted.

Thank you for providing this comment referring to LO 021 01 01 02 (05).

EASA would like to state that the wording 'CS-25 Large Aeroplanes' is the name of the certification specifications document and that is just the way it is.

comment 60-B comment by: KLM Flight Academy

021 01 02 00 04 It seems this is an LO because it has a number. But it is written in Italic. Maybe make this 'explanation' of stress and strain a BK subject?

response Noted.

Thank you for providing this comment referring to LO 021 01 02 00 (04).

EASA likes to point out that for editorial reasons it has been given an LO reference. It is a remark to that LO section and therefore not applicable to any licence.

comment 61-B comment by: KLM Flight Academy

021 01 03 00 04 Just like with fatigue also: "Describe (define?) corrosion, its effects and how it can be etc."

response Not accepted.

Thank you for providing this comment referring to LO 021 01 03 00 (04).

EASA is of the opinion that the text of this LO is correct.

Fatigue may be directly influenced by the way the pilot operates the aircraft whereas corrosion is more an effect of the surrounding environment, thus largely beyond the control of the pilot. The chemical reason for corrosion is not of any practical use to a pilot.

comment	<p>62-B comment by: KLM Flight Academy 021 01 03 00 05 Don't understand second part of the LO. What can the pilot do to minimise the effects?</p>
response	<p>Noted.</p> <p>Thank you for providing this comment referring to LO 021 01 03 00 (05).</p> <p>The pilot may choose not to operate at low level or reposition the aircraft in order to minimise exposure to salt water, etc. This is mainly relevant to helicopter operations.</p>
comment	<p>63-B comment by: KLM Flight Academy 021 01 03 00 06 Propose to adjust LO level to 'state'</p>
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to LO 021 01 03 00 (06).</p> <p>EASA is of the opinion that the text of this LO is correct.</p> <p>Using 'explain' improves the level of knowledge as the implications must also be considered rather than stating a fact.</p>
comment	<p>64-B comment by: KLM Flight Academy 021 01 05 01 and 021 01 05 01 01 condition monitored = condition monitoring. Add 'condition monitoring' to LO title.</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to LOs 021 01 05 01 and LO 021 01 05 01 (01).</p> <p>EASA agrees to reword the LO title and LO (01).</p> <p>The text will be amended as follows:</p> <p>021 01 05 01 Maintenance methods: hard-time and on-condition monitoring</p> <p>Explain the following terms:</p> <ul style="list-style-type: none"> — hard-time or fixed-time maintenance; — on-condition maintenance-; — condition monitoring.
comment	<p>65-B comment by: KLM Flight Academy 021 02 01 00 01 Cannot see if this LO is deleted or not? I should say a pilot must know something about the basic construction methods of the aircraft. That is at least: the difference between truss web (or girder framework) and (semi) monocoque and between braced and cantilever. Also sandwich (with (honeycomb) filler should be part of this LO.</p>
response	<p>Noted.</p> <p>Thank you for providing your comment referring to LO 021 02 01 00 (01).</p> <p>The LO is meant to be deleted and EASA will correct the deletion with strikethrough for the</p>

entire LO.

comment **66-B** comment by: *KLM Flight Academy*
 021 02 01 00 02
 'screwing' is missing from the list.
 Why added text?
 response Accepted.
 Thank you for providing your comment referring to LO 021 02 01 00 (02).
 EASA agrees to add the wording 'screwing' to the list.
 The text will be amended as follows:
 Describe the following attachment methods used for aircraft parts and components:
 — riveting;
 — welding;
 — bolting;
 — pinning;
 — adhesives (bonding);
 — **screwing.**
 Regarding your question on the added text: The added text is to specify that only attachment methods found on aircraft are relevant, otherwise the LO is much too broad.

comment **67-B** comment by: *KLM Flight Academy*
 021 02 01 00 04
 Don't understand this new LO. What is meant with the 'development of a faulty attachment'?
 response Noted.
 Thank you for providing your comment referring to LO 021 02 01 00 (04).
 Faulty attachment is an attachment that is coming loose. The LO will be reworded slightly to improve clarity. The intention of the LO is to show how this may be discovered by a pilot from a pilot's point of view.

comment **68-B** comment by: *KLM Flight Academy*
 021 02 02 00 04
 LO should be rewritten:
 Carbon, glass etc. in itself is not a composite material.
 Kevlar is a tradename, use aramid instead.
 Matrix is not a composite material.
 Fibres are made of carbon, glass or aramid.
 response Accepted.
 Thank you for providing your comment referring to LO 021 02 02 00 (04).
 EASA agrees to reword this LO.

The text will be amended as follows:

Explain the principle of a composite material, and give examples of typical non-metallic materials used on aircraft:

- carbon;
- glass;
- aramid;
- resin or filler.

comment 69-B

comment by: KLM Flight Academy

021 02 02 00 06

'resistance to fatigue/corrosion' or just 'fatigue' and 'corrosion'?

Make 'cost' a separate line.

response Accepted.

Thank you for providing your comment referring to LO 021 02 02 00 (06).

EASA agrees to reword this LO.

The text will be amended as follows:

State the advantages and disadvantages of composite materials compared with metal alloys by considering the following:

- strength-to-weight ratio;
- capability to tailor the strength to the direction of the load;
- stiffness;
- electrical conductivity (lightning);
- resistance to fatigue and corrosion;
- resistance to corrosion and cost;
- discovering damage during a pre-flight inspection.

comment 70-B

comment by: KLM Flight Academy

021 02 03 00 There are no LOs on the construction of ctl surfaces.

response Noted.

Thank you for providing your comment referring to Subject 021 02 03 00.

The topic heading does not mention construction of control surfaces. Subsequent LOs include control surface elements.

comment 71-B

comment by: KLM Flight Academy

021 02 03 01 02 (new)

Which (dis)advantages? Only construction wise or also aerodynamic/stability wise?

Prefer distinction between low-, mid- and high wing/tail. Name T-tail should be mentioned as other name for high tail.

response Not accepted.



Thank you for providing your comment referring to LO 021 02 03 01 (02) (new).
 EASA would like to state that this LO is for pilots and not engineers, thus ‘construction’ has been deleted from the heading and it is now only design. T-tail is already in the list (bottom).

comment 72-B comment by: *KLM Flight Academy*
 021 02 03 02 01
 What has been reworded?
 Some helicopters have a tailplane as well

response Noted.
 Thank you for providing your comment referring to LO 021 02 03 02 (01).
 The wording ‘reworded’ in the column ‘comments’ is a mistake. The LO has not been changed at all; it matches the text that is currently applicable in the AMCs. It’s only applicable to the ATPL(A) and CPL(A).

comment 73-B comment by: *KLM Flight Academy*
 021 02 03 03 03
 Which countermeasures? It would be nice if the LOs already give/summarise what the candidate should know. LOs of other subjects do summarise what a candidate must know. This 04 LO is partly an answer to the 03 LO.

response Accepted.
 Thank you for providing your comment referring to LO 021 02 03 03 (03).
 EASA agrees to reword LOs (03) and (04).
 The text will be amended as follows:
 Describe Explain the principle of flutter, flutter damping and resonance for the wing and control surfaces.
 Explain the following countermeasures used to achieve significance on stress relief and reduce resonance flutter of the following:
 — chord-wise and span-wise position of masses (e.g. engines, fuel, and balance masses for wing and control balance masses);
 — torsional stiffness;
 — bending flexibility;
 — fuel-balancing procedures during flight (automatic or applied by the pilot).

comment 74-B comment by: *KLM Flight Academy*
 021 02 04 00 01
 This does not only apply to the fuselage but also to the wings and the tail. Therefore it would be better to put this LO under 021 02 01 00.

response Not accepted.
 Thank you for providing your comment referring to LO 021 02 04 00 (01).
 EASA does not agree to put this LO under 021 02 01 00. This LO specifies fuselage

construction and that is more than sufficient to a pilot.

comment 75-B comment by: *KLM Flight Academy*

021 02 04 00 06 Also mention the solution? tailbumper or automatic overrotation limiter?

response Noted.

Thank you for providing your comment referring to LO 021 02 04 00 (06).

comment 76-B comment by: *KLM Flight Academy*

021 02 04 00 07

Better: outward and inward opening.

What exactly is meant with 'hinge location'? left/right side, upper/lower side or inner/outer side?

Pls make a distinction between latching and locking: doors are closed first, then latched and then possibly locked with a key.

response Not accepted.

Thank you for providing your comment referring to LO 021 02 04 00 (07).

EASA is of the opinion that the text of this LO is correct.

comment 77-B comment by: *KLM Flight Academy*

021 02 04 00 08

Pls give more info on the desired (dis)advantages: (ease of) construction wise, structure wise (pressurisation?) or just practicality?

What is meant with: 'two types' at double bubble: two radii or are there two types of double bubble?

response Not accepted.

Thank you for providing your comment referring to LO 021 02 04 00 (08).

EASA does not see the need to give more information on the desired (dis)advantages.

This LO is for pilots, hence this LO is 'BK' and therefore not examinable. The two double-bubble types are vertical and horizontal.

comment 78-B comment by: *KLM Flight Academy*

021 02 04 00 10

Only the windshields are heated for structural purposes. The side windows are (sometimes) heated for demisting/defogging only.

response Not accepted.

Thank you for providing your comment referring to LO 021 02 04 00 (10).

EASA would like to state that this LO specifically concerns the issue of bird strike.

comment 79-B comment by: *KLM Flight Academy*

021 02 04 00 11 Is this still applicable in modern aircraft?

response Noted.

Thank you for providing your comment referring to LO 021 02 04 00 (11).

EASA would like to confirm that aeroplanes are still made with a DV window.

comment **80-B** comment by: *KLM Flight Academy*

021 02 04 00 12 Deeper LO level Explain?

response Accepted.

Thank you for providing your comment referring to LO 021 02 04 00 (12).

EASA agrees to replace the wording 'State' by 'Explain'.

The text will be amended as follows:

~~State~~ Explain the need for an eye-reference position.

comment **81-B** comment by: *KLM Flight Academy*

021 02 05 01 05 Isn't this 081 Principles of Flight?

response Noted.

Thank you for providing your comment referring to LO 021 02 05 01 (05).

This LO does not belong to Subject 081 'Principles of flight (helicopter)'. There may also be mechanical reasons in addition to the aerodynamic ones.

comment **82-B** comment by: *KLM Flight Academy*

021 02 05 02 01 What is a flight surface? Or does one mean: flight control surface? Also next LO (02).

response Accepted.

Thank you for providing your comment referring to LO 021 02 05 02 (01) and (02).

EASA agrees to reword LO (02) and to delete LO (01).

The text will be amended as follows:

~~Name the main components of flight and control surfaces.~~

Describe the fatigue life and methods of checking for serviceability of flight and control surface components and materials.

comment **83-B** comment by: *KLM Flight Academy*

021 02 05 03 03

I think pilots should know that blades can be balanced. Therefore I propose: "State that helicopter blades can be balanced statically and dynamically both spanwise and chordwise.". Maybe it is good to mention what solutions are possible.

response Not accepted.

Thank you for providing your comment referring to LO 021 02 05 03 (03).

EASA is of the opinion that this LO is correct.

This LO is for pilots and not engineers. A pilot is not competent nor trained to perform balancing maintenance actions. This LO described the procedure for maintenance actions, thus not relevant.

comment **84-B** comment by: *KLM Flight Academy*



021 02 05 03 04
 It is not clear what remains from this LO after the rewording. Pilots must know what blade tracking is, especially as they are sometimes involved in the process. But indeed no technical, maintenance related details.

response Noted.

Thank you for providing your comment referring to LO 021 02 05 03 (04).

EASA would like to state that the grey-highlighted text in the NPA is the only text remaining, the list has been deleted (this is an omission in the NPA text).

comment 85-B comment by: KLM Flight Academy
 021 02 05 03 06 'Explain' or 'State'?

response Noted.

Thank you for providing your comment referring to LO 021 02 05 03 (06).

The higher level wording (explain) is more appropriate for this LO.

comment 86-B comment by: KLM Flight Academy
 021 02 05 03 07 Explain or better 'State'

response Accepted.

Thank you for providing your comment referring to LO 021 02 05 03 (07).

EASA agrees to replace the wording 'Describe' by 'State'.

The text will be amended as follows:

~~Describe~~ State the three planes of vibration measurement, i.e. vertical, lateral, fore and aft.

comment 87-B comment by: KLM Flight Academy
 021 02 06 00 02 Then the candidate should know what 'stress' is and what a '(load) cycle' is. Pls consider terms such as 'force', 'load' 'stress', 'strain' etc. to be regarded as Basic Knowledge.

response Not accepted.

Thank you for providing your comment referring to LO 021 02 06 00 (02).

Your proposed revision may be considered in future amendments to the LOs.

comment 88-B comment by: KLM Flight Academy
 021 03 02 01 01 ... hydraulic fluid with regard to:

response Accepted.

Thank you for providing your comment referring to LO 021 03 02 01 (01).

EASA agrees to reword this LO.

The text will be amended as follows:

List and explain the desirable properties of a hydraulic fluid with regard to:

[...]

comment	89-B 021 03 02 01 03 Understood but I think a pilot should know that high flying a/c have different types of hydraulic fluid than low flying a/c. Proposal: "State the type of hydraulic fluid is tailored to the operation of the aircraft"	comment by: <i>KLM Flight Academy</i>
response	Partially accepted. Thank you for providing your comment referring to 021 03 02 01 (03). EASA agrees that this LO is relevant and will be retained, but will not reword it.	
comment	90-B 021 03 02 01 05 BK?	comment by: <i>KLM Flight Academy</i>
response	Accepted. Thank you for providing your comment referring to LO 021 03 02 01 (05). EASA agrees that this LO is relevant and will be retained. This LO belongs to 'BK' and an 'X' will be added in the 'BK' column.	
comment	91-B 021 03 02 02 01 Pls standardise in 'operating principle' throughout the LOs. Also standardise in: 'operating principle' or in 'principle of operation'. What principle is meant? Transferring power by means of hydraulic fluids? Or 'force-amplification by means of pressurised fluids? or?	comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing your comment referring to LO 021 03 02 02 (01). Your proposed revision may be considered in future amendments to the LOs.	
comment	92-B 021 03 02 02 03 As far as I know a passive system is normally not pressurised (only on demand); an active system is always pressurised. I regard a hydraulic power pack for instance as a passive system. The pump is only on when there is a demand.	comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing your comment referring to LO 021 03 02 02 (03). EASA is of the opinion that this LO is correct.	
comment	93 021 03 02 02 04 Arbitrary: If you want the same force with an all-mechanical system, the system may have a large size as well.	comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing your comment referring to LO 021 03 02 02 (04). This LO is simply a comparison between the designs as 'BK'.	
comment	94-B	comment by: <i>KLM Flight Academy</i>

response	<p>021 03 02 02 05 Prefer 'consumers' instead of 'uses'. (simplified English)</p> <p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 021 03 02 02 (05).</p> <p>EASA is of the opinion that this LO is correct. The current wording (uses) implies what hydraulics are used for rather than some list of consumers.</p>
comment	<p>95-B comment by: KLM Flight Academy</p> <p>021 03 02 02 06 'or' instead of 'and'? 3000 instead of 3 000 (same for 2000).</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to LO 021 03 02 02 (06).</p> <p>EASA agrees with your proposed editorial corrections.</p> <p>The text will be amended as follows:</p> <p>State that hydraulic systems can be classified as either high pressure (typically 3000 psi or higher) and or low pressure (typically up to 2000 psi).</p> <p>Regarding the numbers, this will be corrected as well in LOs (07) and (08).</p>
comment	<p>96-B comment by: KLM Flight Academy</p> <p>021 03 02 02 07 Combine LOs 06, 07 and 08.</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO's 021 03 02 02 (06), (07) and (08).</p> <p>EASA does not agree to combine (06), (07) and (08). Your proposed revision may be considered in future amendments to the LOs.</p>
comment	<p>97-B comment by: KLM Flight Academy</p> <p>021 03 02 02 10 Okay, not too much detail indeed. But pilot must know the different types of pump, their operating principle and their possible control. A gear-type pump uses gears to displace fluid, does not regulate pressure and cannot be set to off. A (multi-)piston type pump uses pistons to displace fluid, can regulate pressure and can be set to off from the flight deck, i.e. the pump keeps running but there is no output. My personal opinion is that, as soon as there is a flight deck control (on/off switch) and/or indication that is not aircraft-type specific, the pilot must know what the consequence of this control/indication is.</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to LO 021 03 02 02 (10).</p> <p>EASA agrees that this LO is relevant and will be retained.</p> <p>In comment 267-B, a similar issue was raised regarding deletion of LO (10).</p>
comment	<p>98-B comment by: KLM Flight Academy</p> <p>021 03 02 02 11</p> <p>The listing does not summarise the 'sources of hydraulic pressure' but lists the different pump drives.</p> <p>Pls change 'engine gearbox' in 'engine accessory gearbox' as some engines have an internal</p>

gearbox as well.

response Partially accepted.

Thank you for providing your comment referring to LO 021 03 02 02 (11).

EASA agrees to amend this LO, but differently from your proposal.

The text will be amended as follows:

~~State that for an aeroplane, the power sources of a hydraulic pressure pump can be:~~

Explain the following different sources of hydraulic pressure, their typical application and potential operational limitations:

- manual;
- engine gearbox;
- electrical;
- air (pneumatic and ram-air turbine);
- hydraulic (power transfer unit) or reversible motor pumps;
- accessory.

comment 99-B comment by: KLM Flight Academy

021 03 02 02 12 The listing does not summarise the 'sources of hydraulic pressure' but lists the different pump drives.

Pls change 'engine gearbox' in 'engine accessory gearbox' as some engines have an internal gearbox as well.

response Not accepted.

Thank you for providing your comment referring to LO 021 03 02 02 (12).

EASA is of the opinion that this LO is correct. This LO is satisfactory as it stands, covering helicopter licences.

comment 100-B comment by: KLM Flight Academy

021 03 02 02 13

Would it be an idea to put the operating principle of the pump in this listing? Proposal: "hydraulic pumps (gear-type and multi-piston type)".

Knowledge about the 'case drain line' is only relevant if the pilot understands the operating principle of the hydraulic pump (see previous remark in deleted LO 10).

I think the pilot must know the consequence of a hyd res low pressure (also see LO 19). In that case there should be an LO that says: "Explain the hydraulic reservoir is normally pressurised by (bleed) air to prevent pump cavitation and/or vapour locking".

'Selector valves' instead of 'elector valves'.

'pipes' or 'lines'?

response Not accepted.

Thank you for providing your comment referring to LO 021 03 02 02 (13).

EASA does not agree to put the operating principle of the pump in this listing. Your proposed revision may be considered in future amendments to the LOs.

comment	101-B 021 03 02 02 14 "Explain the function of the demand pump installed on many transport aeroplanes."	comment by: KLM Flight Academy
response	Accepted. Thank you for providing your comment referring to LO 021 03 02 02 (14). EASA agrees to reword this LO. The text will be amended as follows: Explain why the function of the demand pump installed on many transport aeroplanes have 'demand' hydraulic pumps.	

comment	102-B 021 04 01 02 Missing: ground-flight switches	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing your comment referring to Subject 021 04 01 02. EASA is of the opinion that this is already implied within the present heading.	

comment	103-B 021 04 01 02 01 'oleo' > 'oleo-pneumatic' as many shock struts include a fluid and a gas. Also the 'tilted' bogie? 'drag struts' > 'drag stays/struts' 'torsion links' > 'torsion/torque links' From last bullet point it is not clear if 'retraction mechanism' is for teh doors only or also for teh complete landing gear. Propose to make separate bullet: "retraction/extension mechanism." What is meant with emergency operation? There is an LO (08) that is about emergency extension already.	comment by: KLM Flight Academy
response	Partially accepted. Thank you for providing your comment referring to LO 021 04 01 02 (01). EASA agrees to amend this LO (01), but differently from your proposal. For consistency, the same amendment is made for LO (02) as it is practically the same list, only for helicopters. The text of LO (01) and (02) will be amended as follows: Explain the function of the following components of a landing gear: [...] — gear doors and retraction mechanisms (normal and emergency operation).	

comment	104-B 021 04 01 02 03 What is this (03) LO different than a previous one (01). Cannot be that here other names are used than in LO 01.	comment by: KLM Flight Academy
response	Noted. Thank you for providing your comment referring to LO 021 04 01 02 (03).	

For this LO (03), a diagram is used in examinations and candidates are asked to identify the components described in 021 04 01 02 01.

comment 105-B comment by: KLM Flight Academy

021 04 01 02 04

Propose to replace 'operation' with 'retraction and extension'.

Also including centering of the nose wheel and possible main wheel braking?

response Not accepted.

Thank you for providing your comment referring to LO 021 04 01 02 (04).

EASA is of the opinion that this LO is satisfactory as it stands as that includes any centring and brake system cycling, etc., since that forms part of the operation.

comment 106-B comment by: KLM Flight Academy

021 04 01 02 05 normal and back-up indication?

response Noted.

Thank you for providing your comment referring to LO 021 04 01 02 (05).

This LO states indication and therefore cover any eventualities.

comment 107-B comment by: KLM Flight Academy

021 04 02 00 01

Hydraulical steering and (all) mechanical steering?

response Noted.

Thank you for providing your comment referring to LO 021 04 02 00 (01).

This LO states operating principle thus covers all eventualities.

comment 108-B comment by: KLM Flight Academy

021 04 02 00 05 Also state the solution to prevent shimmy i.e. the 'shimmy damper'.

response Accepted.

Thank you for providing your comment referring to LO 021 04 02 00 (05).

EASA agrees to reword this LO.

The text will be amended as follows:

Define the term 'shimmy' and the possible consequences of shimmy for the nose- and the main-wheel system and explain the purpose of a shimmy damper to reduce the severity of shimmy.

comment 109-B comment by: KLM Flight Academy

021 04 03 01 03 'steel or carbon' > 'steel and carbon'.

response Accepted.

Thank you for providing your comment referring to LO 021 04 03 01 (03).

EASA agrees to replace 'or' with 'and'.

The text will be amended as follows:

~~Describe their characteristics, advantages and disadvantages such as:~~
 Describe the characteristics, advantages and disadvantages of steel or carbon brake discs referring to:

- weight;
- temperature limits;
- internal-friction coefficient;
- wear.

comment 110-B comment by: KLM Flight Academy
 021 04 03 03 01
 The text of this LO is also stated in the next LO (02).
 I propose a rewording of the 01 LO: " Describe the operating principle of an anti-skid system where the applied brake pressure is reduced for optimum braking performance".
 Or, like in the autobrake LO: "Describe the operating principle of the anti-skid system."
 response Partially accepted.
 Thank you for providing your comment referring to LO 021 04 03 03 (01).
 EASA agrees to reword this LO but slightly different from your two proposals.
 The text will be amended as follows:
 Describe the operating principle of an anti-skid where excessive system where the brake pressure applied is automatically reduced for optimum breaking performance is based on maintaining the optimum wheel-slip value.

comment 111-B comment by: KLM Flight Academy
 021 04 03 03 02 'braking performance' or 'braking efficiency'?
 response Noted.
 Thank you for providing your comment referring to LO 021 04 03 03 (02).
 Can be either; however, slip ratio for maximum braking performance is more appropriate.

comment 112-B comment by: KLM Flight Academy
 021 04 03 04 03 Pls reword as this is quite type specific.
 Status: OFF - ARMED - ACTIVE.
 Deactivated is the same as OFF?
 ABS can be armed and/or active in the RTO Mode or in the Land Mode. RTO Mode is full brake pressure; Land modes (1/2/3, low/med/hi etc.) is a fixed decel rate.
 response Not accepted.
 Thank you for providing your comment referring to LO 021 04 03 04 (03).
 EASA is of the opinion that this LO is correct and will not be reworded.
 This question is not type-specific as all general types will have an OFF state (autobrake is off, i.e. manual braking), ARMED state (autobrake automatically activated at a certain condition) and ACTIVATED (from armed state)/DEACTIVATED (by overriding using manual brakes).

comment	113-B 021 04 04 01 Also 'tubes'? Inflation with nitrogen? Approximate pressure levels? (low) pressure indication?	comment by: KLM Flight Academy
response	Noted. Thank you for providing your comment referring to LO 021 04 04 01. The internal workings of a tyre are of very limited relevance to a pilot, and so are pressure levels. This is for engineers. Whether the use of nitrogen is relevant should be considered during further updates bearing in mind that pilots are not authorised to refill tyres without specific operator training for that procedure.	
comment	114-B 021 04 04 01 04 Also something on recognition and (oper) consequence of tyre wear/damage (canvas/chevrons etc)?	comment by: KLM Flight Academy
response	Accepted. Thank you for providing your comment referring to LO 021 04 04 01 (04). EASA agrees to reword this LO. The text will be amended as follows: Explain implications of and how to identify tread separation and wear or damage with associated increased risk of tyre burst.	
comment	115-B 021 05 01 00 02 ruddervator? elevon? stabilator?	comment by: KLM Flight Academy
response	Noted. Thank you for providing your comment referring to LO 021 05 01 00 (02). V-tail and delta wing is not a common design used for 'normal' aeroplanes. Stabilator is not found on large aeroplanes, making all of the above of limited relevance at this stage.	
comment	116-B 021 05 01 00 03 Pls add term 'boosted' to partially powered.	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing your comment referring to LO 021 05 01 00 (03). EASA is of the opinion that this LO is correct and will not be reworded.	
comment	117-B 021 05 01 02 'artificial feel'	comment by: KLM Flight Academy
response	Not accepted.	

Thank you for providing your comment referring to Subject 021 05 01 02.

EASA is of the opinion that this LO is correct and will not be reworded by adding the term 'artificial feel'.

comment 118-B

comment by: KLM Flight Academy

021 05 01 04 01

Pls add term 'servo valves' as other name for 'control valves'.

'Electrical wire' is mentioned two times.

What exactly is meant with 'elec wiring' as this LO is about a hydro-mechanical flight control system? Hyd shut-off valves? Or does one mean FBW but that is other LO.

Missing: (interconnected) control column, control wheel, pedals.

Separate LO necessary for indication and warning (see header of this LO number).

response Partially accepted.

Thank you for providing your comment referring to LO 021 05 01 04 (01).

EASA agrees to delete the second 'electrical wiring' term.

The text will be amended as follows:

List and describe the function of the following components of a flight control system:

- actuators;
- control valves;
- cables or electrical wiring;
- electrical wiring;
- control surface position sensors.

comment 119-B

comment by: KLM Flight Academy

021 05 02 01 02

Does this include the Krueger flaps, plain flaps, split flaps, Fowler flaps etc?

What about knowledge about the construction and operation of other tabs (balance tab, servo tab, spring tab etc?)

Pls make clear distinction between aerodynamic LO's and construction LO's.

response Noted.

Thank you for providing your comment referring to LO 021 05 02 01 (02).

This LO (02) asks candidates to list (identify or name) secondary flight control surfaces. This LO is not intended to cover construction nor operation as this is covered to sufficient depth in further LOs under 021 05 02 01 XX.

comment 120-B

comment by: KLM Flight Academy

021 05 02 01 03

Apart from the actuation methods also the different 'control' methods? Elec and/or mechanical? Manual and/or automatic ('spoiler armed' for instance). 'Mixer unit' to mix control wheel input with (roll) spoilers?

response Noted.

Thank you for providing your comment referring to LO 021 05 02 01 (03).



This LO has sufficient depth of knowledge as it stands as pilots need to know about actuation methods in the event of failures.

comment 121-B comment by: KLM Flight Academy
 021 05 03 00 Compared to aeroplanes I do miss the mechanical flt ctl system and the boosted system (or even fully powered flt ctl system). If in a boosted system the pressure fails the ctl forces may become excessive. Accumulators temporarily supply pressure to let crew to reduce airspeed as to reduce ctl forces.

response Noted.

Thank you for providing your comment referring to Subject 021 05 03 00: Helicopter: flight controls.

The LOs under subject 021 05 03 00 are satisfactory as they stand.

comment 122-B comment by: KLM Flight Academy
 021 05 03 00 11`
 Would be nice if some more info is given on what exactly should be known.
 Proposal: "Describe and explain the purpose of a trim system using the following terms: force trim sw, force gradient etc (see LO 14

response Accepted.

Thank you for providing your comment referring to LO 021 05 03 00 (11).

EASA agrees to reword this LO.

The text will be amended as follows:

Describe and explain the purpose of a trim system using the following terms:

- force-trim switch;
- force gradient;
- parallel trim actuator;
- cyclic 4-way trim switch;
- interaction of trim system with an SAS/SCAS/ASS stability system;
- trim-motor indicators.

comment 123-B comment by: KLM Flight Academy
 021 05 04 00 01
 'Explain or 'Describe'?
 '(control column/wheel or control stick)?
 Pedals?
 'Electrical signalling' or 'electrical wiring'?
 'Flt ctl comp' or just 'flt computers'? (autopilot often also uses flt ctl comp) which is different.
 More info on Boeing/Airbus philosophy? (turns, 1-g flt etc.?)

response Accepted.

Thank you for providing your comment referring to LO 021 05 04 00 (01).

EASA agrees to reword this LO.

The text will be amended as follows:

Explain that an FBW flight control system is composed of the following:

- pilot's input command (control column/sidestick/rudder pedals column);
- electrical signalling paths, including:
 - pilot input to computer;
 - computer to flight control surfaces;
 - feedback from aircraft response to computer;
- flight control computers;
- actuators;
- flight control surfaces.

comment	<p>124-B comment by: <i>KLM Flight Academy</i></p> <p>021 05 04 00 01</p> <p>'Explain or 'Describe'?</p> <p>'(control column/wheel or control stick)'</p> <p>Pedals?</p> <p>'Electrical signalling' or 'electrical wiring'?</p> <p>'Flt ctl comp' or just 'flt computers'? (autopilot often also uses flt ctl comp) which is different.</p> <p>More info on Boeing/Airbus philosophy? (turns, 1-g flt etc.?)</p>
response	<p>Noted.</p> <p>Thank you for providing your comment referring to LO 021 05 04 00 (01).</p> <p>This comment is a duplicate of your comment #123-B.</p>
comment	<p>125-B comment by: <i>KLM Flight Academy</i></p> <p>021 05 04 00 07</p> <p>takeover > take over?</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to LO 021 05 04 00 (07).</p> <p>The right wording in this context is 'takeover' (noun).</p>
comment	<p>126-B comment by: <i>KLM Flight Academy</i></p> <p>021 06 01 02 01</p> <p>787 is bleed-air less a/c. Makes use of compressors. Cannot be regarded 'bleed-air' anymore.</p> <p>I would prefer 'engine compressor' and 'APU compressor'.</p> <p>Then also 'HP air supply' as many a/c also have a LP air supply for conditioned air.</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 021 06 01 02 (01).</p> <p>This LO (01) is for bleed-air supply as stated in the heading. 021 06 03 01 (14) covers</p>

aeroplanes that don't have bleed-air systems.

comment 127-B comment by: KLM Flight Academy
 021 06 01 02 02
 'ice protection' is better (apart from anti-icing bleed-air is also used for de-icing).
 add 'pressurisation of water tank'?

response Accepted.
 Thank you for providing your comment referring to LO 021 06 01 02 (02).
 EASA agrees to replace 'anti-icing' with 'ice protection', while general pressurisation and air conditioning is sufficient. EASA will not add the wording 'pressurisation of water tank'.
 The text will be amended as follows:
 State that for an aeroplane a bleed-air supply can be used for the following systems or components:

- ~~anti-icing~~ ice protection;
- engine air starter;
- pressurisation of a hydraulic reservoir;
- air-driven hydraulic pumps;
- pressurisation and air conditioning.

comment 128-B comment by: KLM Flight Academy
 021 06 01 02 04
 I would suggest 'Explain the function of the following components of a bleed-air supply system'?

response Not accepted.
 Thank you for providing your comment referring to LO 021 06 01 02 (04).
 EASA is of the opinion that this LO is correct and will not be reworded. This suggestion may be considered for the next update of the LOs.

comment 129-B comment by: KLM Flight Academy
 021 06 01 02 08
 Also the consequences of these malfunctions?

response Accepted.
 Thank you for providing your comment referring to LO 021 06 01 02 (08).
 EASA agrees to add wording regarding the consequences of these malfunctions.
 Text will be amended as follows:
 List State the following air-bleed-air malfunctions:

- over-temperature;
- over-pressure;
- low pressure;
- overheat/duct leak;

and describe the potential consequences.

comment **130-B** comment by: *KLM Flight Academy*

021 06 02 01 03

Like in LO 04 please also add here the name of the components.

response Not accepted.

Thank you for providing your comment referring to LO 021 06 02 01 (03).

EASA is of the opinion that this LO covers satisfactory depth of knowledge as it stands.

comment **131-B** comment by: *KLM Flight Academy*

021 06 02 01 04

Am not sure but do helicopters comprise ACM as well? ACM is not the same as vapour cycle system.

Pls change 'pack' in 'cooling pack'.

What are the isolation valves doing in an airco system? I think they have a function in the bleed-air system.

response Not accepted.

Thank you for providing your comment referring to LO 021 06 02 01 (04).

EASA is of the opinion that this LO (04) is correct as it stands.

comment **132-B** comment by: *KLM Flight Academy*

021 06 03 01 03

Pls give more info: some a/c had humidifiers but others had de-humidifiers. Difficult to interpret LO.

response Not accepted.

Thank you for providing your comment referring to LO 021 06 03 01 (03).

EASA is of the opinion that this LO is correct and will not be reworded.

The stated LO does not include humidity as this is sufficiently covered by LO 021 06 03 01 (02).

comment **133-B** comment by: *KLM Flight Academy*

021 06 03 01 04

The name 'pack' may refer to the complete airco system. Better is 'cooling pack'.

Same remark again on 'isolation valves'. What is isolation valve? Airco pack shut-off valve?

response Not accepted.

Thank you for providing your comment referring to LO 021 06 03 01 (04).

EASA is of the opinion that this LO is correct and will not be reworded. This suggestion may be considered for the next update of the LOs.

comment **134-B** comment by: *KLM Flight Academy*

021 07 01 00 04

Don't forget the pressurised air for the pneumatic boots. Not necessarily hot.

response Noted.

Thank you for providing your comment referring to LO 021 07 01 00 (04).

Boots are covered separately in 021 07 01 00 (06).

comment 135-B

comment by: KLM Flight Academy

021 08 02 02 02

Don't understand. Is LO 01 deleted and replaced with LO 02? Why not simply "fuel As far as I know a trim fuel tank is not a component of the fuel system.

response Noted.

Thank you for providing your comment referring to LO 021 08 02 02 (02).

LO(01) is amended and the full stop at the end of the sentence replaced by a colon. The list of the former LO(02) is now part of LO(01).

comment 136-B

comment by: KLM Flight Academy

021 08 02 02 05

But that LO number is for PE's. This LO number is about TE's. Maybe make one new LO for both PE and TE fuel systems?

response Not accepted.

Thank you for providing your comment referring to LO 021 08 02 02 (05).

EASA does not agree to make one new LO for both PE and TE fuel systems. These types are of similar construction for either engine type, hence describing them once is sufficient.

comment 137-B

comment by: KLM Flight Academy

021 08 02 02 07

Fuel transfer is not mentioned in the previous LO. Fuel transfer is important for large transport a/c.

response Not accepted.

Thank you for providing your comment referring to LO 021 08 02 02 (07).

This LO is deleted and does not cover fuel transfer. The fuel crossfeed LO (06) is a duplicate of 021 08 01 02 (05).

comment 138-B

comment by: KLM Flight Academy

021 09 01 01 04

Also add something on 'screening'? As to prevent EMI.

response Not accepted.

Thank you for providing your comment referring to LO 021 09 01 01 (04).

EASA is of the opinion that this LO is correct and something on 'screening' is not needed. Screening of wires and equipment is not relevant to a pilot as it is engineering level. The subject of this section is static electricity and the design and procedural precautions needed to ensure that it doesn't build up to dangerous levels, and to mitigate its potential effects.

comment 139-B

comment by: KLM Flight Academy

021 09 01 02 03



There always has been a difference between a push switch and the push button. The push switch has two operating positions while the push button has only one (springloaded) operating.

What exactly is meant? The way the switches are in the same position? I.e. up or down? In or out? Rotary switches in the 12 o'clock position?

response Noted.

Thank you for providing your comment referring to LO 021 09 01 02 (03).

It is the different types of switches on the aircraft that use the terms that are published in the aircraft documentation. Either a switch will have a light to indicate its state (pushbutton switch) or it can be ascertained by its physical position (all the others).

comment 140-B comment by: KLM Flight Academy
 021 09 01 02 04 BK?

response Not accepted.

Thank you for providing your comment referring to LO 021 09 01 02 (04).

EASA does not agree that this LO is BK material. The measure is shown on the instruments, making this an absolute minimum.

comment 141-B comment by: KLM Flight Academy
 021 09 01 02 07 if you name ptc/ntc also other types have to be named Light sensitive, pressure sensitive

response Not accepted.

Thank you for providing your comment referring to LO 021 09 01 02 (07).

EASA does not agree with your argumentation.

comment 142-B comment by: KLM Flight Academy
 021 09 01 03 01 No practical use.

response Partially accepted.

Thank you for providing your comment referring to LO 021 09 01 03 (01).

EASA does not agree that this LO has no practical use, but will mark this LO as 'BK' by adding an 'X' in the BK column.

comment 143-B comment by: KLM Flight Academy
 021 09 01 03 02 BE aware of the difference between phase of a three fase wiring and phase angle. It is not clear what is meant.

response Noted.

Thank you for providing your comment referring to LO 021 09 01 03 (02).

This LO (02) does not say anything about phase difference but purely what an electrical phase is and that there are one-, two- or three-phase systems.

comment 144-B comment by: KLM Flight Academy

response	021 09 01 03 04 BK? Not accepted. Thank you for providing your comment referring to LO 021 09 01 03 (04). EASA does not agree that this LO is BK material. The measure is shown on instruments.
comment	145-B 021 09 01 03 06 See earlier remark about phase comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing your comment referring to LO 021 09 01 03 (06). This LO is also BK since phase shift is recurring in other subjects too, thus intended as a recap.
comment	146-B 021 09 01 05 BK? comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing your comment referring to Subject 021 09 01 05. EASA does not agree that these LOs of this deleted Subject is BK material. That level of depth is not required for a pilot in any setting.
comment	147-B 021 09 01 06 01 BK? comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing your comment referring to LO 021 09 01 06 (01). EASA does not agree that this LO (01) is BK material. This is a fact which may explain technical events on an aircraft.
comment	148-B 021 09 01 06 The term electromagnet not used in lo's. Formally one cannot make questions referring to term electromagnet. comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing your comment referring to Subject 021 09 01 06. The heading of the LO is electromagnetism, thus this is a valid term. There is no LO stating the requirement to describe an electromagnet as a component.
comment	149-B 021 09 01 06 02 but also number of windings, core material (permeability) comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing your comment referring to LO 021 09 01 06 (02). This is correct but not relevant to a pilot. The only influence a pilot may have is on the

current.

comment **150-B** comment by: *KLM Flight Academy*

021 09 01 06 03 and 04 pls combine these two

response Not accepted.

Thank you for providing your comment referring to LO 021 09 01 06 (03).

EASA is of the opinion that both LOs should remain separate.

comment **151-B** comment by: *KLM Flight Academy*

021 09 01 06 05 rewording not clear

response Accepted.

Thank you for providing your comment referring to LO 021 09 01 06 (05).

EASA agrees that this LO is not clear and will reword it.

The text will be amended as follows:

Explain the principle of electromagnetic induction and how two electrical components or systems may affect each other through this principle.

comment **152-B** comment by: *KLM Flight Academy*

021 09 01 07 change title to Fuses and ...

response Partially accepted.

Thank you for providing your comment referring to Subject 021 09 01 07.

EASA agrees to change the title of this Subject, but differently from your proposal.

The heading will be amended as follows:

021 09 01 07 Circuit breakers protection

comment **153-B** comment by: *KLM Flight Academy*

021 09 01 07 01

what is the difference between the 'working principle' and the 'operating principle'? If none, pls stick to the same wording.

response Accepted.

Thank you for providing your comment referring to LO 021 09 01 07 (01).

EASA agrees to replace 'operating' with 'working'.

The text will be amended as follows:

Explain the ~~operating~~ working principle of a fuse and a circuit breaker.

comment **154-B** comment by: *KLM Flight Academy*

021 09 01 07 05 new

Also something on possibility to replace fuses coming from a spare lamp/fuse box?

response Not accepted.

Thank you for providing your comment referring to LO 021 09 01 07 (05).

EASA would like to state that this LO (05) concerns computer resets and not fuses.

comment 155-B comment by: KLM Flight Academy

021 09 01 08 04
which symbols? NEN? DIN? EU? US?

response Accepted.

Thank you for providing your comment referring to LO 021 09 01 08 (04).

EASA agrees to reword this LO (04) by adding a sentence regarding the applicable symbols.

The text will be amended as follows:

Explain Describe the following five basic logic functions, as used in aircraft FCOM documentation, and recognise their schematic symbols according to the ANSI/MIL standard: AND, OR, NOT, NOR and NAND.

- AND;
- OR;
- NOT;
- NOR;
- NAND.

comment 156-B comment by: KLM Flight Academy

021 09 03 00 (remark)
The 'commutator' in the DC generator can also be regarded as a rectifier.
DC alternator two times mentioned.

response Noted.

Thank you for providing your comment referring to Subject 021 09 03 00.

These are the terms being used. They may be considered for revision during further updates of the LOs.

comment 157-B comment by: KLM Flight Academy

021 09 03 03 03
it would be good to state the CSD/IDG has an own oil system for cooling, lubrication and operation. A IDG oil leak is not the same as an engine oil leak.

response Accepted.

Thank you for providing your comment referring to LO 021 09 03 03 (03).

EASA agrees that it will be good to state that the CSD/IDG has an own oil system for cooling, lubrication and operation.

A new LO will be inserted as follows:

Explain that a CSD/IDG has its own, independent oil system and how a leak from this may appear as an engine oil leak.

comment 158-B comment by: KLM Flight Academy

021 09 04 01 02

	<p>What is difference between 'emer bus' and 'emer AC and/or DC bus' for instance? Forgot to cross-out?</p>
response	<p>Partially accepted.</p> <p>Thank you for providing your comment referring to LO 021 09 04 01 (02).</p> <p>EASA agrees that the first 7 terms should have been deleted.</p> <p>The text will be amended as follows:</p> <p>Describe the function of the following buses:</p> <ul style="list-style-type: none"> — main bus, — tie bus, — essential bus, — emergency bus, — ground bus, — battery bus, — hot (battery) bus, — AC bus; — DC bus; — emergency AC or DC bus; — essential AC or DC bus; — battery bus; — hot bus; — ground servicing or maintenance bus.

comment	159-B	comment by: KLM Flight Academy
	021 09 04 03 02	
	first summary crossed out or not?	
response	<p>Partially accepted.</p> <p>Thank you for providing your comment referring to LO 021 09 04 03 (02).</p> <p>EASA agrees that the first 3 terms should have been deleted.</p> <p>The text will be amended as follows:</p> <p>Describe the distribution consequences of:</p> <ul style="list-style-type: none"> — APU electrical supply and external power priority switching; — loss of (all) generator(s); — bus failure. <p>Describe the following distribution consequences:</p> <ul style="list-style-type: none"> — power transfer between different power supplies; — power transfer in the event of a supply failure; 	

— loss of all normal AC supplies.

In comment 232-B, the same issue was raised regarding this LO (02).

comment 160-B comment by: KLM Flight Academy

021 09 04 04 02

add: 'protection in the case of an overcurrent'.

response Not accepted.

Thank you for providing your comment referring to LO 021 09 04 04 (02).

EASA does not agree to add your proposed wording.

These are the failure scenarios to be considered. Differential fault is a variant of overcurrent protection.

comment 161-B comment by: KLM Flight Academy

021 09 04 04 03

not very practical as this process is automated and in a previous LO the prerequisites for paralleling are already mentioned.

response Accepted.

Thank you for providing your comment referring to LO 021 09 04 04 (03).

EASA agrees that this LO is not relevant as this process is automated, and in a previous LO the prerequisites for paralleling are already mentioned.

comment 162-B comment by: KLM Flight Academy

021 11 02 04 13

My personal opinion is ATPL pilot must have heard of term 'turbine creep'.

response Noted.

Thank you for providing your comment referring to LO 021 11 02 04 (13).

The pilot has no influence on this, thus no real relevance.

comment 163-B comment by: KLM Flight Academy

021 11 04 01 09

And the IHUMS then? Trending is very important for helicopter engines and gearboxes.

response Not accepted.

Thank you for providing your comment referring to LO 021 11 04 01 (09).

EASA likes to state that this LO (09) is not helicopter-specific, and concerns use and not trending.

comment 164-B comment by: KLM Flight Academy

021 11 04 02 To what level?

response Noted.

Thank you for providing your comment referring to Subject 021 11 04 02.

EASA would like to state that this LO is already expanded to a satisfactory level.

comment 165-B comment by: KLM Flight Academy
 021 11 06 01 04
 'Explain' would be better. APU may operate at 'high' altitudes but the exact altitude depends on the elec and/or bleed air load.

response Not accepted.
 Thank you for providing your comment referring to LO 021 11 06 01 (04).
 EASA does not agree that the wording 'Explain' would be better. This comment does not fit in with 021 11 06 01 (04), but rather with 021 11 06 01 (03). The suggestion is already implied by the LO.

comment 166-B comment by: KLM Flight Academy
 021 16 04 00 05 Practical use?

response Accepted.
 Thank you for providing your comment referring to LO 021 16 04 00 (05).
 EASA agrees that this LO (05) has no practical use and will be deleted.

comment 232-B comment by: Howard JONES
Comments on LOs as indicted by LO number

021 09 01 08 (04) & (06)
 What practical use does this LO serve?
 I have been unable to find 'a typical logic circuit schematic' in an FCOM or other similar manual that would require knowledge of logic gates. Please provide a reference source so that this LO can be demonstrated.

021 09 02 01 (03)
 Would energy density be a useful thing to add to this list?

021 09 02 01 (12)
 If this LO is just about Lithium batteries then 'particularly' can be deleted; if not, reword so that it makes more sense as to what the LO is about.
 Having had extensive experience carrying Lithium batteries and understanding and applying the rules in ICAO TIs and IATA DGs, this LO looks like it is not sure what it's there for. What is it that the student is expected to know after having satisfied this LO? It is not clear to me.

021 09 02 01 (13)
 As written this LO seems to suggest that the pilot can do something about containing a thermal runaway. Rewrite along the lines of, 'Describe how the risk of battery thermal runaway is reduced at the design stage highlighting the following'; or words to that effect.

021 09 03 00
 There are two standard expressions for DC alternator, surely there can only be one?
 'permanent magnet alternator/generator: self-exciting AC generator' this standard expression could cause confusion. An alternator has DC output not AC output.

021 09 03 02 (02)

Surely this should be with 021 09 03 01 (04)'

021 09 03 02 (07)

The LO calls for a list only - no description.

021 09 04 03 (02)

Should the whole of the first part of this LO have been deleted?

021 09 04 03 (06)

This LO suddenly introduces real and reactive loads with no previous teaching on what these two things are. I think that there needs to be further LOs to explain what these are, this would also help putting a CSD into context. In essence 021 09 04 03 (05) needs reinstating in its original form.

021 09 05 02 (01)

'Describe how' or 'State that' but not 'Describe that'.

021 09 05 02 (02)

Delete 'type', unnecessary.

response Thank you for your multiple comments.

EASA has carefully assessed all the comments received.

Regarding your comment referring to LO 021 09 01 08 (04) and (06): Noted.

FCOMs typically do not include complex logic diagrams. There is a limited use of logic gates in some system diagrams such as undercarriage and warning systems. Airbus FCOMs is one example.

Regarding your comment referring to LO 021 09 02 01 (03): Not accepted.

EASA is of the opinion that it is not needed to add 'energy density' to this list. That concerns manufacturers, not pilots.

Regarding your comment referring to LO 021 09 02 01 (12): Accepted.

EASA agrees to reword this LO and to delete the wording 'particularly'.

The text will be amended as follows:

Explain how ~~particularly~~ lithium-type batteries pose a threat to aircraft safety and what affects this risk:

[...]

Regarding your comment referring to LO 021 09 02 01 (13): Not accepted.

EASA is of the opinion that the LO is correct.

A pilot may have to do something to contain a thermal runaway occurring in a device on the flight deck. The cabin crew are trained to deal with similar events in the cabin. A pilot has no influence over battery design.

Regarding your comment referring to LO 021 09 03 00: Noted.

There appears to be an error with the deletion of some lines. Source document will be consulted.

Regarding your comment referring to LO 021 09 03 02 (02): Not accepted.

With the current layout of the LOs there is no common voltage control LO covering both AC and DC generators.

Regarding your comment referring to LO 021 09 03 02 (07): Noted.

The various supplies are described separately throughout the LOs. This is for awareness of the multitude of supplies available on a large aeroplane.

Regarding your comment referring to LO 021 09 04 03 (02): Partially accepted.

Thank you for providing your comment referring to LO 021 09 04 03 (02).

EASA agrees that the first 3 terms should have been deleted.

The text will be amended as follows:

~~Describe the distribution consequences of:~~

- ~~— APU electrical supply and external power priority switching;~~
- ~~— loss of (all) generator(s);~~
- ~~— bus failure.~~

Describe the following distribution consequences:

- power transfer between different power supplies;
- power transfer in the event of a supply failure;
- loss of all normal AC supplies.

In comment 159-B, the same issue was raised regarding this LO (02).

Regarding your comment referring to LO 021 09 04 03 (06): Not accepted.

There is no need for separate LOs describing lower level of knowledge required. Covering this LO will include at least a very brief introduction of the concept of real and reactive loads.

Regarding your comment referring to LO 021 09 05 02 (01): Accepted.

EASA agrees to change the wording 'Describe that' into 'Describe how'.

The text will be amended as follows:

~~Explain the operating principle of an electric motor as being an electrical current carrying conductor inside a magnetic field that experiences a Lorentz/electromotive (EMF) force.~~

Describe how the torque of an electrical motor is determined by the supplied voltage and current and the resulting magnetic fields within the machine.

Regarding your comment referring to LO 021 09 05 02 (02): Accepted.

EASA agrees to delete the word 'type'.

The text will be amended as follows:

State that electrical motors can be either AC or DC type.

comment 262-B

comment by: FTEJerez

Comment on 021 01 01 02 (01) and (02)

NPA proposal: LOs removed. Reference to failure conditions and probability is removed.

The description of each failure condition and the correlation between failure severity and probability numbers shall be removed as not relevant, but pilots should be made aware of:
A) the same failure can have different outcome on safety margin, structural integrity, workload of the crew and effects on the passengers depending on the conditions in which the failure occurs.

B) Removing the concept of "extremely improbable" (10^{-9}) removes also a link to the concept of redundancy and the reasons why redundancy is widely implemented in aviation systems. (10^{-9}) is the answer to all those questions "why just two of this?" "why not more systems?". It is the cornerstone concept that shows that there is no such thing as a perfectly safe aircraft and the reason why pilots need to undergo this thorough training.

Recommendation: Keep the LO

response Not accepted.

Thank you for providing your comment referring to LOs 021 01 01 02 (01) and (02).

EASA considers that these LOs are not relevant and will remain deleted.

It is the responsibility of the designer to ensure that the required levels of redundancy are met. Facts about the probability are of no practical use to a pilot. The pilot needs to know what level of redundancy is available but that is type-specific, hence belongs in a type rating.

comment 263-B

comment by: FTEJerez

Comment on 021 01 02 00 (01)

NPA proposal: LO removed

Definition of stress, strain, bending, torsion etc should stay in, at least as BK. They set the basis for the explanation of other examinable subjects, like fatigue, design philosophies, aeroelastic effects, etc...

Recommendation: keep the LO as BK

response Not accepted.

Thank you for providing your comment referring to LO 021 01 02 00 (01).

EASA considers this LO is not relevant and will remain deleted. The reworded subsequent LOs cover this to a satisfactory depth.

comment 264-B

comment by: FTEJerez

Comment on 021 02 02 00 (01)

NPA proposal: LO removed.

It is unfair to request pilots to know why composite materials are better or worse than metal materials when it comes to strength, elasticity, stiffness, specific strength, etc... if these concepts are not explained before.

Recommendation: This LO should stay in at least as BK.

response Not accepted.
 Thank you for providing your comment referring to LO 021 02 02 00 (01).
 EASA considers this LO is not relevant.

comment 265-B comment by: FTEJerez
Comment on 021 03 02 01 (03), (04), (05)
 NPA proposal: LOs removed
 Pilots should know what hydraulic fluid is used in the system (same as they need to know which fuel the aircraft uses) as they should also know the basic principles of a hydraulic system.
Recommendation: Keep them as BK

response Partially accepted.
 Thank you for providing your comment referring to LOs 021 03 02 01 (03), (04) and (05).
 EASA has accepted comments 98-B and 90-B to retain LO (03) and LO (05), and also has accepted comment #8-B to retain LO (04).
 Only LO (05) will be 'BK'.
 In comment 292-B, a similar issue was raised regarding deletion of LO (10).

comment 266-B comment by: FTEJerez
Comment on 021 03 02 02 (07)
Recommendation: This LO should include a note on newer large transport aircrafts (A380, A350, B787), where the hydraulic system working pressure can go up to 4000-5000 psi

response Accepted.
 Thank you for providing your comment referring to LO 021 03 02 02 (07).
 EASA agrees to reword this LO.
 The text will be amended as follows:
~~State that the normal hydraulic pressure of most large transport aircraft is 3 000 psi.~~
 State that a high-pressure hydraulic system is typically operating at 3 000 psi but on some aircraft a hydraulic pressure of 4 000 to 5 000 psi may also be used.
 In comment 9-B, the same issue was raised regarding this LO (07).

comment 267-B comment by: FTEJerez
Comment on 021 03 02 02 (10)
 NPA proposal: LO Removed
 It should stay in at least as BK, so pilots are taught how pressure and flow are provided into the hydraulic system. It also helps to understand how hydraulic motors and PTUs work (which is actually an LO).
 Additionally, it is difficult to explain LO(14) in this chapter without commenting on the

	different types of pumps (constant volume and constant pressure)
response	<p><u>Recommendation:</u> Keep as BK</p> <p>Accepted.</p> <p>Thank you for providing your comment referring to LO 021 03 02 02 (10).</p> <p>EASA agrees that this LO is relevant and will be retained.</p> <p>In comment 97-B, a similar issue was raised regarding deletion of LO (10).</p>
comment	<p>268-B comment by: FTEJerez</p> <p>Comment on 021 03 02 02 (17)</p> <p>NPA proposal: LO removed</p> <p>The effects of a leak in the system should be known to a pilot. Actually, if in LO(19) and (20) in this same chapter pilots are instructed about the system monitoring, it should be also taught them what conditions might generate abnormal readings in the cockpit (such as internal or external leaks)</p> <p><u>Recommendation:</u> Keep the LO as examinable.</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 021 03 02 02 (17).</p> <p>EASA assumes that you are referring to LO (18) because in your argumentation you write about leaks. EASA considers this LO (18) is not relevant and will remain deleted.</p> <p>A leak is a leak, and liquid and/or pressure levels may be affected. Where this leak is, is of very limited relevance to a pilot.</p>
comment	<p>269-B comment by: FTEJerez</p> <p>Comment on 021 04 01 02 (09)</p> <p>LO should include a note to state that gravity/free fall is the most common emergency landing gear extension mechanism on large transport aircrafts.</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 021 04 01 02 (09).</p> <p>EASA does not see the need to include a note to state that gravity/free fall is the most common emergency landing gear extension mechanism on large transport aircraft.</p> <p>This is of no practical use to a pilot. The aircraft has the emergency extension mechanism it has been chosen by the designers.</p>
comment	<p>270-B comment by: FTEJerez</p> <p>Comment on 021 07 01 00 (04)</p> <p>Might be worth putting in a note with regards to electrical de-ice/anti-ice systems. Typically they were said to be used for small turboprops aircrafts, engine intakes, propellers and windscreens, but today large transport aircrafts with bleed-less engines (B-</p>

787) can use electrical de-icing/anti-icing for large aerodynamic surfaces as well

response Not accepted.

Thank you for providing your comment referring to LO 021 07 01 00 (04).

EASA does not see the need to include a note with regard to electrical de-icing/anti-icing systems.

The LO does not specify where the types of designs are used to leave it open for any technological advances as aircraft design changes.

comment 271-B comment by: FTEJerez

Comment on 021 08 01 01 (01)

This LO should include the acronym AVTUR and mention both Jet-A and Jet-A1

Comment on 021 08 02 01 (01)

This LO should include the acronym AVTUR

response Not accepted.

Thank you for providing your comment referring to LOs 021 08 01 01 (01) and 021 08 02 01 (01).

EASA does not agree to include the acronym AVTUR in the LOs mentioned. AVTUR is a military term and it is highly unlikely a civil pilot will ever encounter it.

comment 272-B comment by: FTEJerez

Comment on 021 08 02 02 (08)

The magnetic float type fuel level/quantity indicator is actually called dropstick (or floatstick), not dripstick.

For completeness, dipstick, dripstick and dropstick fuel level/quantity indicators should all be mentioned

response Accepted.

Thank you for providing your comment referring to LO 021 08 02 02 (08).

EASA agrees to reword this LO.

The text will be amended as follows:

Describe the use and purpose of drip sticks (manual magnetic indicators) (may also be known as dip stick or drop stick).

comment 274-B comment by: René Meier, Europe Air Sports

Check

response Noted.

comment

275-
Bcomment by: *Southern Cross International BV*Attachment [#2](#)Comment on 021 01 02 00 (05):

It is proposed to add:

- Explain the structural certification requirements for the rudder and vertical stabilizer on transport category aircraft,
- Explain that full or nearly full rudder deflections in one direction, followed by a full or nearly full rudder deflection in the opposite direction (sometimes referred to as "rudder reversals") can result in potentially dangerous loads on the vertical stabilizer, even at speeds below the Design Maneuvering Speed (VA).
- State that rapid and large alternating rudder and elevator control inputs, especially in combination with large changes in pitch, roll or yaw (e.g. large sideslip angles) are prohibited as these may result in structural failures at any speed, including speeds below the Design Maneuvering Speed (VA).

Justification: In February 2002, the National Transportation Safety Board (NTSB) issued a Safety Recommendation in relation to the accident that happened on November 12th, 2001 with an Airbus A300-600 that crashed after separation of the vertical stabilizer from the fuselage. The NTSB addressed an industry-wide safety issue involving omissions in pilot training on transport-category airplanes. Specifically, the NTSB has learned that many pilot training programs do not include information about the structural certification requirements for the rudder and vertical stabilizer on transport-category airplanes. Further, the NTSB has learned that sequential full opposite rudder inputs (sometimes colloquially referred to as "rudder reversals")—even at speeds below the design maneuvering speed—may result in structural loads that exceed those addressed by the requirements. See attached document.

All large aircraft Airplane Flight Manuals now show a limitation on the application of full or nearly full rudder deflections in one direction, followed by a full or nearly full rudder deflection in the opposite direction.

response

Not accepted.

Thank you for providing your comment referring to LO 021 01 02 00 (05).



EASA is of the opinion that this LO is correct. Your proposed text is covered by LO 021 05 01 04 (05).

comment	<p>276-B</p> <p>Attachment #3</p> <p>Comment on 021 11 02 04: A new LO is proposed:</p> <ul style="list-style-type: none"> • Explain the term “core lock” • Explain the conditions that may cause a core lock and the consequences. <p>See attached document for justification.</p>	comment by: <i>Southern Cross International BV</i>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to Subject 021 11 02 04.</p> <p>EASA does not see the need to insert a new LO in this Subject. This is covered by the LOs in 021 11 04 01 XX series concerning engine operation and recognising engine seizure and using engine instrument indications to assess damage.</p>	
comment	<p>277-B</p> <p>Dear Sir/Madam,</p> <p>Enclosed the general comments of the Netherlands on the <u>Notice of Proposed Amendment 2016-03 (B)</u></p> <p>Subject 021</p> <p>In the year 2012 the name of the subject 021 has been changed in: ‘Airframe and Systems, Electrics and Powerplant’. ‘Emergency equipment’ has since then been moved to subject 070 ‘Operational Procedures’. There are no emergency equipment LO’s in this subject anymore.</p> <p>Deleted LO’s</p> <p>In many LO’s that have a summary, only the first line is crossed-out. It is not clear if the remainder of the LO’s remain still valid, see for example 021 02 01 00 01.</p> <p>Why is ‘fuel transfer’ deleted? Which components should be known from a piston engine? Why is knowledge about pressure and temperature sensors deleted? Not even basic knowledge. I think pilots should have a basic understanding about sensor systems. A pilot must, for instance, know that a thermocouple is for (high) temperature sensing. A pilot must have heard of a (pressure) capsule. Is the sensor mechanical or electronical/digital? Where is the sensor located? Fuel gauges and angular speed sensors are still in the LO’s. In the proposal this does not seem consistent.</p> <p>For many LO’s is not clear what is meant with the objective. E.g.: “Explain the development of a faulty attachment” (21 02 01 00 04) and it is not clear what should be learned about ‘humidity control’. There are aircraft that have humidifiers but there are also aircraft that have de-humidifiers.</p>	comment by: <i>CAA-NL</i>

In LO's of other subjects (062 Radio navigation for instance) the LO's state exactly what a candidate must know. In the 020 LO's it is not always clear what is expected. An exception is 021 02 04 00 07. Between brackets is exactly stated what is meant. We strongly propose do this everywhere.

What is meant with the 'aircraft positions error' at the altimeter LO? (022 02 04 00 09).

What is meant with 'GPWS modes of operation' (022 12 09)?

Very confusing and lengthy LO's on ACAS and TCAS (022 12 10). Terms are mixed up, LO's are repeated and too much detail when comparing with other alerting system LO's.

There has always been a difference between the EFIS EADI and PFD. Now it seems both displays are considered the same (022 13).

We suggest to make all the LO's consistent in wording. Example: 'operating principle' instead of 'working principle' or 'principle'.

Consistency is also required when working with knowledge levels to a certain detail. The construction of a wing and the construction of a fuselage should require the same amount of detail. This remark applies for both aeroplanes and helicopters.

It is important there are no mistakes in LO's. Students, text book writers, question writers and question evaluators rely on these LO's. Unfortunately the content of LO's is not always correct.

As an example: carbon, glass and Kevlar etc. are not composite materials but are part of a composite material (021 02 02 00 02).

Another example is dynamic pressure; dynamic pressure is not measured (022 02 01 01 01) but calculated.

TAT is no input to an ADC.

Many LO's can also be made available to Helicopters. Sometimes LO's for aeroplanes and helicopters can be combined with a small adaption in text.

It is also difficult to find out if an LO is for small aircraft and/or for large aircraft. For example the LO on flight controls.

In some part of the text same components have different names. Maybe it is worth to spell-out all these names as a candidate might have heard about a 'ground-flight switch', but never of a 'squat switch' which is exactly the same.

Sometimes important 'items' are missing. Example: the ground flight switches (weight-on/off-wheel switches or squat switches) are not mentioned in the LO's.

I miss important (basic) knowledge about permanent magnets and electromagnets. Such info is important when dealing with generators and compasses.

I think a pilot should know a CSD or an IDG has its own oil system. When oil is found underneath an engine an airline pilot must know there are several oil/fluid systems connected onto the engine. Therefore it is also important the pilot can distinguish between engine oil and hydraulic fluid.

I think a pilot might know electrical fuses can be replaced by the pilot.

When reading the gyroscopic instruments LO's, it seems that a pilot no longer has to know which instrument uses a gyroscope. We recommend to keep this.

There are still many 'double' LO's.

response	<p>The term ‘instrument error’ is a general term which is applicable to each instrument. Take out the ‘instrument error’ in the separate instrument LO’s (ASI, ALT, VSI etc.) and make a ‘general’ LO on instrument error.</p> <p>We propose to do the same for the term ‘position error’. It is difficult to describe the position error for each separate instrument.</p> <p>Noted.</p> <p>Duplicate of comment 53-B.</p>
comment	<p>279-B comment by: FTEJerez</p> <p>Comment on 021 10 02 01</p> <p>(04) (05) NPA Proposal: removed</p> <p>These LOs should stay in, as they will help explain the concept of detonation and its relation to weak mixtures.</p> <p><u>Recommendation:</u> Might be left in the LOs as Basic Knowledge (BK)</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LOs 021 10 02 01 (04) and (05).</p> <p>EASA considers these LOs are not relevant and will remain deleted. This is of no practical use to a pilot as the engine is expected to be operated appropriately according to the manufacturer’s specifications.</p>
comment	<p>280-B comment by: FTEJerez</p> <p>Comment on 021 10 07 01 (07) NPA Proposal: removed</p> <p>The difference between advanced ignition and retarded ignition is still relevant to explain the working principle of the real Otto cycle.</p> <p><u>Recommendation:</u> This information should stay in, at least as BK</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 021 10 07 01 (07).</p> <p>EASA considers this LO is not relevant and will remain deleted. This is too detailed for pilots as they have no control over the internal timings of the engine.</p>
comment	<p>281-B comment by: FTEJerez</p> <p>Comment on 021 10 10 02 (03) NPA proposal: Removed</p> <p>Might be kept in as BK, as it is important for the pilot to know how to crank the prop manually in case of hydraulic on an inverted in line piston engine</p>

response Recommendation: Kept as BK
 Not accepted.
 Thank you for providing your comment referring to LO 021 10 10 02 (03).
 EASA considers this LO is not relevant and will remain deleted. This is too specialised and not representing typical engine designs used in aircraft. If an aircraft suffers from this effect, it will be apparent in the aircraft documentation or operating procedures.

comment 282-B comment by: FTEJerez
Comment on 021 11 01 02 (02)
 NPA proposal: removed
 Should be kept in as BK, it helps explaining the temperature and pressure measurements in the engine (EPR, P2T2, P30, EGT, TGT, ITT, etc...)

response Recommendation: kept in as BK
 Not accepted.
 Thank you for providing your comment referring to LO 021 11 01 02 (02).
 EASA considers this LO is not relevant and will remain deleted. No documentation aimed for pilots has information on station numbering for engines.

comment

283-B

comment by: FTEJerez

Comment on 021 11 02 04 (10) (12) (13)

NPA proposal: LO removed.

It should stay in, as creep is a failure mode described in SYS, so part of AGK.

Recommendation: kept and examinable.

Comment on 021 11 02 04 (11)

The word "wheels" should be replaced by "disks"

response

Thank you for your multiple comments.

Regarding your comment referring to LOs 021 11 02 04 (10) (12) and (13): Not accepted.

EASA considers this LO is not relevant and will remain deleted. The pilot has no influence over this nor is there any way to inspect this effect.

Regarding your comment referring to LO 021 11 02 04 (11): Partially accepted.

EASA will not replace 'wheels' with 'disks', but will add 'discs' next to 'wheels'.

The text will be amended as follows:

Explain the high mechanical thermal stress in the turbine blades and wheels/discs.

comment 284-B

comment by: FTEJerez

Comment on 021 11 03 01 (01)

The LO is quite generic. There should be a list of components in the engine fuel system to be discussed (LP pump, HP pump, filters, FCU, FCOC, flowmeter, fuel manifold, nozzles, HP fuel cock).

There should be a schematic provided as well in the LOs, to define the sequential position of each component (especially the FCOC with regards to the LP and HP fuel pumps --> in old GTEs the FCOC was after the HP pump and before the FCU, but today is between LP and HP pumps).

response Partially accepted.

Thank you for providing your comment referring to LO 021 11 03 01 (01).

EASA agrees to amended this LO to specify the components. Flow sequence is of no practical use to a pilot.

The text will be amended as follows:

Name the main components of the engine fuel system and state their function:

- filters;
- low-pressure (LP) pump;
- high-pressure (HP) pump;
- fuel manifold;
- fuel nozzles;
- HP fuel cock;
- fuel control; or
- hydromechanical unit.

comment 285-B

comment by: FTEJerez



Comment on 021 11 04 01 (15)

The LO should include instruction to give qualitative examples of fuel and oil pressure (<100 psi and ~300 psi respectively) in a typical GTE. This has been asked already in an EASA phase 1 exam recently, so it should be explicitly mentioned in the LOs.

response Not accepted.

Thank you for providing your comment referring to LO 021 11 04 01 (15).

EASA does not agree to include instruction to give qualitative examples of fuel and oil pressure in a typical GTE. Numerical examples like that is of no practical use to a pilot as this is not shown on any instrument.

comment 289-B

comment by: FAA

Page 37-38: 021 05 04 00 Aeroplane: Fly-by-Wire (FBW) control systems

(04) The proposed rewording of this LO uses FBW terms specific to Airbus. Other manufacturers, such as Boeing or Dassault use different terminology to describe the different modes. It is reasonable to expect an ATPL or a CPL to understand what a FBW system is and that there are different modes. Requiring competency in explaining the different modes seems more appropriate for the type rating than the license itself.

(05) New: A high-level understanding that with mode degradation you will see an increase in pilot workload and a decrease in flight-envelope protections would be appropriate. If the choice of the terms 'describe the implications' means more than that, we disagree with requiring that level of knowledge at the licensing level. That is more appropriate for the type rating.

(06) New: Describing the implications in the prescribed scenarios is not appropriate at the licensing level given the variability in aircraft design and is more appropriate for the type rating.

(07) Describing the implications in the prescribed scenarios is not appropriate at the licensing level given the variability in aircraft design and is more appropriate for the type rating.

Page 141: 022 02 03 00 Angle-of-attack (AoA) measurement

(07) New: Explaining how an incorrect AoA measurement can affect the controllability of a flight-envelope protected airplane seems more appropriate for a type rating than a licensing exam.

Page 181-182: 022 06 05 00 Autoland: design and operation

(01)-(09) We disagree with the proposal to add these learning objectives to the IR. A pilot getting their IR at this time will not be flying an airplane that has autoland. In the event the pilot does make it to an airplane that has autoland prior to receiving the ATPL, those airplanes will require a type rating and those pilots will learn and be tested about autoland at that point. Given the technology will eventually make it to airplanes that do not require a type rating, no more than basic awareness such as (01) and (02) should be added at this point.

response Thank you for your multiple comments.



Regarding your comment referring to LO 021 05 04 00 (04): Accepted.

EASA agrees to reword this LO.

The text will be amended as follows:

~~State the existence of degraded modes of operation.~~

Explain the different modes of operation:

- normal operation (e.g. normal law or normal mode);
- downgraded operation (e.g. alternate law or secondary mode);
- direct law.

In comment 157-E, the same issue was raised regarding this LO (04).

Regarding your comment referring to LO 021 05 04 00 (05) new: Not accepted.

EASA would like to state that this LO addresses pilot workload and how available protections are affected by mode degradation. This is highly relevant to a pilot.

Regarding your comment referring to LO 021 05 04 00 (06) new: Not accepted.

EASA would like to state that this LO addresses pilot workload during generic scenarios that can occur in any highly computerised aeroplane. This is highly relevant to a pilot as it encourages thinking beyond ticking boxes.

Regarding your comment referring to LO 021 05 04 00 (07): Not accepted.

EASA would like to state that this LO is a result of fly-by-wire designs where awareness of some control fundamentals is essential to a pilot.

Regarding your comment referring to LO 022 02 03 00 (07): Noted.

Please refer to response in CRD to NPA 2016-03 for Subject 022.

Regarding your comment referring to LO 022 06 05 00: Noted.

Please refer to response in CRD to NPA 2016-03 for Subject 022.

comment 290-B

comment by: DGAC FRANCE

General comment

First DGAC France would like to thank EASA for the update of the learning objectives, the theoretical knowledge syllabi and ground school exams. We congratulate EASA on the comprehensive overhaul of the learning objectives which will lead to more simplicity. We notice in particular that the subject 022 in particular is well done, the learning objectives are clearer and the curriculum is both more precise and less redundant.

Secondly DGAC France supports the introduction of the TEM concept and application in the training programs. Nevertheless, without entering too much into details DGAC France wants to develop only two points among those that caught our attention and arose questions.

§ One of the goals of the area 100 KSA is to teach the future pilots the need for developing these core competencies so that they could manage the threats and errors in the TEM model.

We would like to emphasize that there is no need to assess future pilots on that knowledge, the only need is that the trainees understand the use of competencies in a TEM model, and the way they can rely on them.



The ICAO-defined competencies should be all introduced (and not only a selection of them) with their ICAO definitions, in order to prepare students to use them during practical training and need not to be assessed during the theoretical part of the training.
 We suggest ensuring an identical level of use within the ATOs, that the observable indicators for these learning objectives should be in compliance with the ICAO principles.
 DGAC France also considers that it is necessary to ensure consistency between the different EASA working groups on the EBT core competencies before implementing them.
 § We are surprised by the important focus on mental maths developed in this NPA. Mental maths should only be exercised to develop the situation awareness competency. Therefore, the assessment should be as less pervasive as possible since we do not see a significant safety or competency concern nowadays with the evolution of the cockpits.

response Noted.
 Thank you for providing this general remark.

comment 291-B comment by: DGAC FRANCE

Doc B
Page 3/248
Page 4/248

Subject:
SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT
syllabus reference 021 01 01 02
Level of certification
 LO (01) Explain and state the safety objectives associated with failure conditions (AMC 25.1309, Fig.2).
 LO (02) Explain the relationship between the probability of a failure and the severity of the failure effects.

Content of comment:
 The NPA propose to delete these two LOs because of “no practical use” ; This knowledges are necessary to understand the concept of “fail safe” commonly used for some systems’ design and operation.
Alternative draft for proposed amendment

This two LO’s should be maintained.

021 01 01 02 – Level of certification
LO (01) Explain and state the safety objectives associated with failure conditions (AMC 25.1309, Fig.2).
LO (02) Explain the relationship between the probability of a failure and the severity of the failure effects.

response Not accepted.

Thank you for providing your comment referring to LOs 021 01 01 02 (01) and (02).
 EASA considers these LOs are not relevant and will remain deleted. It is the responsibility of the designer to ensure that the required levels of redundancy are met. Facts about the probability are just that and of no practical use to a pilot. The pilot needs to know what

level of redundancy is available but that is type-specific, hence belongs in a type rating.

comment 292-B

comment by: DGAC FRANCE

Doc B
Page 19/248
Subject:
SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT
syllabus reference 021 03 02 01 –
Hydraulic fluids : types, characteristics, limitations
 LO (03) List of two different types of hydraulic fluids :
 - Synthetic,
 - Mineral.

LO (04) State that different types of hydraulic fluids cannot be mixed.
 LO (05) State that at the pressures being considered, hydraulic fluid is considered incompressible

Content of comment:

The NPA proposes to delete these three Los because of “no practical use” :
 LO (03) and (04) could happen to be useful to pilots in case of a diversion to an airport with limited technical and maintenance support.
 LO (05) is the basic physics rule which allows to understand the working principle of hydraulic power, and should be kept as a minimum knowledge for pilots.

Alternative draft for proposed amendment

This three LO’s should be maintained.

syllabus reference 021 03 02 01 –
Hydraulic fluids : types, characteristics, limitations
 LO (03) List of two different types of hydraulic fluids :
 - Synthetic,
 - Mineral.

LO (04) State that different types of hydraulic fluids cannot be mixed.
 LO (05) State that at the pressures being considered, hydraulic fluid is considered incompressible.

response Partially accepted.

Thank you for providing your comment referring to LOs 021 03 02 01 (03), (04) and (05).
 EASA has accepted comments 98-B and 90-B to retain LO (03) and LO (05), and also has accepted comment 8-B to retain LO (04).
 Only LO (05) will be ‘BK’.
 In comment 265-B, a similar issue was raised regarding deletion of LO (10).

comment 293-B

comment by: DGAC FRANCE

Doc B

Page 30/248

Subject:

SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT

syllabus reference 021 04 03 04

Autobrake

LO (04) Describe how an autobrake system setting will result in a given rate of deceleration, and how the amount of braking applied may be affected by :

- The use of reverse thrust,
- Slippery runway.

Content of comment:

Part of this LO should be rephrased, as an autobrake system will not always result in a given rate of deceleration. For example, this is indeed the case for the LOW and MED modes on Airbus families, but the MAX mode will order the maximum pressure to the brakes, which may result in a variable rate of deceleration during the landing or acceleration stop roll.

Alternative draft for proposed amendment

Part of this LO should be rephrased, as an autobrake system will not always result in a given rate of deceleration.

response Accepted.

Thank you for providing your comment referring to LO 021 04 03 04 (04).

EASA agrees to reword this LO.

The text will be amended as follows:

Describe how an autobrake system setting will either apply maximum braking (RTO or MAX) or result in a given rate of deceleration, where the amount of braking applied may be affected by:

- the use of reverse thrust;
- slippery runway.

comment 294-B

comment by: DGAC FRANCE

Doc B

Page 39/248

Subject:

SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT

syllabus reference 021 05 04 00

Aeroplane : fly-by-wire (FBW) control system

LO (07) Describe the implication of :

- Dual control input made by the pilots,
- The control takeover facility available to the pilots.

Content of comment:



For this new LO, it should be noted that it only applies for aircraft equipped with sidesticks (there are no possible separated added dual inputs on control columns although they can be FBW system, as on Boeing airplanes).

Alternative draft for proposed amendment

Specify that this LO is only applies for aircrafts equipped with sidesticks.

response Accepted.

Thank you for providing your comment referring to LO 021 05 04 00 (07).

EASA agrees that this LO should be reworded to specify that it only applies to aircraft equipped with sidesticks.

The text will be amended as follows:

For aircraft using sidestick for manual control, describe the implications of:

- dual control input made by the pilots;
- the control takeover facility available to the pilots.

comment 295-B

comment by: DGAC FRANCE

Doc B

Page 65/248

Subject:

SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT

syllabus reference 021 09 04 01

Electricity – Distribution - General

LO (07) Explain that load sharing is always achieved during parallel operations.

Content of comment:

The NPA proposes to delete this LO because of “no practical use”. For pilots, it is necessary to understand the concept of “load shedding”, purpose of LO (8)

Alternative draft for proposed amendment

This LO should be maintained.

LO (07) Explain that load sharing is always achieved during parallel operations.

response Not accepted.

Thank you for providing your comment referring to LO 021 09 04 01 (07).

EASA considers these LOs are not relevant and will remain deleted. Knowledge of load sharing is not required in order to explain load shedding. Load shedding simply reduces the generator load, thus whether the loads have been shared 50/50 before the failure is of no importance.

comment 296-B

comment by: DGAC FRANCE

Doc B



Page 73/248

Subject:

SUBJECT 021 — AIRFRAME AND SYSTEMS, ELECTRICS, POWER PLANT AND EMERGENCY EQUIPMENT

syllabus reference 021 10 01 02

Engine : design, operation, components and materials

LO (04) Describe the gas-state changes, the valve positions and the ignition timing during the four strokes of the theoretical piston-engine cycle.

Content of comment:

The NPA proposes to delete this LO because of “no practical use”.

It can be considered as basic knowledge for pilots regarding the operating principle of a piston engine.

Alternative draft for proposed amendment

This LO should be maintained.

LO (04) Describe the gas-state changes, the valve positions and the ignition timing during the four strokes of the theoretical piston-engine cycle.

response Not accepted.

Thank you for providing your comment referring to LO 021 10 01 02 (04).

EASA considers this LO is not relevant and will remain deleted. LO 021 10 01 02 (01) provides sufficient depth of knowledge. The internal workings of the engine are of no practical use as the pilot is not an engineer to adjust any of these parameters.

comment 157-E

comment by: Lx

Comments are concerning NPA 2016-03(B)

Subject 020-ARCRAFT GENERAL KNOWLEDGE

THIS COMMENTS ARE UPLOADED HERE [NB: sub-NPA E], BECAUSE THE Add/edit Comments - FUNKTION FOR DOCUMENT DOES NOT WORK.

Technical review of the TK syllabi, LOs, and examination procedures for ATPL, MPL, CPL, and IRs: Subjects 020, 021 & 022

For questions concerning the comments you are welcome to contact:

Hans – Günter Luxa Phone +49(0)421 5592 235 e-mail: hans-guenter.luxa@lft.dlh.de

021 01 01 02 (04) New

We should prefer the action verb “state” rather than “explain” because the LO is about a fact.

021 01 02 00 (04)

Why “remark” and not “define”? To fulfil LO above (03) the student has to know the meaning of stress and strain



021 02 02 00 (08) New

This is a nice LO. The question is : What can be demanded of the candidate when demonstrating that he/ she meets the LO? What level of knowledge is desired? Is it like a statement about this fact? Should the candidate give examples? And which examples?

Suggestion: use the action verb "state"

021 02 04 00 (08)

Please delete this LO because of "no practical use" for a pilot

021 05 02 01 (05)

Limiting flight speeds

or

Limiting operation speeds ?

Please define in this LO

021 05 04 00 (04)

I think, this LO is Airbus- specific:

Suggestion:

Interpret different modes of operation:

Use the Airbus A320 EFCS as example and describe

Normal law/ alternate law/ direct law in cruise flight

Concerning

- speed , AOA and flight path control

- degree of flight envelope protection

LO (05) (06)New (07)

Are also Airbus specific or Aeroplane EFCS specific and should be a part of a Type Rating

Suggestion : use the action verb "name" or "state" ... that there are implications for pilot workload"

021 07 02 00 (01)

Delete

- Mechanical system using air pressure

In my opinion there is no practical use!

response Thank you for providing your multiple comments.

Regarding your comment referring to LO 021 01 01 02 (04): Not accepted.

EASA is of the opinion that the text of this LO is correct. 'Explain' encourages thinking of reasons rather than reiterating a fact.

Regarding your comment referring to LO 021 01 02 00 (04): Noted.

Regarding your comment referring to LO 021 02 02 00 (08) new: Accepted.

EASA agrees to replace the word 'Describe' with 'State'.

The text will be amended as follows:

State that several types of materials are used on aircraft and that they are chosen based on type of structure or component and the required/desired material properties.

Regarding your comment referring to LO 021 02 04 00 (08): Not accepted.

This LO is BK and can remain as is.

Regarding your comment referring to LO 021 05 02 01 (05): Accepted.

The wording 'limiting flight speeds' is the correct wording.

The text will be amended as follow:

Describe the requirement for limiting **flight** speeds for the various secondary flight control surfaces.

Regarding your comment referring to LO 021 05 04 00 (04): Accepted.

EASA agrees to reword this LO.

The text will be amended as follows:

~~State the existence of degraded modes of operation.~~

Explain the different modes of operation:

normal operation (e.g. normal law or normal mode);

downgraded operation (e.g. alternate law or secondary mode);

direct law.

In comment 289-B, the same issue was raised regarding this LO (04).

Regarding your comment referring to LOs 021 05 04 00 (05), (06) and (07): Partially accepted.

EASA agrees that these LOs need to be reworded and will be amended to make them more generic. The principles are the same, and knowledge beyond stating facts is essential for understanding the FBW system benefits and limitations.

The text will be amended as follows:

Describe the implications for pilot workload during flight in normal operation (normal law/normal mode) during the following scenarios:

an undetected system error activates the envelope protection;

aircraft departs from intended flight path;

aircraft does not respond as expected to control inputs.

For aircraft using sidestick for manual control, describe the implications of:

dual control input made by the pilots;

the control takeover facility available to the pilots.

Regarding your comment referring to LO 021 07 02 00 (01): Not accepted.

EASA agrees that this LO is relevant and will be retained. It may be considered during the next update of the LOs.

Additional comments received by email:

comment	<p><i>Per email</i></p> <p>As it was not possible to add the comments to the CRT I send you this mail with our comments:</p> <p>021 AIRFRAME and SYSTEM</p> <p>021 01 02 00 (01) For the basic comprehension of failure of an aircraft system even in a modern aircraft (fly-by-wire) the terms of stress, strains etc. should be known.</p> <p>021 10 02 01 (04) A CPL – students must know the combustion process of the engine in the aircraft he flies.</p> <p>021 10 04 02 (04, 05) A "must to know" for a pilot flying aircrafts with fuel and mixture control system</p>	comment by: SAT: Blatter Patrick
response	<p>Thank you for your multiple comments.</p> <p>Regarding your comment referring to LO 021 01 02 00 (01): Noted.</p> <p>The reworded subsequent LOs cover this to a satisfactory depth.</p> <p>Regarding your comment referring to LO 021 10 02 01 (04): Noted.</p> <p>This is of no practical use to a pilot as the engine is expected to be operated appropriately according to the manufacturer's specifications.</p> <p>Regarding your comment referring to LOs 021 10 04 02 (04) and (05): Noted.</p> <p>There is no benefit for a pilot to know the technical intricacies of the engine construction. A pilot is a user and not a designer or engineer.</p>	

Appendix A — Attachments

 [B.pdf](#)

Attachment #1 to comment [#261](#)

 [A02_01_02.pdf](#)

Attachment #2 to comment [#275](#)

 [NTSB Core Lock Recommendation.pdf](#)

Attachment #3 to comment [#276](#)



Appendix
to ED Decision 2018/001/R
**Subject 022 — AIRCRAFT GENERAL KNOWLEDGE:
INSTRUMENTATION**

RELATED NPA: 2016-03(B) — RMT.0595 — 6.2.2018

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3. Summary of the outcome of the consultation

Please refer to the Explanatory Note to Decision 2018/001/R.



4. Individual comments and responses

In responding to comments, a standard terminology has been applied to attest EASA's position. This terminology is as follows:

- (a) **Accepted** — EASA agrees with the comment and any proposed amendment is wholly transferred to the revised text.
- (b) **Partially accepted** — EASA either agrees partially with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.
- (c) **Noted** — EASA acknowledges the comment but no change to the existing text is considered necessary.
- (d) **Not accepted** — The comment or proposed amendment is not shared by EASA.

(General Comments)	-
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comment	23-B	comment by: <i>Bristol Groundschool</i>
response	<p>022 01 01 00 (10). You have 'loss pressure sensing'. I believe that should be 'loss of pressure sensing'</p> <p>Accepted.</p> <p>Thank you for providing your comment referring to LO 022 01 01 00 (10). The text will be amended as follows:</p> <p>(10) Explain the implications of the following pressure measurement errors, both for engine indications and other systems:</p> <ul style="list-style-type: none"> — loss of pressure sensing; — incorrect pressure indications. 	
comment	24-B	comment by: <i>Bristol Groundschool</i>
response	<p>022 01 04 00 (04) has litres/hour and US gallons/hour. However, in 022 01 03 00 (02) both imperial and US gallons are mentioned. Suggest adding Imperial gallons/hour to 022 01 04 00 (04).</p> <p>Accepted.</p> <p>Thank you for providing your comment referring to LO 022 01 04 00 (04). EASA agrees to add 'imperial gallons/hour' to this LO (04). The text will be amended as follows:</p> <p>List the following units used for fuel flow when measured by volume per hour:</p> <ul style="list-style-type: none"> — litres/hour; — imperial gallons/hour; — US gallons/hour. 	
comment	25-B	comment by: <i>Bristol Groundschool</i>

response	022 02 02 01 (04). The wording is quite vague. Might be better to give examples of the systems requiring TAT, pretty much as you have done for 022 02 03 00 (04) for AoA.
	<p>Accepted.</p> <p>Thank you for providing your comment referring to LO 022 02 02 01 (04). EASA agrees to reword this LO (04). The text will be amended as follows:</p> <p>Explain why TAT is often displayed and that TAT is the temperature input to the air-data computer.</p>
comment	26-B comment by: Bristol Groundschool
	022 02 05 00 (01). What about knots? Rare on large aircraft, but still found widely in aviation.
response	Not accepted.
	<p>Thank you for providing your comment referring to LO 022 02 05 00 (01). EASA would like to state that this LO is on the subject of vertical speed, and ICAO Annex 5 lists only m/s and ft/min as the relevant units. In any case, nautical miles per hour (kt) is impracticable for use as a unit of vertical speed.</p>
comment	27-B comment by: Bristol Groundschool
	022 02 06 00 (07). Should also cover Helicopter licences. green, yellow and red are the same for (H) as they are for (A); just need to differentiate the 'blue line' speed for (H) as VNE in autorotation rather than VYSE for (A). Either that or a near duplicated LO (07a) perhaps?
response	Accepted.
	<p>Thank you for providing your comment referring to LO 022 02 06 00 (07). EASA agrees that there should be a separate LO on this subject for helicopters. A new LO will be created and the following LOs renumbered:</p> <p>Define and explain the following colour codes that can be used on an ASI:</p> <ul style="list-style-type: none"> — green arc (normal operating speed range); — red line (VNE); — blue line (maximum airspeed during autorotation). <p>In comment 261-B, the same issue was raised regarding this new LO.</p>
comment	28-B comment by: Bristol Groundschool
	022 02 07 00 (06). Does this mean that all of the questions regarding temperature changes and CAS/Mach will be removed from the QB? This must be scrupulously done to ensure that such questions do not appear to an unsuspecting/unprepared candidate.
response	Accepted.
	<p>Thank you for providing your comment referring to LO 022 02 07 00 (06). EASA agrees to amend the text to improve clarity and some wording after 'level flight' will be added.</p> <p>The text will be amended as follows:</p> <p>State the relationship between Mach number, CAS and TAS, and interpret their variations according to FL and temperature changes.</p> <p>Explain the relationship between CAS, TAS and Mach number.</p> <p>Explain how CAS, TAS and Mach number vary in relation to each other during a climb, a</p>

descent, or in level flight in different temperature conditions.

comment 29-B comment by: Bristol Groundschool
022 03 01 00 (04). Potentially misleading. Suggest amend to '...will align itself to both the horizontal (azimuth) and vertical (dip) components of the...'

response Accepted.
Thank you for providing your comment referring to LO 022 03 01 00 (04).
EASA agrees to reword this LO (04).
The text will be amended as follows:
Describe that a magnetic compass will align itself to both ~~with~~ the horizontal (azimuth) and vertical (dip) components of the Earth's magnetic field, thus will not function in the vicinity of the magnetic poles.

comment 30-B comment by: Bristol Groundschool
022 03 04 00 (04). Suggest edit to '...system as an example of application for a flux valve...'

022 05 00 00. I would argue against the move of INS/IRS **back** to Gen Nav. I know that the argument is that it is a system, not an instrument, but then so are TAWS/GPWS, TCAS, Radalt etc. To my little brain instrumentation should cover anything on the flight deck with which the pilot interfaces to the aircraft - and its systems.

response Thank you for your multiple comments.
Regarding your comment referring to LO 022 03 04 00 (04): Accepted.
EASA agrees to reword this LO (04).
The text will be amended as follows:
Give the remote-reading compass system as example of application **for a flux valve.**
Regarding your comment referring to Subject 022 05 00 00: Noted.
It has been determined that INS/IRS remain in Subject 022.

comment 31-B comment by: Bristol Groundschool
022 06 04 00 (07). Suggest edit to '...how it may lead to an undesirable...'

response Accepted.
Thank you for providing your comment referring to LO 022 06 04 00 (07).
EASA agrees to reword this LO (07).
The text will be amended as follows:
Describe the consequences of not understanding what the FMAs imply or missing mode changes, and how it may lead to an undesirable aircraft state.

comment 32-B comment by: Bristol Groundschool
022 06 05 00 (02) and (07). As MLS is being removed from RNAV, suggest deleting it here too.

response Accepted.
Thank you for providing your comment referring to LOs 022 06 05 00 (02) and (07).
EASA agrees to delete the reference to MLS in LOs (02) and (07).
The text will be amended as follows:
~~List and describe the main components of an autoland system.~~
Explain the significance of the following components required for an autoland:
— **autopilot;**
— **autothrust;**



- radio altimeter;
 - ILS receivers.
- Describe typical failures that, if occurring below the alert height, will trigger a warning:
- all autopilots disengage;
 - loss of ILS signal or component thereof;
 - excessive ILS deviations;
 - radio-altimeter failure.

comment 33-B comment by: Bristol Groundschool
 022 07 01 03 (02). Suggest 'MOT (mark on target) be included as a SAR mode. There is an oblique reference to it as an 'over-flown point', but it could be more specific.

response Accepted.
 Thank you for providing your comment referring to LO 022 07 01 03 (02).
 EASA agrees to include the abbreviation MOT (mark on target) as a SAR mode.
 The text will be amended as follows:
 Explain that the Search and Rescue (SAR) modes of AFCS include the following functions:

- ability to autohover;
- facility for mark on target (MOT) approach to hover;
- automatically transition down from cruise down to a predetermined point or over-flown point;
- ability for the rear crew to move the helicopter around in the hover;
- the ability to automatically transition back from the hover back to cruise flight;
- the ability to fly various search patterns.

comment 34-B comment by: Bristol Groundschool
 022 07 02 01 (02). 'coupled', not 'couple'.

response Accepted.
 Thank you for providing your comment referring to LO 022 07 02 01 (02).
 EASA agrees to correct this editorial.
 The text will be amended as follows:
 Explain that the number of sensors will be dependent on the number of coupled modes of the system.

comment 35-B comment by: Bristol Groundschool
 022 07 03 01 (03). 'force trim', not 'forced trim'.

response Accepted.
 Thank you for providing your comment referring to LO 022 07 03 01 (03).
 EASA agrees to correct this editorial.
 The text will be amended as follows:
 Describe a simple SAS with forced trim system which uses magnetic clutch and springs to hold cyclic control in the position where it was last released.

comment 36-B comment by: Bristol Groundschool
 022 07 04 04 (02). Suggest this should mirror 022 06 03 00 (03) by listing the types of



response	<p>display to be examined.</p> <p>Accepted.</p> <p>Thank you for providing your comment referring to LO 022 07 04 04 (02). EASA agrees to reword this LO (02) by listing the types of display to be examined. The text will be amended as follows:</p> <p>Describe the different types of display:</p> <ul style="list-style-type: none"> – pitch and roll crossbars; – V-bar.
comment	<p>37-B comment by: Bristol Groundschool</p> <p>022 10 01 01 (07). Disagree. D-ATIS can populate the arrival details on some FMS/FMC automatically, so it is relevant and of practical use.</p>
response	<p>Not accepted.</p> <p>Thank you for providing your comment referring to LO 022 10 01 01 (07). EASA wishes to clarify that this LO is stating a fact that is covered by previous LOs to a satisfactory level.</p>
comment	<p>38-B comment by: Bristol Groundschool</p> <p>022 10 01 02 (05). -digital ATIS (D_ATIS) is surely an ATC, not AOC, function?</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to LO 022 10 01 02 (05). EASA agrees to move the line digital ATIS (D-ATIS) from LO (05) to LO (06). The text will be amended as follows:</p> <p>Give examples of airline operations communications (AOC) data link messages such as:</p> <ul style="list-style-type: none"> – out of the gate, off the ground, on the ground, into the gate (OOOI); – load sheet; – passenger information (connecting flights); – weather reports (METAR, TAF); – maintenance reports (engine exceedances); – aircraft technical data; – free-text messages. <p>Give examples of air traffic communications (ATC) datalink messages such as:</p> <ul style="list-style-type: none"> – departure clearance; – oceanic clearance; – digital ATIS (D-ATIS); – controller–pilot data link communications (CPDLC).
comment	<p>39-B comment by: Bristol Groundschool</p> <p>022 11 04 00. Man-machine interface? Should be Human-machine interface in these enlightened times surely?</p>
response	<p>Accepted.</p> <p>Thank you for providing your comment referring to the heading of Subject 022 11 04 00.</p>



EASA agrees to replace 'Man-machine interface' with 'Human-machine interface'.

The heading will be amended as follows:

022 11 04 00 Human-machine interface (CDU/MCDU)

comment	40-B	comment by: Bristol Groundschool
	022 14 01 00 (02). The 'area microphone' is commonly known as the cockpit area microphone (CAM) in the industry, as well as elsewhere in EASA documentation, so why not call it that here?	
response	Accepted. Thank you for providing your comment referring to LO 022 14 01 00 (02). EASA agrees to replace 'area microphone' with 'cockpit area microphone (CAM)'. The text will be amended as follows: List the main components of a CVR: <ul style="list-style-type: none"> – a shock-resistant tape recorder or digital storage associated with an underwater locating device beacon (ULB); – a cockpit area microphone (CAM); – a control unit with the following controls: auto/on, test and erase, and a headset jack; – limited flight-deck controls such as erase and test switches. 	
comment	41-B	comment by: Bristol Groundschool
	022 15 01 00 (06). Too vague. Please specify examples at least of 'peripherals'.	
response	Accepted. Thank you for providing your comment referring to LO 022 15 01 00 (06). EASA agrees to reword this LO. The text will be amended as follows: With the help of the relevant 022 references, give examples of airborne computers, such as ADC, FMS, GPWS, etc., and list the possible peripheral equipment for each system such as: <ul style="list-style-type: none"> – ADC with pitot probe(s), static port(s) and indicators; – FMS with GPS, CDU/MCDU and ND; – GPWS with radio altimeter, ADC and ND. 	
comment	42-B	comment by: Bristol Groundschool
	Overall this NPA represents, in the personal opinion of the writer, a welcome move away from unnecessary depth of technical knowledge and towards better understanding of the pilot/aircraft interface. Notwithstanding the comments made by me above, I heartily endorse the proposals.	
response	Noted. Thank you for providing your general comment on this NPA.	
comment	43-B	comment by: UK CAA
	The UK CAA has no comments on Part B.	
response	Noted. Thank you for providing your general comment on Part B of this NPA.	



comment

261-B

comment by: *European Cockpit Association*

Attachment [#1](#)

NPA 2016-03 (B)	Page nb	European Cockpit Association - Comments
SUBJECT 020 — AIRCRAFT GENERAL KNOWLEDGE		
SUBJECT 021 — Airframe and systems, electrics, power plant and emergency equipment:		
021 01 05 01 - Maintenance methods: hard time and on condition	7 & 8	The proposed provision lacks the knowledge of fix intervals and contents of maintenance checks (A,B,C,D,IL,R- Check)
021 02 05 00 - Helicopter: Flight controls structural aspects	15	Keep the LO's (02) and (03) which are removed because "No practical use". In fact, the type of rotors designs are very important to understand the use and capabilities of each helicopter. Not totally addressed in 021 15 02 01 (01)
021 04 01 02 (01), (02) and (03)	24 and 25	Identify clearly that are different LO's for aeroplanes and helicopters. In the caso of LO (3) is also applicable to helicopters.
021 04 01 02 (07) - System components, design, operation, indications and warnings, on ground/in-light protections, emergency extension systems	26	This LO is also applicable to helicopters
021 04 02 00 (04) - Nose-wheel steering	27	This LO is also applicable to helicopters
021 04 02 00 (05) - Nose-wheel steering	27	The term and consequences of "shimmy" do not apply to helicopters so this LO should be removed
021 04 04 01 - Wheels, rims and tyres; Types, structural components and materials, operational limitations, thermal plugs	30	Add Learning Objective: Identify cuts and damages (outside check) and know the limits. Describe how damages arise (e.g. flat spots)
021 04 05 00 (01) - Helicopter equipment	31	Add: And its limitations



021 05 04 06 Aeroplane: fly-by-wire (FBW) control systems	39	Add to the Learning Objective 021 05 04 06 the following: Describe solutions or actions to regain control.
021 07 01 00 ANTI-ICING AND DE-ICING SYSTEMS Types, design, operation, indications and warnings, operational limitations	46	Add Learning Objective: Know the certification requirements for de- and anti-icing components and state that real life condition can be much worse.
021 12 01 01 (01) and (02) - Smoke detection	110	This LO is also applicable to helicopters
021 16 03 00 (01) - Auxiliary systems hoist	118	Remove LO's. Justification: modern hoist/which systems are not longer driven by the aux gearbox. Are normally electrically driven.
SUBJECT 022 — INSTRUMENTATION		General remark: Good update of the Learning Objectives in the field of instrumentation, removing irrelevant topics and adding useful new ones. In particular addition of FMA's, fly-by-wire, general improved automation knowledge and unreliable airspeed are excellent. At the same time, what is still missing is the implementation of HUD displays on more next-gen aircraft as the B787/737Max/A350/etc.
022 01 01 00 (04) - Pressure gauge	127	Maintain both LO's. We consider important to understand the operating principles of sensors and therefore the understanding of the measurement and instrument errors
022 01 02 00 (04) and (05) - Temperatur sensing	129	Maintain both LO's. We consider important to understand the operating principles of sensors and therefore the understanding of the measurement and instrument errors
022 01 09 02 operating principle of a vibration-monitoring system	136	No practical use for this LO: <i>Describe the operating principle of a vibration-monitoring system using the following two types of sensors: — piezoelectric crystal, — magnet.</i>
022 02 03 05 Angle-of-attack (AoA) measurement	141	It is unclear what is desired from the student with the wording: <i>Give examples of different types of AoA displays.</i>
022 02 04 07 Altimeter	142	To the existing text " <i>Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale</i> " add Digital (in HUD displays)
022 02 06 00 Airspeed indicator	145	022 02 06 00 (2): Undo rewording and include Groundspeed as well in the list of speeds. 022 02 06 00 (5): Include the HUD Display. 022 02 06 00 (7): Include the lower amber band.
022 02 06 00 (07) - Airspeed indicator	146	Include this LO's for helicopters but with "as appropriate to aeroplanes or helicopters". ASI in helicopters also has colour codes but with different

		meaning. IE barber's pole is used for VNE in autorotation.	
022 02 06 00 (09) - Airspeed indicator	14 6	Introduce a new bullet for unreliable speed: "Aircraft attitude". This is important when a very low speed (<30 KIAS) or hover in helicopters	
022 02 07 00 - Machmeter	14 7 14 8	Machmeter and LSS are of no use for helicopters, but if the LO is included for IR courses it will affect also to helicopters IR modular courses which is of no sense.	
022 02 08 00 Air Data Computer / Air Data Reference System	14 8	<u>Do not remove Learning Objective 022 02 08 00 (10).</u> Students should be able to tell the difference between raw data and an ADC/ADRS system, and the advantage of having ADC's/ADRS	
022 02 08 00 (02)(03)- Air Data Computer / Air Data Reference System	14 9	Bullets like AoA and "Flaps" should include a phrase like : "as appropriate for airplanes or helicopters". Flaps bullet and landing gear positions should be separated.	
022 06 00 07 Aeroplane Automatic Flight Control Systems	16 7	Explain how a state of self-induced oscillations may be detected, describe the effects of self-induced oscillations and technique to stop the oscillations and maintain positive control of the aircraft.	
022 06 02 00 Autopilot system: design and operation	16 9	In connection to the LO 022 06 02 00 (13): <i>Describe the purpose of the synchronization function when engaging the autopilot and explain why the autopilot should be engaged when the aircraft is in trim</i> - <u>insert a new LO: Explain why using trim with the autopilot engaged is not allowed, and possible consequences, e.g. A/P Disconnect /aircraft out of trim. Also, Add Learning Objective: Describe FPA (Flight Path Angle). FPA-Mode is missing in the enumeration.</u>	
022 06 03 00 Flight director: design and operation	17 8	Comment on LO 022 06 03 00 (5): If the FD is showing unwanted commands, it should be switched off. <u>Add new LO 022 06 03 00 (9): Explain the importance of checking the FMC data and/or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed thus turned off.</u>	
022 08 00 00 - Trims - Yaw damper - FEP	19 1	Many helicopters use already such systems, including FEP, FBW, etc. So the introduction of this LO for helicopters will be a matter of time. A question remains, whether it should be added at this stage.	
022 09 00 00 AUTOTHRUST –	19	In LO 022 09 00 00 (5) amend the wording: <i>Explain</i>	



AUTOMATIC THRUST CONTROL SYSTEM	6	<i>how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed. Also, add in addition: indications/trend vectors are correct, but the reaction should not be too aggressive.</i>
022 09 00 00 (06):	19	Amend the wording LO 022 09 00 00 (06): Explain the threats associated with the use of autothrust:
022 10 00 00 - Communications systems	6	resulting in the pilot losing the sense of energy (e.g. thrust, speed) awareness.
022 10 00 00 - Communications systems	19	This LO should be included also for helicopters.
022 12 10 00 ACAS/TCAS principles and operations	7	Besides ACARS, ATSU or FANS - helicopters use the same systems.
022 12 10 00 ACAS/TCAS principles and operations	22	In LO 022 12 10 00 (19): add bullet point: - bellow 1100 feet above ground no descent RA can be generated
022 13 03 01 Electronic Flight Instrument Systems (EFIS), design & operation	1 & 22	In LO 022 12 10 00 (21) take into consideration that the green area not displayed in most aircraft. (at least not on Boeing aircraft)
022 13 03 02 Primary Flight Display (PFD), Electronic Attitude Direction Indicator (EADI)	22	Do not delete LO 022 13 03 00 (3); also see LO 022 13 03 00 (6). General knowledge about the function of a Symbol Generator is required
022 13 04 00 Engine parameters, crew warnings, aircraft systems, procedure and mission display systems	5	Remark on the LO 022 13 03 02 (8) - not common on most PFD displays, usually shown on ND.
022 13 04 00 Engine parameters, crew warnings, aircraft systems, procedure and mission display systems	23	Remark on the LO 022 13 04 00 (1) Electronic checklist (display unit) not common on all airplanes, e.g. 737 does not have such a system. Rephrase so it doesn't appear that any crew alerting system is connected with electronic checklists.
022 14 01 00 - CVR	6	Not all aircraft have system displays with system diagrams/schematics. Rephrase to "An aircraft display unit"
022 15 01 00 Digital circuits and computers: general, definitions and design	24	This LO is also applicable to helicopters
022 15 01 00 (08)	0	Remark on 022 15 01 00 (5) - clarify the wording (unclear what knowledge is expected from the student): <i>Define and explain the terms 'multitasking' and 'multiprocessing'.</i>
Missing topics in Subject 022:	24	No practical use for this LO.
	7	Head Up Display (HUD) LO 1: State the components used in a HUD system.
	X	



	<p>LO 2: Explain the possible advantage of having a HUD.</p> <p>LO 3: Name the data shown on a typical HUD (Altitude/Heading/Speed/Trends/Flight Path Vector (FPV)/TCAS Advisory/FMA.</p> <p>LO 4: Name the data NOT shown on a typical HUD (Wx information/Navigation information/TCAS map display.</p> <p>LO 5: Explain the principle of the FPV</p> <p style="text-align: right;">LO 6: State display modes on a HUD. (Full display/decluttered)</p> <p>Synthetic Vision System (SVS)/Enhanced Vision Systems (EVS)</p> <p>LO 1: Explain the working principle of a SVS/EVS system.</p> <p>LO 2: Explain the possible advantage of having a SVS/EVS.</p>
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response

NOTE: All 021 comments are addressed in the related CRD to NPA 2016-03(B) for Subject 021.

Thank you for your extensive feedback, which has been greatly appreciated.

EASA has carefully assessed all the comments received.

Each comment has been dealt with on a one-by-one basis. Comments on LOs as indicated by LO number.

Regarding your comment referring to LOs 022 01 01 00 (04) and (05): Partially accepted.

EASA agrees that only LO (04) is relevant and will be retained.

Regarding your comment referring to LOs 022 01 02 00 (04) and (05): Not accepted.

EASA is of the opinion that these LOs (04) and (05) are not relevant and will not be retained. The technical principle of these designs is of no practical use to a pilot.

Regarding your comment referring to LO 022 01 09 00 (02): Not accepted.

EASA is of the opinion that this LO (02) is relevant and will not be deleted. This LO will remain as 'BK', i.e. not examinable.

Regarding your comment referring to LO 022 02 03 00 (05): Accepted.

EASA agrees to reword this LO.

The text will be amended as follows:

Give examples of and interpret different types of ~~angle-of-attack (AoA)~~ displays:

- simple light arrays of green, amber and red lights;



- gauges showing a numerical scale.

Regarding your comment referring to LO 022 02 04 07 (07): Accepted.

EASA agrees to add 'digital (in HUD displays)'.

The text will be amended as follows:

Give examples of associated displays: pointer, multi-pointer, drum, vertical straight scale, and digital (in HUD displays).

Regarding your comment referring to LOs 022 02 06 00 (02), (05) and (07): Partially accepted.

EASA agrees to add 'HUD display' in LO (05), but will not take over your other two proposals.

The text will be amended as follows:

~~(05)~~ Give examples of an ASI display: pointer, vertical straight scale, and digital (HUD display).

EAS is not a parameter used by pilots and ground speed is out of context. HUD scale will be included. The meaning of 'lower amber band' is not clear.

Regarding your comment referring to LO 022 02 06 00 (08): Accepted.

EASA agrees that there should be a separate LO on this subject for helicopters.

A new LO will be created and the following LOs renumbered:

Define and explain the following colour codes that can be used on an ASI:

- green arc (normal operating speed range);
- red line (VNE);
- blue line (maximum airspeed during autorotation).

In comment 27-B, the same issue was raised regarding this new LO.

Regarding your comment referring to LO 022 02 06 00 (10): Accepted.

EASA agrees that 'aircraft attitude' should be added to the list.

The text will be amended as follows:

Define the term 'unreliable airspeed' and describe the means by which it can be recognised such as:

- different airspeed indications between ASIs;
- unexpected aircraft behaviour;
- buffeting;
- aircraft systems warning;
- aircraft attitude.

Regarding your comment referring to Subject 022 02 07 00: Accepted.

EASA agrees that all the LOs of this subject should be only applicable to ATPL(A).

The 'X' under the column 'IR' will be deleted.

Regarding your comment referring to LOs 022 02 08 00 (02) and (03): Accepted.

EASA agrees to reword these LOs.



The text will be amended as follows:

List the following possible input data:

- TAT₇;
 - static pressure₇;
 - total pressure₇;
 - measured temperature₇;
 - angle of attack AoA₇;
 - flaps position₇;
 - and landing gear position₇;
- stored aircraft data.

List the following possible output data, as applicable to aeroplanes or helicopters:

- IAS₇;
- TAS₇;
- SAT₇;
- TAT₇;
- Mach number₇;
- angle of attack AoA₇;
- altitude₇;
- vertical speed₇;
- ~~V_{MO}/MMO~~ V_{MO}/M_{MO} pointer.

Regarding your comment referring to LO 022 02 08 00 (10): Not accepted.

EASA would like to state that the advantage of processed data is a given.

Regarding your comment referring to LO 022 06 01 00 (07) is correct: Partially accepted.

EASA agrees that the suggested text for this LO in the NPA is too broad and the LO will be reworded.

The text will be amended as follows:

Explain how a state of self-induced oscillations may be detected and describe the effects of self-induced oscillations:

- aircraft controllability;
- aircraft safety;
- timely intervention as a way of mitigating loss of control;
- techniques that may be used to maintain positive control of the aircraft.

Regarding your comment referring to LOs 022 06 02 00 (06), (25) and (28): Partially accepted.

EASA agrees to amend these LOs. The use of trim with autopilot engaged will be



added to 022 06 02 00 (28) which is an LO covering trim. FPA will be included in the list in 022 06 02 00 (06) and introduced into 022 06 02 00 (25) as it is similar to V/S mode in function.

The text will be amended as follows:

~~Explain and describe the following longitudinal (or vertical) modes: pitch, vertical speed, level change, altitude hold (ALT), profile or VNAV, G/S.~~

Explain the following vertical modes:

- vertical speed (V/S);
- flight path angle (FPA);
- level change (LVL CHG)/open climb (OP CLB) or open descent (OP DES);
- speed reference system (SRS);
- altitude (ALT) hold;
- vertical navigation (VNAV)/managed climb (CLB) or descent (DES);
- glideslope (G/S).

[...]

Explain the dangers of mismanagement of the following modes:

- use of V/S and lack of speed protection, i.e. excessive V/S or FPA may be selected with subsequent uncontrolled loss or gain of airspeed;
- arming VOR/LOC or APP outside the protected area of the localiser or ILS.

[...]

Explain the following regarding autopilot and aircraft with manual trim:

- the autopilot may not engage unless the aircraft controls are in trim;
- the aircraft will normally be in trim when the autopilot is disconnected;
- use of manual trim when the autopilot is engaged will normally lead to the autopilot disconnecting and a risk of an out of trim situation.

Regarding your comment referring to LO 022 06 03 00: Accepted.

EASA agrees to create a new LO (09) covering solution to incorrect FD indications.

The following new LO will be inserted:

Explain the importance of checking the FMC data or selected autopilot modes through the FMA when using the flight directors. If the flight directors are showing incorrect guidance, they should not be followed and turned off.

Regarding your comment referring to LO 022 08 00 00: Noted.

EASA agrees that this is a valid argument and should be considered for the next update of the LOs.

Regarding your comment referring to LO 022 09 00 00 (05): Accepted.

EASA agrees that this LO should be reworded.



The text will be amended as follows:

~~Explain the limitations of an AT system in case of turbulence.~~

Explain how flight in turbulence/wind shear giving fluctuating airspeed indications may lead to the autothrust overcompensating in an oscillating manner and that manual thrust may be required to settle the airspeed. Airspeed indications/trend vectors may give an indication of appropriate thrust adjustments but any reaction should not be too aggressive.

Regarding your comment referring to LO 022 09 00 00 (06): Accepted.

EASA agrees that this LO should be reworded.

The text will be amended as follows:

Explain the threats associated with the use of autothrust resulting in the pilot losing the sense of energy (e.g. speed, thrust) awareness.

Regarding your comment referring to Subject 022 10 01 01: Accepted.

EASA agrees that all the LOs of this Subject should be applicable to both ATPL(H) and ATPL/IR. The 'X' will be added under the column 'ATPL(H)' and 'ATPL/IR'.

Regarding your comment referring to LOs 022 12 10 00 (19) and (21): Partially accepted.

EASA is of the opinion that this point is included in LO 022 12 10 00 (19) already, except stating no RA below 1000 ft. Numerical value not that important as may vary slightly. EASA will amend LO 022 12 10 00 (21) to reflect this.

The text will be amended as follows:

~~Explain that an RA is presented as a possible vertical speed on a TCAS indicator or on the Primary Flight Display (PFD).~~

Explain the indications of a TA and an RA and how an RA will generate a red area on the VSI. Some variants will also include and a green area. To manoeuvre the aircraft to comply with the RA, the pilot should 'avoid the red' or 'fly the green'.

Regarding your comment referring to LO 022 13 03 01: Not accepted.

EASA is of the opinion that a symbol generator function is not relevant. Its existence and that there may be a switching facility is sufficient.

Regarding your comment referring to LO 022 13 03 02: Not accepted.

EASA would like to state that the majority of PFDs on commercial aircraft have heading information shown in some form.

Regarding your comment referring to LO 022 13 04 00 (01): Accepted.

EASA agrees that this LO should be reworded.

The text will be amended as follows:

State the purpose of the following systems:

- engine instruments centralised display unit;
- crew alerting system/aircraft ~~associated with an electronic checklist~~ display unit;



- facility for appropriate on-screen checklists;
- that the aircraft systems display unit enables the display of normal and degraded modes of operation of the aircraft systems;
- that the systems/aircraft display unit is able to show pictorial systems diagrams/schematics and associated parameters.

Regarding your comment referring to LO 022 14 01 00: Accepted.

EASA agrees that all the LOs of this Subject should be applicable to all helicopter licences. The 'X' will be added under the column 'ATPL/IR', 'ATPL(H)' and 'CPL(H)' .

Regarding your comment referring to LO 022 15 01 00 (05): Partially accepted.

EASA agrees that the wording of this LO is unclear. Instead of rewording it, this LO will be deleted.

Regarding your comment referring to LO 022 15 01 00 (08): Accepted.

EASA agrees that this LO has no practical use and it will be deleted.

Regarding your comment referring to HUD comment: Accepted.

EASA agrees that LOs are needed, covering HUD, SVS and EVS.

The following new subject 'Head-up display (HUD), synthetic vision system (SVS) and enhanced visual system (EVS)' with its LOs will be inserted as follows:

022 13 07 00 Head-up display (HUD), synthetic vision system (SVS) and enhanced visual system (EVS).

022 13 07 01 Components, benefits, modes of operation

(01) State the components of a typical HUD installation:

- HUD projector and stowable combiner;
- HUD controls such as declutter and dimmer;
- HUD computer.

(02) Explain the reasons and benefits of having an HUD:

- increased situational awareness due to reduced need to look inside to view primary flight information;
- lower minima for both departure and landing;
- improving accuracy of flying by reducing the susceptibility to entering a state of aircraft upset.

(03) Describe how the HUD replicates the information on the primary flight display (PFD) by showing the following data:

- altitude;
- speed, including speed trend;
- heading;
- flight path vector (track and vertical flight path);
- flight mode annunciator (FMA);
- CAS, TAWS and wind shear command annunciations.



(04) Describe the following modes of operation of an HUD:

- normal display mode that may automatically adapt the information based on phase of flight;
- declutter function.

(05) Describe the principle of SVS:

- an enhanced database used as reference to provide terrain and ground features to be shown on the PFD;
- limitations due to being a synthetic image not based on actual sensory information thus not lowering landing minima;
- implications if aircraft position accuracy becomes reduced.

(06) Describe the principle of EVS:

- includes external sensors such as infrared cameras to generate a real-time image on the PFD or in the HUD;
- limitation of the fact an infrared camera uses temperature and temperature difference in order to produce an image;
- enables lower minima because of the real-time image enhancing the visibility as experienced by the pilot.

comment 287-B comment by: Luftfahrt-Bundesamt
 The LBA has no comments on NPA 2016-03 (B).
 response Noted.
 Thank you for providing this general comment.

comment 311-B comment by: GNSS Centre of Excellence
020
 New Los, especially in part 022, covers nearly all of our previous proposals from CABILAVI project

 Minor concerns only
022 03 03 01 GNSS compass
 LO Explain the principle of operations of a GNSS compass.

022 15 01 00 Digital circuits and computers: General, definitions and design
 LO Explain the single event effect (SEE) – possible causes and danger of radiation.

 remark: We added all our concerns in one document in NPA part (A) and again divided relevant information to relevant NPA part
 response Not accepted.
 Thank you for providing this comment referring to the GNSS compass.
 EASA would like to inform that the GNSS compass is not commonly found in aircraft. EASA may add an LO on the GNSS compass, when it becomes a common feature. Your proposed new LO in Subject 022 15 01 00 is not relevant to a pilot.



Notice of Proposed Amendment 2016-03(B) — General and specific comments. NOTE: Due to technical issues, the FlashPaper version of this sub-NPA does not contain segments for each Subject. Therefore, when placing comments on this sub-NPA, you are kindly requested to indicate clearly the Subject, topic, subtopic, paragraph and LO number you are commenting on. Example: 'Comment on 021 08 02 02 (01)'.

p. 1

comment 2-B

comment by: ENAIRE

NPA file – Item reference - Page: (B) - 022 11 03 00 - Page 210

Comment: The new reference (08) seems to imply that all multi-sensor FMS calculate an hybrid position solution from all the available navigational inputs received at the same time. However, this is not always the case, as some FMS use only one navigation input at a time, and only switch to the others if the primary one has failed.

Proposed action: to rephrase reference (08) so that the different FMS architectural options are more clearly addressed.

response Accepted.

Thank you for providing this comment referring to LO 022 11 03 00 (08).

EASA agrees to rephrase LO (08) so that the different FMS architectural options are more clearly addressed.

The text will be amended as follows:

Explain how the FMS will create its own FMS position fix and that the FMS calculations will be based on the FMS position. Depending on the type of system, the FMS position may be calculated from:

- a single source of position data where the most accurate available at a given time will be used;
- multiple sources from which a position will be derived using the combined inputs.

comment 3-B

comment by: ENAIRE

NPA file – Item reference - Page: (B) - 022 11 03 00 - Page 210

Comment: The new reference (09) mentions “RNAV/GNSS approaches”. However the ICAO circular 336 has already been issued to replace this chart terminology, and this seems to leave out RNAV (RNP) (ie. RNP AR) approaches.

Proposed action: to replace “RNAV/GNSS approaches” for the more generic term “RNP approaches” covering a) the current RNAV(GNSS), b) the future titles of the latter, and c) the current RNAV (RNP) charts which are also impacted by a GNSS loss.

response Partially accepted.

Thank you for providing this comment referring to LO 022 11 03 00 (09).

EASA agrees to replace ‘RNAV/GNSS approaches’ for the more generic term ‘RNP/PBN approaches’ (instead of your proposed ‘RPN approaches’).

The text will be amended as follows:

Explain the implications of a reduction in available position inputs to the FMS, especially GPS in relation to the capability of performing RNP/PBN approaches.

comment 4-B

comment by: ENAIRE

NPA file – Item reference - Page: (B) - 022 13 03 02 - Page 229

Comment: The new reference (09) asks to describe “ILS localiser/glideslope or horizontal/vertical flight path deviation indicator”. However, both GBAS approaches and RNP APCH with vertical guidance (LNAV/VNAV, LPV) display such elements too.

Proposed action: to add GBAS and RNP APCH, ie. “ILS/GBAS/SBAS localiser/glideslope or



horizontal/vertical flight path deviation indicator". Notice that these new systems have been addressed in (C)- **033 02 01 05** producing a degree of internal inconsistency.

response Accepted.

Thank you for providing this comment referring to LO 022 13 03 02 (09). EASA agrees to add these terms. The text will be amended as follows:

Describe the typical design and location of the following information:

- flight mode annunciators (FMAs);
- vertical speed indicator including TCAS RA command indications;
- radio altitude;
- ILS localiser/glideslope and RNP/PBN, GBAS or SBAS horizontal/vertical flight path deviation indicator;
- decision altitude/height (DA/H).

comment 45-B comment by: FTEJerez

Comments on 022 01 00 00

022 01 01 00 (04) (05) (07) (09)

All these LOs were removed because they are said to no have any practical use. While they are not fundamental to understand how to directly operate the system, they are crucial to understand its limitations.

Given that we know have the BK tag, I would say these LOs are a perfect example of knowledge that we should require to be taught in class and included in approved manuals, but not directly examinable.

Ex.: How do we explain hysteresis errors without these basics?

Recommendation: included back as Basic Knowledge.

022 01 02 00 (04) (05)

All these LOs were removed because they are said to no have any practical use. While they are not fundamental to understand how to directly operate the system, they are crucial to understand its limitations.

Given that we know have the BK tag, I would say these LOs are a perfect example of knowledge that we should require to be taught in class and included in approved manuals, but not directly examinable.

Recommendation: included back as Basic Knowledge.

022 01 04 00 (05)

All these LOs were removed because they are said to no have any practical use. While they are not fundamental to understand how to directly operate the system, they are crucial to understand its limitations.

Given that we know have the BK tag, I would say these LOs are a perfect example of



knowledge that we should require to be taught in class and included in approved manuals, but not directly examinable.

Recommendation: included back as Basic Knowledge.

response Thank you for your multiple comments on Subject 022 01 00 00.
Regarding your comment referring to LOs 022 01 01 00 (04), (05), (07) and (09): Not accepted.

EASA does not see the need to retain these LOs and make them 'BK'. These LOs will not be restored.

Regarding your comment referring to LOs 022 01 02 00 (04) and (05): Not accepted.
EASA does not see the need to retain these LOs and make them 'BK'. These LOs will not be restored.

Regarding your comment referring to LO 022 01 04 00 (05): Not accepted.
Furthermore, EASA would like to state that the type of sensor is of no importance as such. What is important is understanding the importance and purpose of the parameter and not the type of sensor used.

comment **48-B** comment by: *FTEJerez*

Comments on 022 02 00 00

022 02 02 01 (03)

Ram rise becomes specially relevant at high altitudes where we have high Mach Numbers that could give us icing conditions relatively low IAS. Teaching Ram Rise without a reference to Mach Number is misleading.

Recommendation: LO kept in the syllabus.

022 02 06 00 (02)

Why was EAS removed from the list?

We propose it is included back on:

Define and explain the relationship between the following:

- indicated airspeed (IAS);
- calibrated airspeed (CAS);
- equivalent airspeed (EAS);
- true airspeed (TAS).

response Thank you for your multiple comments on Subject 022 02 00 00.
Regarding your comment referring to LO 022 02 02 01 (03): Not accepted.
EASA does not see the need to retain this LO. This does not warrant a separate LO as it is not possible to explain the difference TAT versus SAT without including the influence of Mach number or IAS for that matter.
Regarding your comment referring to LO 022 02 06 00 (02): Not accepted.
EASA does not see the need to retain this LO. EAS is not a speed used by line pilots nor is it shown on any instrument.

comment **50-B** comment by: *FTEJerez*



Comments on 022 04 00 00:

The redactors of the changes proposed here to reduce the teaching of gyro instruments to describing the face of the instrument, and its indications (with the exception of the slip indicator, where its principle of operation is still an LO).

Basic principles of gyro theory such as degrees of freedom, gimbal systems and tie mechanisms and the principles of operation of the difference gyros are fundamental to understand how to properly identify reading errors and their sources. This knowledge is of great use to the pilot when filling a tech log and communicating with the maintenance engineers.

The level of knowledge required after the proposed changes seems to be more adequate to a Type Rating course, at which point the pilot should have his ATPL course knowledge to build on top of.

Recommendation: include back the following LOs eliminated for "no practical use" and mark them as Basic Knowledge:

- 022 04 01 00 (03), (06), (08)
- 022 04 02 00 (03), (04)
- 022 04 03 00 (02), (03), (04), (07), (08)
- 022 04 04 00 (02), (03), (04)
- 022 04 05 00 (03)

Recommendation: include back the following LOs eliminated for "no practical use" :

- 022 04 02 00 (06)
- 022 04 03 00 (05)
- 022 04 04 00 (06)

response Thank you for your multiple comments on Subject 022 04 00 00.

Regarding your general comment referring to Subject 022 04 00 00: Noted.

EASA would like to state that the objective of this change to the LOs is to get away from learning facts and figures for the sake of it. A pilot is operating (flying) the aircraft and not constructing or repairing it. Therefore, the emphasis should be on operational issues and system-wide factors and limitations rather than in-depth technical construction and pedantic facts about individual elements.

Regarding your comment referring to LO 022 04 01 00 (03): Accepted.

EASA agrees that this LO is relevant and will be retained. This belongs to 'BK' and an 'X' will be added in the column 'BK'.

Regarding your comment referring to LO 022 04 01 00 (06): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. All gyros in aircraft are tied so no practical use to a pilot.

Regarding your comment referring to LO 022 04 01 00 (08): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. The construction of gyros is of no practical use to a pilot.

Regarding your comment referring to LO 022 04 02 00 (03) and (04): Not accepted.

EASA does not agree that these LOs are relevant and will not retain them. The construction



and degrees of freedom of a gyro is of no practical use to a pilot.

Regarding your comment referring to LO 022 04 03 00 (02): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. Design and construction are of no practical use to a pilot.

Regarding your comment referring to LO 022 04 03 00 (03): Accepted.

EASA agrees that this LO is relevant and will be retained. This belongs to 'BK' and an 'X' will be added in the column 'BK'.

Regarding your comment referring to LO 022 04 03 00 (04): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. A pilot will never see, let alone service, the gimbal system of an artificial horizon.

Regarding your comment referring to LO 022 04 03 00 (05): Accepted.

EASA agrees that this LO is relevant and will be retained.

Regarding your comment referring to LOs 022 04 03 00 (07) and (08): Not accepted.

EASA does not agree that these LOs are relevant and will not retain them. A vertical gyro unit is slowly becoming obsolete.

Regarding your comment referring to LO 022 04 04 00 (02): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. Design and construction are of no practical use to a pilot.

Regarding your comment referring to LOs 022 04 04 00 (03) and (04): Not accepted.

EASA does not agree that these LOs are relevant and will not retain them. The construction and degrees of freedom of a gyro are of no practical use to a pilot.

Regarding your comment referring to LO 022 04 05 00 (03): Accepted.

EASA agrees that this LO is relevant and will be retained. This belongs to 'BK' and an 'X' will be added in the column 'BK'.

Regarding your comment referring to LO 022 04 02 00 (06): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. In reality, this is a theoretical exercise only. Practically, either a turn is at a given bank angle or at rate-1 indication on the instrument.

Regarding your comment referring to LO 022 04 03 00 (05): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. These errors are so small that they have no relevance in the practical world.

Regarding your comment referring to LO 022 04 04 00 (06): Not accepted.

EASA does not agree that this LO is relevant and will not retain it. This is a purely theoretical exercise without any practical application to a line pilot.

comment 51-B

comment by: FTEJerez

Comments on 022 05 00 00

The basic principles, design, errors and principles of operation of the INS/IRS should remain a part of instruments as teaching the basics would be out of context in General Navigation.

Recommendations:

Classified as Basic Knowledge:

- 022 05 01 01



- 022 05 01 02, with the exception of the 3rd and 4th LO inside this, where the student should be tested on
- 022 05 01 03, with the exception of the 3rd LO, where the student should be tested on
- 022 05 02 01
- 022 05 02 02, with the exception of the 4th and 7th LO, where the student should be tested on
- 022 05 02 03

Fully examinable LOs

- 022 05 02 04

response Noted.

Thank you for your multiple comments on Subject 022 05 00 00.

Noted. The move of the LOs from Subject 022 to Subject 061 has been revoked and INS/IRS will remain in Subject 022.

comment 52-B

comment by: FTEJerez

Comments on 022 06 00 00

022 06 01 00

In this LO the redactor choose to focus on the concepts of closed-loops and open-loops and eliminate the references to the concepts of inner-loops and outer loops, with which we profoundly disagree.

Learning the differences between inner loop and outer loop establishes the practical use of the closed loop concept and builds the bridge to the interaction logic between the Guidance (Flight Director) and Stability/Control (Auto Pilot) functions.

Recommendation:

4. maintain 022 06 01 00 (04)
5. re-write 022 06 01 00 (05) as:
List the following different elements of a inner loop / outer loop control system and explain their basic function and how they are related:
 - *input signal;*
 - *error detector;*
 - *signal processing (computation of output signal according to control laws);*
 - *output signal;*
 - *signal processor providing a measured output signal according to set criteria or laws;*
 - *control element such as an actuator;*
 - *feedback signal to error detector for comparison with input signal*

022 06 03 00

Recommendation: bring back LO (02), at least as Basic Knowledge.

response Thank you for your multiple comments on Subject 022 04 00 00.



Regarding your comment referring to LO 022 06 01 00 (04): Not accepted.
EASA does not agree that this LO is relevant and will not retain it. The LO serves no practical purpose to a line pilot. The technicality of inner and outer loop is of no practical use as the function and limitations of the autopilot are important and not the fact of outer loop being guidance and inner loop being control.

Regarding your comment referring to LO 022 06 01 00 (05): Not accepted.
EASA does not see the need to rewrite this LO (05). Autopilots are closed loop systems and the inner/outer loop fact is of no practical use to a pilot.

Regarding your comment referring to LO 022 06 03 00 (02): Not accepted.
EASA does not agree that this LO is relevant and will not retain it. Compiling a list of computer names and input parameters is of no practical use. The revised 022 06 03 00 01 makes this LO redundant.

comment 53-B

comment by: KLM Flight Academy

In general the following remarks can be made:

Subject 021

In the year 2012 the name of the subject 021 has been changed in: 'Airframe and Systems, Electrics and Powerplant'. 'Emergency equipment' has since then been moved to subject 070 'Operational Procedures'. There are no emergency equipment LO's in this subject anymore.

Below is just a summary of all my remarks on the NPA for subject 020. I put many more, detailed remarks in the applicable pdf document. On request I can make this document available to the applicable EASA working group.

Deleted LO's

In many LO's that have a summary, only the first line is crossed-out. It is not clear if the remainder of the LO's remain still valid, see for example 021 02 01 00 01.

Why is 'fuel transfer' deleted?

Which components should be known from a piston engine?

Why is knowledge about pressure and temperature sensors deleted? Not even basic knowledge. I think pilots should have a basic understanding about sensor systems. A pilot must, for instance, know that a thermocouple is for (high) temperature sensing. A pilot must have heard of a (pressure) capsule. Is the sensor mechanical or electronical/digital? Where is the sensor located? Fuel gauges and angular speed sensors are still in the LO's. Does not seem consistent.

I am not happy with the deletion of so many computer LO's (022 15). Please add at least some basic info. Pilots rely on computers everywhere. They should know more on their behaviour. I am willing to write a text proposal.

Etc.

LO's not clear

From too many (new) LO's, I don't understand what is meant with the objective. Example: "Explain the development of a faulty attachment" (21 02 01 00 04).

One more example: It is not clear what should be learned about 'humidity control'. There are aircraft that have humidifiers but there are also aircraft that have de-humidifiers.

In LO's of other subjects (062 Radio navigation for instance) the LO's state exactly what a candidate must know. In the 020 LO's it is not always clear what is expected. An exception is 021 02 04 00 07. Between brackets is exactly stated what is meant. I strongly propose do this everywhere.



What is meant with the 'aircraft positions error' at the altimeter LO? (022 02 04 00 09).
What is meant with 'GPWS modes of operation' (022 12 09)?
Very confusing and lengthy LO's on ACAS and TCAS (022 12 10). Terms are mixed up, LO's are repeated and too much detail when comparing with other alerting system LO's.
There has always been a difference between the EFIS EADI and PFD. Now it seems both displays are considered the same (022 13).
Etc.

Consistency
It would be nice if the LO's are consistent in wording. Example: 'operating principle' instead of 'working principle' or 'principle'.
Consistency is also required when working with knowledge levels to a certain detail. The construction of a wing and the construction of a fuselage should require the same amount of detail. This remark applies for both aeroplanes and helicopters.
Etc.

Mistakes
It is extremely important there are no mistakes in LO's. Students, text book writers, question writers and question evaluators rely on these LO's. Unfortunately the content of LO's is not always correct. As an example: carbon, glass and Kevlar etc. are not composite materials but are part of a composite material (021 02 02 00 02).
Another example is dynamic pressure; dynamic pressure is not measured (022 02 01 01 01) but calculated.
TAT is no input to an ADC.
I am not happy with the new LO on the FWS (022 12 02). Don't agree with the explanation of the MWL and the MCL for instance.
Etc.

Applicability
Many LO's can also be made available to Helicopters. Sometimes LO's for aeroplanes and helicopters can be combined with a small adaption in text.
It is also difficult to find out if an LO is for small aircraft and/or for large aircraft. Example is the LO on flight controls.
Etc.

Terms
Sometimes the same component has different names. Maybe it is worth to spell-out all these names as a candidate might have heard about a 'ground-flight switch', but never of a 'squat switch' which is exactly the same.
Etc.

Missing
Sometimes important 'items' are missing. Example: the ground flight switches (weight-on/off-wheel switches or squat switches) are not mentioned in the LO's.
I miss important (basic) knowledge about permanent magnets and electromagnets. Such info is important when dealing with generators and compasses.
I think a pilot should know a CSD or an IDG has its own oil system. When oil is found underneath an engine an airline pilot must know there are several oil/fluid systems connected onto the engine. Therefore it is also important the pilot can distinguish between engine oil and hydraulic fluid.



I think a pilot might know electrical fuses can be replaced by the pilot.
When reading the gyroscopic instruments LO's, it seems a pilot no longer has to know which instrument uses a gyroscope. That is strange. I strongly recommend: "Mention the operating principle of a turn and balance indicator, an attitude indicator, and a directional gyro". I also think the pilot must know which of these instruments use 'rigidity' and which one uses 'precession' (without going too much in detail). Furthermore I miss the 'error behaviour' of a gyroscopic instrument (error behaviour is discussed for the air data instruments).

Strongly recommend to keep the LO's on inner and outer loop systems in autoflight (022 06). This perfectly explains the new LO on oscillations.
Etc.

Combined LO's

Many LO's can be combined into one LO with a minor adaption in text.

Double LO's

There are still many 'double' LO's.

The term 'instrument error' is a general term which is applicable to each instrument. Take out the 'instrument error' in the separate instrument LO's (ASI, ALT, VSI etc.) and make a 'general' LO on instrument error.

Consider to do the same for the term 'position error'. It is difficult to describe the position error for each separate instrument.
Etc.

Aircraft type/manufacturer related

Sometimes I see Airbus terms that are not used in Boeings (ATSU for instance at 022 10).

On the other hand do we have to implement Airbus' 'alpha-floor protection' and Boeing's 'thrust latch' or are these term too type specific and possibly outdated already?

Etc.

Typo's & spelling errors

Still a number of typo's and spelling errors need to be corrected.

Moved LO

It is not wise to move the 022 05 Inertial navigation LO's to subject 061 General Navigation. Like magnetic compasses, AHRS, FMS and EFIS, all technical systems that are used in navigation are explained in subject 022 Instrumentation. Within this subject the architecture of these systems and their interrelationship and subsequent possible error behaviour are described. When taking out one system, the relative context (cohesion) is gone. On the other hand it would be wise to leave the operational use of the navigation systems in the subjects 061 General Navigation and 062 Radio navigation. Therefore I think some LO's for FMS (022 11) can stay in or move (back) to subject 061/062).

It is good that the CPDLC messages move to subject 091 Communications. Also recommend to move the LO on the 'log-on phase' (022 10 02 07) to subject 091.

Summarising

It is clear that a lot of good work has been done already. But the job is not finished. This NPA is not ready for publication. It still looks like a working document and we are in the middle of the process of converting the 'old' LO's into a new competency based document.



response Noted.
Thank you for your multiple comments on Subjects 021 and 022.
EASA has carefully assessed all the comments received.
Due to the layout of this comment (53-B), each paragraph is addressed individually with its own individual paragraph in the list in this section.
All the comments from both Subject 021 and 022 are addressed in the CRD to NPA 2016-03(B) for Subject 021, and EASA would like to refer you to this CRD.

comment 167-B comment by: KLM Flight Academy
022 01 01 00 04
pilot should know difference between mechanical and/or electr sensor! Also difference between sensor with/without moving parts!

response Not accepted.
Thank you for providing this comment referring to LO 022 01 01 00 (04).
EASA is of the opinion that the construction of sensors to an engineering level is of no relevance to a pilot yet the measured parameter (reading) is.

comment 168-B comment by: KLM Flight Academy
022 01 01 00 10
'other syst' also air data?

response Noted.
Thank you for providing this comment referring to LO 022 01 01 00 (10).
Air data parameters are specified separately (022 02 00 00). This section of the LO covers pressure gauges other than air data.

comment 169-B comment by: KLM Flight Academy
022 01 02 00 07
'other syst' also air data?

response Noted.
Thank you for providing this comment referring to LO 022 01 02 00 (10).

Air data parameters are specified separately (022 02 00 00). This section of the LO covers pressure gauges other than air data.
This comment is a duplication of your comment 168-B above.

comment 170-B comment by: KLM Flight Academy
022 01 03 00 02
still 'imperial' units?

response Noted.
Thank you for providing this comment referring to LO 022 01 03 00 (02).
'Imperial' is still a valid unit.

comment 171-B comment by: KLM Flight Academy
022 01 03 00 05
'how' goes to deep. Why not simply: state that the system compensates for these changes.

response Not accepted.
Thank you for providing this comment referring to LO 022 01 03 00 (05).
EASA does not agree with your proposal. This is a foundation for covering LO 022 01 03 00 (07).



comment	172-B 022 01 03 00 07 in addition I would propose a checking method to detect if there is a fuel leak by checking fuel on board + fuel used that must sum up to the original quantity	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 01 03 00 (07). EASA does not agree with your proposal, which is not appropriate for this Subject 022. This belongs in Subject 033.	
comment	173-B 022 01 05 00 04 percentage of what?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 01 05 00 (04). The referenced LO 022 01 05 00 04 does not contain anything about percentage.	
comment	174-B 022 01 06 00 02 Do not understand his LO, pleaser clarify	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 01 06 00 (02). EPR engines have special N1 mode type operation that is selectable in the event of an EPR data failure.	
comment	175-B 022 02 01 01 01 dynamic pressure is not a measurement!	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 02 01 01 (01). Dynamic pressure is a measurement and is the difference between total and static pressure, hence not directly but indirectly measured.	
comment	176-B 022 02 01 02 02 Instrument error is a general term not only applicable to the pitot/static system, Strongly propose to make a separate LO about the term instrument error.	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 02 01 02 (02). EASA does not see the need to draft a separate LO about the term 'instrument error'. This LO is specific for pitot/static instruments. Any instrument error relevant to other instruments will be specified in the appropriate LO.	
comment	177-B 022 02 02 01 01 There is no other explanation for OAT than the temperature of the outside air. Only SAT and TAT are defined.	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 02 02 01 (01).	



In the context of the LOs it appears that SAT is the temperature calculated from a TAT reading and OAT is meteorological temperature.

comment 178-B comment by: KLM Flight Academy

022 02 02 01 02

It is not clear whether or not the formula must be used to convert.

response Noted.

Thank you for providing this comment referring to LO 022 02 02 01 (02).

Any calculation method is acceptable, formula or CRP5 navigation computer.

comment 179-B comment by: KLM Flight Academy

022 02 02 01 04

Strange new LO, SAT is also often displayed.

response Noted.

Thank you for providing this comment referring to LO 022 02 02 01 (04).

This LO is only addressing why TAT may be of relevance where shown.

comment 180-B comment by: KLM Flight Academy

022 02 04 00 08

no longer vibrating altimeter?

response Noted.

Thank you for providing this comment referring to LO 022 02 04 00 (08).

This LO is not about altimeter types, but only errors. Time lag is an instrument error and does not warrant a separate entry.

comment 181-B comment by: KLM Flight Academy

022 02 04 00 09

a/c positions error?

response Not accepted.

Thank you for providing this comment referring to LO 022 02 04 00 (09).

EASA would like to state that 'aircraft position error' is the correct wording.

comment 182-B comment by: KLM Flight Academy

022 02 06 00 07

barber pole instead of barber's pole

response Not accepted.

Thank you for providing this comment referring to LO 022 02 06 00 (07).

EASA would like to state that 'barber's pole' is an accepted term.

comment 183-B comment by: KLM Flight Academy

022 02 07 00 03

No practical use.

Do not understand importance of this LO.

response Not accepted.

Thank you for providing this comment referring to LO 022 02 07 00 (03).

EASA is of the opinion that this LO is important. The fact that a Machmeter does not suffer



from compressibility is of practical use as it means that the Mach number shown is correct for all practical purposes.

comment **184-B** comment by: *KLM Flight Academy*

022 02 08 00 02

TAT is no input; TAT and SAT are calculated inside the ADC.

response Noted.

Thank you for providing this comment referring to LO 022 02 08 00 (02).

TAT is an input as that is what the TAT probe senses.

comment **185-B** comment by: *KLM Flight Academy*

022 02 08 00 03

altitude and pressure altitude.

Overspeed signal is also output.

response Not accepted.

Thank you for providing this comment referring to LO 022 02 08 00 (03).

EASA is of the opinion that the list has to be cut off at some point. Altitude is covered and overspeed may come from a flight warning system.

comment **186-B** comment by: *KLM Flight Academy*

022 02 08 00 09

Think this is extremely important for a pilot to know. Knowledge about architecture of computer systems can help the pilot in determining the source of errors. Pls delete BK asterisk.

response Noted.

Thank you for providing this comment referring to LO 022 02 08 00 (09).

This LO is too type-specific unless a particular architecture is chosen and defined. The particular architecture is covered in a type rating. The individual components are covered across the LOs of Subject 022 02 08 00.

comment **187-B** comment by: *KLM Flight Academy*

022 03 02 00 01

But pilot does not have to know about perm. and electr. magnets (LO was deleted from Electrics)

response Noted.

Thank you for providing this comment referring to LO 022 03 02 00 (01).

This is not electrics (021), but instruments (022). A very limited knowledge of magnetism is required for compass systems.

comment **188-B** comment by: *KLM Flight Academy*

022 03 02 00 05 This is General Navigation principle. Transfer from 061 is not appropriate.

response Not accepted.

Thank you for providing this comment referring to LO 022 03 02 00 (05).

EASA still believes this LO (transferred from LO 061 02 01 01 (02)) belongs now to Subject 022 03 02 00 'Aircraft magnetic field' and will remain there.

comment **189-B** comment by: *KLM Flight Academy*

022 03 03 00 04

From this LO it is not clear if the error behaviour must be described as well or only stated.



response	Noted. Thank you for providing this comment referring to LO 022 03 03 00 (04). The LO specifies when the direct-reading compass is regarded as correct and what manoeuvres will result in an error. The magnitude or effect of the error is not described.
comment	190-B comment by: KLM Flight Academy 022 03 04 00 05 There are still a/c with a flux valve and with a dev correction card for this flux valve.
response	Noted. Thank you for providing this comment referring to LO 022 03 04 00 (05). This technology is gradually being phased out, thus the most modern type should be sufficient.
comment	191-B comment by: KLM Flight Academy 022 04 02 00 Better name is: "Turn and balance indicator (Rate-of turn indicator and Turn coordinator)". When reading these LO's, a pilot no longer has to know this instrument uses a gyroscope. That is strange. I strongly recommend: "Mention the operating principle of a turn and balance indicator"
response	Noted. Thank you for providing this comment referring to Subject 022 04 02 00. These are the most common terms being used. The type of sensor is of no importance but the indications are.
comment	192-B comment by: KLM Flight Academy 022 04 03 00 where is 'error behaviour'? Again same remark as before: Pilot should know this instrument is based on a gyroscope that uses the property of rigidity.
response	Noted. Thank you for providing this comment referring to Subject 022 04 03 00. Errors are so insignificant that there is no need for them to be included as that would be a purely theoretical exercise. The type of sensor is of no importance but the indications are.
comment	193-B comment by: KLM Flight Academy 022 04 03 00 02 also add name: "artificial horizon"?
response	Not accepted. Thank you for providing this comment referring to LO 022 04 03 00 (02). EASA does not see the need to add this proposed variety. The present two varieties are sufficient.
comment	194-B comment by: KLM Flight Academy 022 05 00 00 Not logic at all. Subject 022 is about technical solutions and architecture of systems. 061 is for operational use and nav techniques. AHRS also stays in 022, so why a transfer of INS and IRS?
response	Noted.



Thank you for providing this comment referring to Subject 022 05 00 00.
It has been determined that Subject 022 05 00 00 will remain in Subject 022.

comment 195-B comment by: KLM Flight Academy

022 06 01 00 01

The enhancement of flt ctls is a task of the augmentation system (pitch trim, yaw damper etc)

Is safety also an objective of the AFCS?

Don't understand the two LO's 01 and 02.

response

Noted.

Thank you for providing this comment referring to LOs 022 06 01 00 (01) and (02).

Autoflight systems do enhance the flight controls, although when engaged, and not necessarily during manual flight. Properly managed automatics significantly reduce pilot workload and therefore improve safety.

comment 196-B comment by: KLM Flight Academy

022 06 01 00 04

Do not agree, see remark at newly introduced LO 06 and 07:

I think to understand this we should leave-in the concept of the inner- and outer loops. See deleted LO 04.

response

Not accepted.

Thank you for providing this comment referring to LO 022 06 01 00 (04).

EASA does not see the need to retain LO (04). The fact of inner loop and outer loop is of no importance to a pilot. A parameter is selected and the aeroplane should then perform the appropriate manoeuvre.

comment 197-B comment by: KLM Flight Academy

022 06 01 00 05

What is difference between 'signal processing' and 'signal processor'?

response

Partially accepted.

Thank you for providing this comment referring to LO 022 06 01 00 (05).

EASA realises that there is no need for the element 'signal processing' and 'output signal', and will be deleted from the list.

The text will be amended as follows:

List the following different elements of a closed-loop control system and explain their basic function:

- input signal;
- error detector;
- signal processing (computation of output signal according to control laws);
- output signal;
- signal processor providing a measured output signal according to set criteria or laws;
- control element such as an actuator;
- feedback signal to error detector for comparison with input signal.

comment 198-B comment by: KLM Flight Academy



	022 06 01 00 06I I think to understand this we should leave-in the concept of the inner- and outer loops. See deleted LO 04.	
response	Noted. Thank you for providing this comment referring to LO 022 06 01 00 (06). Closed and open loop is about feedback and measured response, and not about the inner/outer loop fact.	
comment	199-B 022 06 02 00 01 delete as reworded in 02	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 06 02 00 (01). EASA does not agree to delete LO (01). Control channels and types of autopilots are not the same thing.	
comment	200-B 022 06 02 00 03 missing: input (different sensor systems incl feedback) output (actuator with (dis)engagement clutch)	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 06 02 00 (03). EASA is of the opinion that no items on the list are missing and will not add your proposed items. The items on the list are to define vital components of the autoflight system. Sensory inputs are given depending on the available modes.	
comment	201-B 022 06 02 00 04 Can TRK nowadays be selected from the flight mode panel?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 06 02 00 (04). Yes, TRK nowadays can be selected from the flight mode panel.	
comment	202-B 022 06 02 00 10 mixed modes? common modes? apart from APP also LAND and/or ILS or outdated?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 06 02 00 (10). This is the defined list that is given. This does not make allowances for types. LAND is not selectable but a result.	
comment	203-B 022 06 02 00 11 Are these two types a generally accepted concept? flt dck ctls move/do not move?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 06 02 00 (11). Sweeping statement can be made as Airbus versus Boeing.	



comment	204-B 022 06 02 00 12 missing: flt path info	comment by: <i>KLM Flight Academy</i>
response	<p>Accepted.</p> <p>Thank you for providing this comment referring to LO 022 06 02 00 (12).</p> <p>EASA agrees to add this missing element in the list. The text will be amended as follows:</p> <p>(12)-List the inputs and outputs of a 3-axis autopilot system.</p> <p>Describe the purpose of the following inputs and outputs for an autopilot system:</p> <ul style="list-style-type: none"> — attitude information; — flight path/trajectory information; — control surface position information; — airspeed information; — aircraft configuration information; — FCU/MCP selections; — FMAs. 	
comment	205-B 022 06 02 00 20 Be very careful with terms 'engaged' and 'disconnected'. The AP is always on, but its clutch is not always engaged. Disconnected means taken loose.	comment by: <i>KLM Flight Academy</i>
response	<p>Noted.</p> <p>Thank you for providing this comment referring to LO 022 06 02 00 (20).</p> <p>The LO states that the autopilot remains engaged (ON) while its servo-actuators are disconnected.</p>	
comment	206-B 022 06 03 00 06 Not clear what is meant.	comment by: <i>KLM Flight Academy</i>
response	<p>Noted.</p> <p>Thank you for providing this comment referring to LO 022 06 03 00 (06).</p> <p>The LO covers the practical use of the flight director, i.e. its indications during different scenarios.</p>	
comment	207-B 022 06 04 00 04 Better LO level is State	comment by: <i>KLM Flight Academy</i>
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to LO 022 06 04 00 (04).</p> <p>EASA does not agree with your proposal. The underlying reason for engaged versus armed mode is the most important part of understanding the use of the automatics of a modern aeroplane.</p>	
comment	208-B 022 06 04 00 06 In that case: Is it wise to add an LO wherein the different FMA status annunciators are	comment by: <i>KLM Flight Academy</i>



response	discussed: "armed or standby (lower line), capture or intercept (upper line with highlight symbol) and active or track (upper line)"? Not accepted. Thank you for providing this comment referring to LO 022 06 04 00 (06). EASA is of the opinion that this is the purpose of LO 022 06 04 00 (06).
comment	209-B 022 06 05 00 02 AP must have an automatic pitch trim. Also discuss the need for multiple AP's engaged during the autoland? comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing this comment referring to LO 022 06 05 00 (02). The LOs of Subjects 022 06 02 XX XX, 022 06 03 XX XX and 022 06 04 XX XX cover all the technical aspects of the individual components. LO 022 06 05 00 (03) covers fail-operational and fail-passive systems.
comment	210-B 022 06 05 00 02 also: auto disengagement of AT upon landing comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing this comment referring to LO 022 06 05 00 (02). EASA does not see the need to add your proposed components to the list. This will be type-specific if so. Normally, the autopilot will not automatically disconnect during an autoland as it is required for the roll-out.
comment	211-B 022 06 05 00 09 Repetition from LO 022 06 05 00 03, so delete comment by: <i>KLM Flight Academy</i>
response	Not accepted. Thank you for providing this comment referring to LO 022 06 05 00 (09). EASA does not agree that this LO is a repetition from LO 022 06 05 00 (03). This LO covers the fail-operational hybrid landing system which is not to be confused with any of the other two.
comment	212-B 022 08 01 00 01 which purposes? auto pitch trim, manual elect pitch trim, and Mach trim? comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing this comment referring to LO 022 08 01 00 (01). This LO covers the basic design and purpose of having any trim system.
comment	213-B 022 08 01 00 02 Are there automatic rudder and aileron trim systems? Or does one mean the 'normal' elec rud and ail trim? In that case the LO should move to subject 021 flight controls. comment by: <i>KLM Flight Academy</i>
response	Noted. Thank you for providing this comment referring to LO 022 08 01 00 (02).



	LO 022 08 01 00 02 is a deleted LO.	
comment	214-B 022 08 02 00 02 Pls state how many (which) purposes? DR damping, turn coordination and N-1 compensation?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 08 02 00 (02). LO 022 08 02 00 02 is a deleted LO.	
comment	215-B 022 08 03 00 03 Also give the names 'alpha-floor protection' (Airbus) and or 'thrust latch' (Boeing) is this outdated?	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 08 03 00 (03). EASA does not see the need to add your proposed protection function to the list. What terms the manufacturers choose to use is of no relevance. Stall protection covers all eventualities.	
comment	216-B 022 09 00 00 02 be careful: not only active but also thrust hold or armed modes	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 09 00 00 (02). These modes are included in the list.	
comment	217-B 022 08 03 00 03 Also give the names 'alpha-floor protection' (Airbus) and or 'thrust latch' (Boeing) is this outdated?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 08 03 00 (03). This is a duplicate of your comment 215-B. EASA does not see the need to add your proposed protection function to the list. What terms the manufacturers choose to use is of no relevance. Stall protection covers all eventualities.	
comment	218-B 022 09 00 00 02 be careful: not only active but also thrust hold or armed modes	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 09 00 00 (02). This is a duplicate of your comment 216-B. These modes are included in the list.	
comment	219-B 022 10 01 01 04 Data tx spd is speed of light. Probably one means the amount of data that can be transmitted in a certain time (bit rate). With digital data one can transfer more information	comment by: KLM Flight Academy



response	in the same time than with voice data.
	<p>Accepted.</p> <p>Thank you for providing this comment referring to LO 022 10 01 01 (04). EASA agrees that this LO is not clear regarding data speed and will reword this.</p> <p>The text will be amended as follows:</p> <p>(04) State the advantages and disadvantages of each transmission mode with regard to:</p> <p>Consider the properties of the communication links with regard to:</p> <ul style="list-style-type: none"> — signal quality; — range/area coverage; — Range; — line-of-sight limitations; — quality of the signal received; — interference due to ionospheric conditions; — data transmission speed.
comment	<p>220-B comment by: KLM Flight Academy</p> <p>022 10 01 02 03</p>
	<p>Now it seems if A03TC always uses ACARS. ATC only uses ACARS for digital data transmission.</p>
response	<p>Noted.</p> <p>Thank you for providing this comment referring to LO 022 10 01 02 (03). The LO specifies the ATSU part which is data link only.</p>
comment	<p>221-B comment by: KLM Flight Academy</p> <p>022 10 01 02 04</p>
	<p>Aircraft manufacturer related. ATSU computer is typical Airbus. All mentioned components are Airbus, Boeing uses other names.</p>
response	<p>Partially accepted.</p> <p>Thank you for providing this comment referring to LO 022 10 01 02 (04).</p> <p>EASA agrees to amend the text to become more generic.</p> <p>The text will be amended as follows:</p> <p>List and describe the following possible onboard components of an ATSU:</p> <ul style="list-style-type: none"> — communications management unit (VHF/HF/SATCOM); — Data Communication Display Unit (DCDU); — Multi Control Display Unit (MCDU) for AOC, ATC and messages from the crew (downlink communication); — ATC message visual warning; — printer. <p>Explain the purpose of the following parts of the on-board equipment:</p> <ul style="list-style-type: none"> — communications computer;



- control display unit (CDU)/multifunction control display unit (MCDU);
- data communication display unit (DCDU);
- ATC message visual annunciator;
- printer.

comment 222-B comment by: KLM Flight Academy

022 10 01 02 06

Isn't a 'departure clearance' officially called an 'route clearance'?

Does a candidate for subject 022 must know what CPDLC is?

response Noted.

Thank you for providing this comment referring to LO 022 10 01 02 (06).

The types of clearances are DCL (departure clearance) and OCL (oceanic clearance). The depth of coverage for CPDLC will be confirmed with communications (091/092).

comment 223-B comment by: KLM Flight Academy

022 10 02 00 06

Abbreviation ATCU not generally known.

response Noted.

Thank you for providing this comment referring to LO 022 10 02 00 (06).

ATCU is the common abbreviation for air traffic control unit.

comment 224-B comment by: KLM Flight Academy

022 10 02 00 07

Also propose to move this 07 LO to 091 communications

response Partially accepted.

Thank you for providing this comment referring to LO 022 10 02 00 (07).

EASA agrees to move the old LO to Subject 090 02 13 00 as new LO (02).

comment 225-B comment by: KLM Flight Academy

022 10 02 00 11

Why not simply state the required differences in this LO?

response Not accepted.

Thank you for providing this comment referring to LO 022 10 02 00 (11).

EASA does not want to simply state the required differences in this LO. Features will change over time, thus the LO remains as is for now.

comment 226-B comment by: KLM Flight Academy

022 11 03 00 01

projections or predictions?

response Accepted.

Thank you for providing this comment referring to LO 022 11 03 00 (01).

EASA agrees to reword 'projections' into 'predictions'.

The text will be amended as follows:

~~List and describe data computation and functions including position computations (multisensors), flight management, lateral/vertical navigation and guidance.~~

Describe typical data that may be provided by the FMS:



- lateral and vertical navigation guidance;
- present position;
- time predictions;
- fuel predictions;
- altitude/flight level predictions.

comment 227-B comment by: KLM Flight Academy

022 12 02 00 01

More info on how FWS works: operating principle: flight phases, classification etc.

response Not accepted.

Thank you for providing this comment referring to LO 022 12 02 00 (01).

EASA is of the opinion that the wording of this LO does not need more information on how FWS works. Inhibitions and classifications of warnings are type-specific. This covers the basics to a sufficient level.

comment 228-B comment by: KLM Flight Academy

022 12 02 00 03

Would propose another classification on alerts. MWL and MCL are both attention getters, The MWL for an emergency, the MCL for an abnormal etc etc. See applicable CS (stated in LO 01). Aircraft type specific.

response Not accepted.

Thank you for providing this comment referring to LO 022 12 02 00 (03).

EASA does not see the need to have another classification on alerts. LOs 022 12 02 00 (03), (04) and (05) cover all three types of alerts.

comment 229-B comment by: KLM Flight Academy

022 12 02 00 05

When pressing the MWL/MCL the alert is acknowledged and silenced simultaneously.

response Noted.

Thank you for providing this comment referring to LO 022 12 02 00 (05).

This is covered by this LO.

comment 230-B comment by: KLM Flight Academy

022 12 04 00 01

what exactly is a stall protection system? Must this protect from approaching a stall condition or must recover from a stall. Stickpusher is stall protect or stall recovery?

response Noted.

Thank you for providing this comment referring to LO 022 12 04 00 (01).

A stall protection system is exactly what it says, protecting the aeroplane from entering a stall. This particular LO is not addressing stall recovery systems. Note that the text has only been changed to read 'Describe' instead of 'State'.

comment 231-B comment by: KLM Flight Academy

022 12 05 00 01

The OWS is not the VMO/MMO pointer but the discrete output signal from the ADC when exceeding Vmo/Mmo.

response Noted.



	Thank you for providing this comment referring to LO 022 12 05 00 (01). Some warning systems use the displayed data as reference. Practically, it makes little or no difference.	
comment	233-B 022 12 05 00 04 'barber pole', 'barber's pole' and/or 'checker bar' or is the latter 'slang'?	comment by: KLM Flight Academy
response	Accepted. Thank you for providing this comment referring to LO 022 12 05 00 (04). EASA agrees to reword this LO. The text will be amended as follows: Describe and give examples of V_{MO}/M_{MO} V_{MO}/M_{MO} pointer: barber's/barber pole pointer, barber's/barber pole vertical scale.	
comment	234-B 022 12 07 00 02 Can refer to applicable CS document.	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 12 07 00 (02). CS-25 has very limited description, thus no real benefit referring to it.	
comment	235-B 022 12 07 00 02 Also: 'operating principle'	comment by: KLM Flight Academy
response	for multiple r/a installations? Noted. Thank you for providing this comment referring to LO 022 12 07 00 (02). This LO is concerning traditional altitude alert and not radio altimeter.	
comment	236-B 022 12 07 00 04 What is considered a display? Which displays does one have to know?	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 12 07 00 (04). LO 022 12 07 00 (04) does not exist.	
comment	237-B 022 12 09 01 03 pls standardise on 'operating principle' instead of 'working principle'	comment by: KLM Flight Academy
response	Accepted. Thank you for providing this comment referring to LO 022 12 09 01 (03). EASA agrees to replace 'working principle' with 'operating principle'. The text will be amended as follows: List the Explain inputs and outputs of a GPWS and describe its operating principle.	
comment	238-B 022 12 09 01 04 Which modes of operation?	comment by: KLM Flight Academy



response	Noted. Thank you for providing this comment referring to LO 022 12 09 01 (04). The various GPWS nodes available according to the common standard.
comment	239-B comment by: KLM Flight Academy 022 12 09 03 01 Maybe 'introduced at a later date', Airbus is experimenting with rwy overrun protection systems.
response	Noted. Thank you for providing this comment referring to LO 022 12 09 03 (01). There is both incursion and overrun systems available but still very limited depending on the software state of the aeroplane. It may be considered for the next update of the LOs.
comment	240-B comment by: KLM Flight Academy 022 12 10 00 I think the ACAS/TCAS LO's should be combined better. Sometimes too much detail, sometimes double info. Not always clear what is ACAS what is TCAS.
response	Noted. Thank you for providing this comment referring to Subject 022 12 10 00. Your suggestion may be considered for the next update of the LOs.
comment	241-B comment by: KLM Flight Academy 022 12 10 00 04 Also 'explain operating principle'. Combine with LO 022 12 10 00 03?
response	Not accepted. Thank you for providing this comment referring to LO 022 12 10 00 (04). EASA is of the opinion that the operating principle is covered to sufficient depth in the subsequent LOs. Combining it with 022 12 10 00 03 may be considered for the next update of the LOs.
comment	242-B comment by: KLM Flight Academy 022 12 10 00 05 pls chk correct names: 'intruders' vs 'traffic'. Name ACAS and TCAS is used simultaneously which may confuse.
response	Noted. Thank you for providing this comment referring to Subject LO 022 12 10 00 (05). This LO only states TCAS.
comment	243-B comment by: KLM Flight Academy 022 13 03 01 07 pls give more info on ND data selector: constraints, wpts, wx , data etc.?
response	Accepted. Thank you for providing this comment referring to LO 022 13 03 01 (07). EASA agrees to give more information on the ND data selector. The text will be amended as follows: Describe the purpose of an EFIS control panel and typical selections that may be available: — altimeter pressure setting;



- navigation display (ND) mode selector;
- ND range selector;
- ND data selector (waypoints, facilities, constraints, data, etc.);
- radio navigation aids selector (VOR 1/2 or ADF 1/2);
- decision altitude (DA)/decision height (DH) selection.

comment	244-B-B 022 13 03 02 01 In the past there was a strict difference between an (old) EADI and a (new) PFD, The EADI did not comprise altitude and v/s info. For me okay to state PFD is EADI but we've to agree on that. Only in a side by side config there is HDG Info on the lower side of the PFD.	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 03 02 (01). This is the way it is now defined in the LOs as it covers a broad variety of modern aircraft types.	
comment	245-B 022 13 03 02 03 lowest selectable airspeed	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 03 02 (03). EASA would like to state that this LO has been deleted in the NPA text.	
comment	246-B 022 13 03 02 04 don't forget the pitch limits in relation to AoA. TCAS RA's (buckets)	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 03 02 (04). This is more type-specific than necessary. Any such indications will be covered in a type rating.	
comment	247-B 022 13 03 03 03 Turn anticipator (curved white line @ turns) Range-to-altitude arc (green)	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 03 03 (03). This is type-specific with regard to symbology (if it is shown in the first place) and colour.	
comment	248-B 022 13 03 03 06 True North up (as far as I know).	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 03 03 (06). North up is sufficient.	



comment	249-B 022 13 03 03 09 'CDU' to read 'FMS CDU'.	comment by: KLM Flight Academy
response	Accepted. Thank you for providing this comment referring to LO 022 13 03 03 (09). EASA agrees to replace 'CDU' with 'FMS CDU'. The text will be amended as follows: Explain the purpose of PLAN mode and its characteristics such as: — no compass information; — north is up on the display unit at all times; — the centre waypoint is the selected waypoint on the FMS CDU; — scrolling through the flight plan on the FMS CDU will shift the map view along the flight path; — the aircraft symbol will be positioned in the appropriate place along the flight path; — using PLAN mode as the primary mode during flight may lead to disorientation and loss of situational awareness.	
comment	250-B 022 13 04 00 03 Systems and Warning Display! (S/D)	comment by: KLM Flight Academy
response	Noted. Thank you for providing this comment referring to LO 022 13 04 00 (03). These terms are type-specific. It is sufficient as it stands, covering systems display.	
comment	251-B 022 14 01 00 01 'State' (or mention) is better than 'describe'. 2nd part of LO is typical 010 Air Law.	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 14 01 00 (01). EASA is of the opinion that the higher level of LO (describe) is preferred.	
comment	252-B 022 14 01 00 02 Remark: A tape recorder can also be a digital storage. Remark: Area microphone is not always separate component: can also be part of control panel. Change 'control unit' in 'control panel'. Ctl unit is often a black box. Combine last two sentences. Add LO: "Describe the operation of the (auto) on/off selection and of the erase facility".	comment by: KLM Flight Academy
response	Not accepted. Thank you for providing this comment referring to LO 022 14 01 00 (02). EASA is of the opinion that the LO is good like it is. The proposed LO already contains reference to 'digital storage'. Even though an area microphone may be located in a control panel, it is still a very distinct component of the system. The LO is only requiring knowledge of the components, not how they work. EASA also is of the opinion that there is no need to add an extra LO as you propose.	



comment	<p>253-B comment by: KLM Flight Academy 022 14 01 00 03 Third and fifth LO both speak about interphone system > combine. Also mention the different microphones in use. Also mention the four recording channels.</p>
response	<p>Partially accepted. Thank you for providing this comment referring to LO 022 14 01 00 (03).</p> <p>EASA agrees to amend this LO to remove duplication of the word 'interphone'. The type of microphones in use and the number of channels are levels of detailed knowledge not required for a pilot.</p> <p>The text will be amended as follows: List the following main parameters recorded on the CVR:</p> <ul style="list-style-type: none"> — voice communications transmitted from or received on the flight deck; — the aural environment of the flight deck; — voice communication of flight crew members using the aeroplane's interphone system; — voice or audio signals introduced into a headset or speaker; — voice communication of flight crew members using the public address system, when if installed.
comment	<p>254-B comment by: KLM Flight Academy 022 14 03 01 0 More info required on what pilot must know.</p>
response	<p>Not accepted. Thank you for providing this comment referring to LO 022 14 03 01 (01).</p> <p>EASA is of the opinion that no additional information is required on what the pilot must know. The content of the LO has not been changed in the NPA text.</p>
comment	<p>255-B comment by: KLM Flight Academy 022 15 00 00 02 02 When a pilot must know there are computer buses to transfer data between the different parts of a computer (both internal and external), then the pilot must also know a computer may consist of different parts such as processor, memory plus input- and output devices. Therefore strongly recommend to leave in (a slightly reworded) LO #02. Then also leave in the term 'peripheral (equipment)' as this term is used in LO #06.</p>
response	<p>Not accepted. Thank you for providing this comment referring to LO 022 15 00 00 02 (02). EASA is of the opinion that there is no need for a pilot to know in depth computer design as the pilot does not design them. The term computer bus is covered by 022 15 01 00 03.</p>
comment	<p>256-B comment by: KLM Flight Academy 022 15 00 00 02 03 Is it worth to mention the existence of different protocols for data transmission such as ARINC-429, -629?</p>



response	Proposal: State the existence of ... Not accepted. Thank you for providing this comment referring to LO 022 15 00 00 02 (03). EASA is of the opinion that it is of no use to a pilot to know data transfer protocols or programming language.
comment	257-B comment by: <i>KLM Flight Academy</i> 022 15 00 00 02 04 Also something about regular software updates?
response	Not accepted. Thank you for providing this comment referring to LO 022 15 00 00 02 (04). EASA does not see the need to add something about regular software updates. That is just a fact and a pilot will not be involved with updating software nor the actual software version in a computer.
comment	258-B comment by: <i>KLM Flight Academy</i> 022 15 00 00 02 08 Use the terms 'internal memory' and 'external memory' when speaking about (non) volatility. Proposal: "volatile memory, requiring electrical power to retain information, is used in internal memories, non-volatile memory, not requiring electrical power to retain information, is used in external memories.
response	Not accepted. Thank you for providing this comment referring to LO 022 15 00 00 02 (08). EASA will not take over your proposal. Where the memory is technically located is of no importance to a pilot.
comment	260-B comment by: <i>Bristol Groundschool</i> 022 05 00 00 I disagree with moving INS/IRS away from Instrumentation and back in to General Navigation. Of course there are areas of overlap, but essentially it is the flight deck interface that makes it - for me anyway - an Instrumentation topic and not Gen Nav. The argument that it is a 'system' rather than an 'instrument' does not hold water. What then of GPWS/TAWS/HTAWS, TCAS, Radalt etc. - are they not also 'systems'?
response	Noted. Thank you for providing this comment referring to LO 022 15 00 00 02 (02). It has been decided that INS/IRS will be moved back to Subject 022.
comment	278-B comment by: <i>Aero-Club of Switzerland</i> NPA 2016-03(B) General remark on Subject 022 Many thanks for the deletion of topics not important to our community, these reductions make learning easier.
response	Noted. Thank you for providing this general comment referring to Subject 022.
comment	289-B comment by: <i>FAA</i> Page 37-38: 021 05 04 00 <i>Aeroplane: Fly-by-Wire (FBW) control systems</i> (04) The proposed rewording of this LO uses FBW terms specific to Airbus. Other



manufacturers, such as Boeing or Dassault use different terminology to describe the different modes. It is reasonable to expect an ATPL or a CPL to understand what a FBW system is and that there are different modes. Requiring competency in explaining the different modes seems more appropriate for the type rating than the license itself.

(05) New: A high-level understanding that with mode degradation you will see an increase in pilot workload and a decrease in flight-envelope protections would be appropriate. If the choice of the terms 'describe the implications' means more than that, we disagree with requiring that level of knowledge at the licensing level. That is more appropriate for the type rating.

(06) New: Describing the implications in the prescribed scenarios is not appropriate at the licensing level given the variability in aircraft design and is more appropriate for the type rating.

(07) Describing the implications in the prescribed scenarios is not appropriate at the licensing level given the variability in aircraft design and is more appropriate for the type rating.

Page 141: 022 02 03 00 *Angle-of-attack (AoA) measurement*

(07) New: Explaining how an incorrect AoA measurement can affect the controllability of a flight-envelope protected airplane seems more appropriate for a type rating than a licensing exam.

Page 181-182: 022 06 05 00 *Autoland: design and operation*

(01)-(09) We disagree with the proposal to add these learning objectives to the IR. A pilot getting their IR at this time will not be flying an airplane that has autoland. In the event the pilot does make it to an airplane that has autoland prior to receiving the ATPL, those airplanes will require a type rating and those pilots will learn and be tested about autoland at that point. Given the technology will eventually make it to airplanes that do not require a type rating, no more than basic awareness such as (01) and (02) should be added at this point.

response Note.

Thank you for providing multiple comments referring to Subjects 021 and 022.

The 021 comments are addressed in CRD to NPA 2016-03(B) for Subject 021.

Regarding your comment referring to LO 022 02 03 00 (07): Not accepted.

EASA is of the opinion that awareness of this is essential to a pilot and can affect any aeroplane with a certain level of envelope protection.

Regarding your comment referring to Subject 022 06 05 00: Partially accepted.

EASA agrees to delete the 'X' from the column 'IR' for this Subject, except for LOs (01) and (02).

comment 290-B

comment by: DGAC FRANCE

General comment

First DGAC France would like to thank EASA for the update of the learning objectives, the theoretical knowledge syllabi and ground school exams. We congratulate the Agency on the comprehensive overhaul of the learning objectives which will lead to more simplicity. We notice in particular that the subject 022 in particular is well done, the learning objectives are clearer and the curriculum is both more precise and less redundant.

Secondly DGAC France supports the introduction of the TEM concept and application in the



training programs. Nevertheless, without entering too much into details DGAC France wants to develop only two points among those that caught our attention and arose questions.

§ One of the goals of the area 100 KSA is to teach the future pilots the need for developing these core competencies so that they could manage the threats and errors in the TEM model.

We would like to emphasize that there is no need to assess future pilots on that knowledge, the only need is that the trainees understand the use of competencies in a TEM model, and the way they can rely on them.

The ICAO-defined competencies should be all introduced (and not only a selection of them) with their ICAO definitions, in order to prepare students to use them during practical training and need not to be assessed during the theoretical part of the training.

We suggest ensuring an identical level of use within the ATOs, that the observable indicators for these learning objectives should be in compliance with the ICAO principles.

DGAC France also considers that it is necessary to ensure consistency between the different EASA working groups on the EBT core competencies before implementing them.

§ We are surprised by the important focus on mental maths developed in this NPA. Mental maths should only be exercised to develop the situation awareness competency. Therefore, the assessment should be as less pervasive as possible since we do not see a significant safety or competency concern nowadays with the evolution of the cockpits.

response

Noted.

Thank you for providing this general comment referring to Subject 022.

comment

297-B

comment by: DGAC FRANCE

Doc B

Page 127/248

Subject:

SUBJECT 022 — INSTRUMENTATION

syllabus reference 022 01 00 00

Sensors and instruments

Content of comment:

This topic is relevant to the theoretical knowledge of an IR pilot. It is a basic knowledge that any IR pilot should be familiar with.

In the syllabus reference 022 01 01 – Pressure gauge, all the learning objectives should be affected to IR exam.

Alternative draft for proposed amendment

In the syllabus reference 022 01 – Pressure gauge, the (9) Learning objectives should be affected to IR exam :

For exams ATPL(A), CPL(A), ATPL(H), ATPL(H)IR, CPL(H) _ add to IR

response

Not accepted.

Thank you for providing this comment referring to Subject 022 01 00 00.

EASA would like to state that a candidate for an IR is already a holder of a pilot licence, thus has the required depth of knowledge for that licence.



comment	<p>298-B</p> <p>Doc B Page 127/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 01 01 00</i> <i>Pressure Gauge</i></p> <p>Content of comment: One LO is missing now : “Describe the different types of sensors used and explain their operating principle”. We can admit that there is a practical use to know that (for example the consequences of a pitot blockage).</p> <p>Alternative draft for proposed amendment</p> <p>Add to the LO the following topic :</p> <p>“Describe the different types of sensor used and explain their operating principle”.</p>	comment by: DGAC FRANCE
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to Subject 022 01 01 00.</p> <p>EASA is of the opinion that in-depth knowledge of types of sensors is of no practical use to a pilot. Implications of blockages/leaks are covered under the relevant type of instrument.</p>	
comment	<p>299-B</p> <p>Doc B Page 129/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 01 02 00</i> <i>Temperature sensing</i></p> <p>Content of comment: One LO is missing now : “Describe the different types of sensors used and explain their operating principle”. We can admit that there is a practical use to know that.</p> <p>Alternative draft for proposed amendment</p> <p>Add to the LO the following topic :</p> <p>“Describe the different types of sensor used and explain their operating principle”.</p>	comment by: DGAC FRANCE
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to Subject 022 01 02 00.</p> <p>EASA is of the opinion that in-depth knowledge of types of sensors is of no practical use to a pilot.</p>	
comment	300-B	comment by: DGAC FRANCE



	<p>Doc B Page 132/296 Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 01 04 00</i> <i>Fuel flowmeters</i></p> <p>Content of comment: One LO is missing now : “Describe the different types of sensors used and explain their operating principle”. We can admit that there is a practical use to know that.</p> <p>Alternative draft for proposed amendment</p> <p>Add to the LO the following topic :</p> <p>“Describe the different types of sensor used and explain their operating principle”.</p> <p>response Not accepted. Thank you for providing this comment referring to Subject 022 01 04 00. EASA is of the opinion that in-depth knowledge of the technical design is of no practical use to a pilot. The pilot is required to know what fuel flow is and the implications of losing the measurement.</p>
comment	<p>301-B comment by: DGAC FRANCE</p> <p>Doc B Page 144/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 02 06 00</i> <i>Airspeed Indicator (ASI)</i></p> <p>Content of comment: EAS speed is missing ; EAS must be covered for ATPLA because some airplane use it in their documentation, for example on Boeing 777, the VMO/MMO speed is expressed in EAS. EAS is also needed to describe the density error.</p> <p>Alternative draft for proposed amendment</p> <p>Add to the LO the following topic :</p> <p>“Equivalent airspeed (EAS)”.</p> <p>response Not accepted. Thank you for providing this comment referring to Subject 022 02 06 00. EASA will not add your proposed new LO. EAS is not a speed used by line pilots nor is it shown on any instrument. If some aircraft use the term in the documentation, that is an exception rather than the norm.</p>
comment	<p>302-B comment by: DGAC FRANCE</p> <p>Doc B</p>



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Subject:

SUBJECT 022 — INSTRUMENTATION

syllabus reference 022 02 06 00

Airspeed Indicator (ASI)

Content of comment:

(10) New – “ambient wind noise inside the aircraft” is not a parameter which is used by the pilot in case of unreliable airspeed indication.

Alternative draft for proposed amendment

In the topic 022 02 06 00 (10), delete the sentence: “ambient wind noise inside the aircraft”.

“Describe the appropriate procedures available to the pilot in event of unreliable airspeed indications :

- Combination of a pitch attitude and power setting,
- ~~Ambient wind noise inside the aircraft,~~
- Use of GPS speed indications and the limitations of this.”

response Not accepted.

Thank you for providing this comment referring to LO 022 02 06 00 (10).

EASA will not delete the sentence you propose. The pilot must be able to relate the entire ambience to the state of the aeroplane. Just using numbers is a dangerous mentality as the numbers will not work in all scenarios, thus the emphasis on thinking pilots. For speed, wind noise is an ever present indication and forms part of the overall cues a pilot has available for any given phase of flight.

comment 303-B

comment by: DGAC FRANCE

Doc B

Page 148/248

Subject:

SUBJECT 022 — INSTRUMENTATION

syllabus reference 022 02 07 00

Machmeter

Content of comment:

The topic ((10) New) “Describe the implications of climbing at constant Mach number or constant IAS with respect to the margin to the stall speed” should be also developed for the descent (not only for clim).

Alternative draft for proposed amendment

Modify the LO :

“Describe the implications of climbing **and descending** at constant Mach number or constant IAS with respect to the margin to the stall speed”.

response Accepted.



Thank you for providing this comment referring to LO 022 02 07 00 (10).
EASA agrees to reword this LO and will add the wording 'descending'.
The text will be amended as follows:

Describe the implications of climbing or descending at constant Mach number or constant IAS with respect to the margin to the stall speed or maximum speed.

comment 304-B

comment by: DGAC FRANCE

Doc B
Page 157/248

Subject:**SUBJECT 022 — INSTRUMENTATION***syllabus reference 022 04 02 00**Rate-of-turn indicator – Turn coordinator – Balance (slip indicator)***Content of comment:**

It is necessary to know the construction and the principles of operation to understand the typical errors of a rate-of-turn indicator

Alternative draft for proposed amendment

Add a topic :

“Describe the construction and the principle of operation of a rate-of-turn indicator”.

response Not accepted.

Thank you for providing this comment referring to Subject 022 03 02 00.

EASA does not see the need to add the new LO you propose. A pilot is using the instruments, and does not construct nor repair them. The pilot needs to interpret the indications and understand them. The errors are so insignificant for normal flying that there is no need to turn this into a theoretical exercise with such limited practical application.

comment 305-B

comment by: DGAC FRANCE

Doc B
Page 158/248

Subject:**SUBJECT 022 — INSTRUMENTATION***syllabus reference 022 04 03 00**Attitude indicator (artificial horizon)***Content of comment:**

It is necessary to know the construction and the principles of operation to understand the typical errors of an attitude indicator.

Alternative draft for proposed amendment

Add a topic :



response “ Describe the construction and the principle of operation of an attitude indicator”.

Not accepted.

Thank you for providing this comment referring to Subject 022 04 03 00.

EASA does not see the need to add the new LO you propose. A pilot is using the instruments, and does not construct nor repair them. The pilot needs to interpret the indications and understand them. The errors are so insignificant for normal flying that there is no need to turn this into a theoretical exercise with such limited practical application.

comment 306-B comment by: DGAC FRANCE

Doc B
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Subject:
SUBJECT 022 — INSTRUMENTATION
syllabus reference 022 04 04 00
Directional gyroscope

Content of comment:
It is necessary to know the construction and the principles of operation to understand the typical errors of a directional gyroscope.

Alternative draft for proposed amendment

Add a topic :

response “Describe the construction and the principle of operation of a directional gyroscope”.

Not accepted.

Thank you for providing this comment referring to Subject 022 04 04 00.

EASA does not agree to add the new LO you propose. A pilot is using the instruments, and does not construct nor repair them. The pilot needs to interpret the indications and understand them. The relevant errors for the directional gyro are covered to a relevant level in LO 022 04 04 00 (07).

comment 307-B comment by: DGAC FRANCE

Doc B
Page 214/248

Subject:
SUBJECT 022 — INSTRUMENTATION
syllabus reference 022 12 03 00
Stall warning systems (SWSs)

Content of comment:
This topic is relevant to the theoretical knowledge of an IR pilot. It is a basic knowledge that any IR pilot should be familiar with.
The syllabus reference 022 12 03 (01) “Describe the function of an SWS and explain why the warning must be unique” should be affected to IR exam.

Alternative draft for proposed amendment



	<p>In the syllabus reference 022 12 03 00 – Stall warning systems (SWSs), the (01) Learning objectives “Describe the function of an SWS and explain why the warning must be unique”, should be affected to IR exam :</p> <p>For exams ATPL(A), CPL(A) _ add to IR</p>
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to LO 022 12 03 00 (01). EASA is of the opinion that the LO is good like it is. The candidate for an IR is already a holder of a pilot licence, thus has the required depth of knowledge for that licence.</p>
comment	<p>308-B comment by: DGAC FRANCE</p> <p>Doc B Page 216/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 12 08 00</i> <i>Radio altimeter</i> LO (05) Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems.</p> <p>Content of comment: It is necessary in this LO to add : - Autothrust - Automatic landing</p> <p>Alternative draft for proposed amendment</p> <p>Complete the LO (05) :</p> <p>“Describe how the radio altimeter provides input to other systems and how a radio-altimeter failure may impact on the functioning of these systems : - Autothrust - Automatic landing”.</p>
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to LO 022 12 08 00 (05). EASA is of the opinion that the LO is good like it is. An issue with the radio altimeter regarding autoland is covered in the relevant LOs for autoland. For GPWS and autothrust, failure of the radio altimeter may have more wide-reaching issues at various stages of flight.</p>
comment	<p>309-B comment by: DGAC FRANCE</p> <p>Doc B Page 218/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 12 10 00</i> <i>ACAS/TCAS principles and operations</i></p>



	<p>Content of comment: A LO should be added for the AP/TCAS system and the Change of FMA when an automatic AP TCAS is triggered.</p> <p>Alternative draft for proposed amendment</p> <p>Add a LO :</p> <ul style="list-style-type: none"> - AP/TCAS system - Change of FMA when an automatic AP TCAS is triggered”.
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to Subject 022 12 10 00.</p> <p>EASA does not see the need to add the new LO you propose. Currently, a TCAS manoeuvre is completed manually without flight director. Some aircraft have the technology for appropriate flight director and autopilot modes but this has yet to enter into use. This LO will be reviewed when automated TCAS manoeuvres become certified and used by operators.</p>
comment	<p>310-B comment by: DGAC FRANCE</p> <p>Doc B Page 242/248</p> <p>Subject: SUBJECT 022 — INSTRUMENTATION <i>syllabus reference 022 14 02 00</i> <i>Flight data recorders (FDRs)</i> LO (02) List the main components of an FDR : - A shock-resistant (data recorder associated with a ULB...</p> <p>Content of comment: “an ULB” iso “a ULB”</p> <p>Alternative draft for proposed amendment</p> <p>LO (02) List the main components of an FDR : A shock-resistant (data recorder associated with a an ULB...</p>
response	<p>Not accepted.</p> <p>Thank you for providing this comment referring to LO 022 15 00 00 02 (02). Correct grammar is the use of ‘a’ since the abbreviation that follows starts with a consonant-sounding letter (/ju:/).</p>
comment	<p>68-F comment by: Lu</p> <p>Here are my comments for document 022 - instruments. Unfortunately the system doesn't allow me to enter my comments in the correct document, so I have to do it here, hoping that you take the 022 comments and shift them to the correct place.</p> <p>022 09 00 00 LO 01-10:Auto Throttle was erased and replaced by Autothrust only. My proposal is, that</p>



also Auto Throttle should be mentioned in the LO's, because in the typical pilots handbook Boeing calls this system Auto Throttle, and Airbus calls it autothrust.

022 13 03 01

In this LO the operating times of the different standby systems are not included. I propose to add an LO like:

'Describe the different types of standby instruments which can either work electronically (Integrated Standby Instrument System, ISIS) or mechanically, and state how long each of them can read a useful indication in case of emergency.'

022 02 07 08

'Describe typical indications of ~~MMO~~ and VMO on analogue and digital instruments.'

In this LO I propose to delete MMO, because it is not indicated on a cockpit indicator

022 02 06 02

This LO only ask for definition of IAS, CAS and TAS, but no longer EAS. My proposal is to keep the definition for EAS like it was before, because there are some effects in the aircraft which relate to the air compressibility effect.

022 03 01 05

'Demonstrate the use of variation values given as E/W or +/- to calculate....'

My propose is to shift this LO to NAV items.

022 03 03 05

The reworded LO is: 'Explain how the use of timed turns eliminates the problem of the turning errors of a direct reading magnetic compass and calculate duration of a rate 1 turn for a given change of heading.'

My propose is to keep the LO like it was written before: 'Explain how to use and interpret the direct reading compass indications during a turn.'

I think it is easier to understand the meaning of it.

022 04 04 07

Explain how the directional gyroscope will drift over time due to the following:....

My propose is to delete: '-aircraft manoeuvring' due to minor effect.

022 05 00 00 (INS/IRS)

Inertial Navigation and Reference Systems (INS and IRS)

The whole chapter was shifted to 061, General Navigation. My propose is to keep this chapter in 022, because there are some important relations between the classic gyros and the INS/IRS. For my point of view I think it is better to keep INS/IRS in 022. For my point of view the function and description of INS/IRS is nearer to gyro and acclerometer effects than to General Navigation.

e

022 11 00 00 (FMS)

In this chapter we have a lot of items which belong to NAV, so my proposal is to shift INS/IRS to 022, and FMS (022 11 00 00) to NAV items.

response Thank you for providing these multiple comments referring to Subject 022.

Regarding your comment referring to Subject 022 09 00 00: Not accepted.

EASA would like to state that autothrust is defined in CS-25 as the term for automatic thrust.



Regarding your comment referring to LO 022 13 03 01 (05): Not accepted.
EASA would like to state that this LO covers the need for standby instruments of any type. They do not necessarily have a time limitation during flight as that depends on the backup electrical systems on board the aircraft.

Regarding your comment referring to LO 022 02 07 00 (08): Not accepted.
EASA does not agree to delete MMO. MMO is very much shown on an instrument if the aircraft is designed to fly fast enough, such as any jet and several turboprop aeroplanes.

Regarding your comment referring to Subject 022 02 06 02: Not accepted.
EASA does not agree to reinstate the definition for EAS like it was before. EAS is not a speed used by line pilots nor is it shown on any instrument. If some aircraft use the term in the documentation, that is an exception rather than the norm.

Regarding your comment referring to Subject LO 022 03 01 00 (05): Not accepted.
Direct-reading compass is an instrument and this is a part of explaining its function.

Regarding your comment referring to Subject LO 022 03 03 05: Not accepted.
EASA does not agree to shift this LO to NAV items. The direct-reading compass does not indicate correct during turns, thus its indications are not reliable. Practically, this is overcome by using timed turns. The LO is aligned with common practice during flight rather than some obscure theoretical exercise.

Regarding your comment referring to Subject LO 022 04 04 00 (07): Not accepted.
EASA does not agree to delete the wording 'aircraft manoeuvring'. Aircraft manoeuvring may be more significant than Earth and transport wander depending on the type of flying.

Regarding your comment referring to Subject 022 05 00 00: Noted.
It has been decided that INS/IRS is not to be moved but to remain in Subject 022.

Regarding your comment referring to Subject 022 11 00 00: Not accepted.
FMS as a system provides far more than navigation, thus belongs in instruments because of integration with other systems.

comment 41-A

comment by: FTEJerez

Comment on Subject 022 — AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION

One of the most common complains we get about our integrated course is regarding the moment Instruments is taught, and I know that this situation is not exclusive to FTEJerez. This subject has two big blocks - basic instruments and advanced instruments - that a student needs in different moments during their training. It is hard to imagine an efficient course where we put a student flying without having learned about basic instruments, the same way it is clearly not in the students best interest to learn about advanced instruments months before his MCC/JOC course.

What we would suggest is that the exam on the subject is split into two:

Basic Instruments

022 01 00 00 SENSORS AND INSTRUMENT

022 02 00 00 MEASUREMENT OF AIR-DATA PARAMETERS

022 03 00 00 MAGNETISM — DIRECT-READING COMPASS AND FLUX VALVE

022 04 00 00 GYROSCOPIC INSTRUMENTS

Advanced Instruments

022 05 00 00 INERTIAL NAVIGATION AND REFERENCE SYSTEMS (INS AND IRS)



022 06 00 00 AEROPLANE: AUTOMATIC FLIGHT CONTROL SYSTEMS
 022 08 00 00 TRIMS — YAW DAMPER — FLIGHT-ENVELOPE PROTECTION
 022 09 00 00 AUTOTHURST — AUTOMATIC THRUST CONTROL SYSTEM
 022 10 00 00 COMMUNICATION SYSTEMS
 022 11 00 00 FLIGHT MANAGEMENT SYSTEM (FMS)/FLIGHT MANAGEMENT AND GUIDANCE SYSTEM (FMGS)
 022 12 00 00 ALERTING SYSTEMS, PROXIMITY SYSTEMS
 022 13 00 00 INTEGRATED INSTRUMENTS — ELECTRONIC DISPLAYS
 022 14 00 00 MAINTENANCE, MONITORING AND RECORDING SYSTEMS
 022 15 00 00 DIGITAL CIRCUITS AND COMPUTERS

Schools that do not have this problem can just teach the subjects back to back and maintain things as they are, but for schools such as ours this would bring relevant pedagogical benefits. Additionally, having two exams allows for a better and more thorough evaluation of the student's knowledge whereas now, to have a suitable exam basically requires we exam each block rather superficially.

response Not accepted.

Thank you for providing this comment referring to Subject 022 — AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION.

Your proposed split between basic and advanced instruments may be considered during future updates of the LOs.

Additional comments received by email:

comment *Per email* comment by: SAT: Blatter Patrick
 As it was not possible to add the comments to the CRT I send you this mail with our comments:

022 INSTRUMENTATION
 022 03 03 00 (03) Deviation compensation on magnetic compass still needle for ATP/ CPL.

response Not accepted.

Thank you for providing this comment referring to LO 022 03 03 00 (03).
 EASA would like to state that the LO is good like it is. A pilot uses the instrument, and does not construct the unit nor perform maintenance actions. An approved engineer will perform the compass swing and adjust any deviation compensation.

comment *Per email* comment by: Glyn Harley
 022 Instrumentation
 This subject should be dived into 2 examinations (Basic and Advances) as there are two many topics for only 1 exam.

response Noted.

Thank you for providing this comment referring to Subject 022 — AIRCRAFT GENERAL KNOWLEDGE — INSTRUMENTATION.

Your proposed split between basic and advanced instruments may be considered during future updates of the LOs.



Appendix A — Attachments

 [B.pdf](#)

Attachment #1 to comment [#261](#)

 [A02_01_02.pdf](#)

Attachment #2 to comment [#275](#)

 [NTSB Core Lock Recommendation.pdf](#)

Attachment #3 to comment [#276](#)

