Appendix 2
to ED Decision 2019/013/R

RELATED NPA 2018-05 — RMT.0673 — 15.7.2019

Table of contents

1. Summary of the outcome of the consultation

In total, 30 comments were received from 17 commentators representing:

— large aeroplane manufacturers (Airbus, Boeing, Bombardier),

— national aviation authorities (CAA (UK), DGAC (France), FAA (USA), LBA (Germany)),

— Eurocontrol,

— pilot associations (ECA, SNPL France/ALPA),

— associations dealing with concerns related to cabin air quality (GCAQE, P-CoC e.V.),

— a union of helicopter maintenance personnel (Norsk Helikopter Ansattes Forbund),

— one individual.

EASA has responded individually to all the comments, as shown in Chapter 2 below.

An overview of these comments and the EASA responses to them is provided below for each topic of the NPA.

Item 1: full and unrestricted movement of cockpit controls: new AMC 25.777(c).

The FAA proposed some text that was already included in the proposed AMC, therefore no change has been made.

SNPL France proposed that the evaluation of the use of controls should only be conducted in a representative simulator. EASA disagrees, so no change has been made.

Item 2: flap and slat interconnection: amended AMC 25.701(d).

No comments received. The proposed amendment is unchanged.

Item 3: ventilation: harmonisation of CS 25.831(a) with FAA FAR 25.831(a), and amendment of AMC 25.831(a).

Several commentators (associations dealing with concerns related to cabin air quality, ECA, one individual) proposed to amend CS 25.831 to prescribe new limits on contaminants and to amend some existing limits, to mandate air monitoring systems, to require additional cabin breathing protection , or to mandate bleed-free architectures. EASA disagrees with these proposals, as they go beyond the objective of NPA 2018-05, which is intended to provide harmonisation with FAR 25.831(a). The proposed changes are controversial and have been subject to extensive debates among stakeholders in recent years, and therefore such changes cannot be made under the scope of RMT.0673. The EASA responses in Section 2 reflect the studies that have been performed and the on-going study dealing with cabin air quality, which are to be considered for decision making on changing the requirements.

SNPL France asked for clarification of the term ‘uncontaminated’, and commented on how air conditioning selected ‘off’ is annunciated in the cockpits of Airbus aeroplanes.

The proposed text of CS 25.831(a) has not been changed, and therefore it will be amended in harmonisation with the FAA rule.

The FAA made several comments on the proposed AMC 25.831(a) in order to add clarifications, and EASA mostly agreed with those comments.

Boeing suggested adopting FAA AC 25-20 and AC 25-22. EASA has not fully adopted these ACs, but some information from these ACs has been implemented in AMC 25.831(a).

Item 4: quantity of available oxygen: amended CS 25.1441(c), new AMC 25.1441(c).

The FAA agreed with the proposed CS 25.1441(c), but suggested that AMC 25.1441(c) should not be specific regarding the number of oxygen masks to be supplied by a source of oxygen supply. EASA agrees, and has revised the AMC.

Item 5: ashtrays in the lavatories: amended CS 25.853(g) in harmonisation with FAA FAR 25.853(g).

Airbus recommended the deletion of CS/FAR 25.853(g), arguing that CS/FAR 25.853(f) already bans smoking in lavatories, and that the majority of commercial flights are performed as non-smoking flights. EASA does not accept this proposal, which goes beyond the scope of the regular update task, and harmonisation with the FAA's regulations is the main goal. Such a change has not yet been agreed with the FAA.

Bombardier commented that CS 25.791(d), dealing with placards, should also be amended to remove an inconsistency with the amended CS 25.853(g). This has been accepted, and CS 25.791(d) will be amended to be in line with FAR 25.791(d).

2. Individual comments and responses

In responding to comments, a standard set of terminology has been applied to show 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 partially agrees 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 to be necessary.

(d) **Not accepted** — The comment or proposed amendment is not agreed by EASA.

comment	*2*	comment by: *NHF Technical committee*
	NHF does not hafve any comments to thes NPA	
response	Noted.	

comment	*3*	comment by: *DGAC France*
	Please note that DGAC France has no specific comment on this NPA.	
response	Noted.	

comment	*4*	comment by: *EUROCONTROL*
	The EUROCONTROL Agency welcomes the publication of EASA Notice of Proposed Amendment 2018-05 concerning 'Regular update of CS-25'. It also thanks EASA for the opportunity that has been given to submit comments. However, the subject of the amendment is considered outside the scope of activities of EUROCONTROL. There is therefore no comments to make. Nevertheless the EUROCONTROL Agency would like to confirm that it will read with interest the comments on the NPA received from stakeholders and the responses given to them by EASA in its future comment-response document (CRD). Like for NPA 2018-05, EUROCONTROL staff will be given access to CRD 2018-05, for their information.	
response	Noted.	

comment	*18*	comment by: *UK CAA*
	Thank you for the opportunity to comment on NPA 2018-05 Regular update of CS-25. Please be advised that there are no comments from the UK CAA.	
response	Noted.	

comment *22* comment by: *DGAC Deputy Head of aircraft and operations rulemaking department*

Please note that DGAC France has no specific comments on this NPA.

response Noted.

comment *23* comment by: *The Boeing Company*

General Comment

THE PROPOSED TEXT STATES:
N/A

REQUESTED CHANGE:

Boeing recommends EASA to add new AMC guidance incorporating guidance from FAA Advisory Circular (AC) 25-20 (paragraphs 5.a., 5.b., 5.c, & 5.e) and FAA AC 25-22 Paragraph 36. SECTION 25.831 – VENTILATION (paragraphs (5)(a), (5)(b) & (5)(c)). These paragraphs of the FAA ACs provide important regulatory advisory guidance, such as an allowance to determine the airflow supplied to a compartment by averaging the total fresh air supply for the number of occupants for a compartment (so called bulk basis), changing the 0.4 lb/min flow guidance to be required for "probable failure conditions" (not loss of an air source), that the ventilation system must be "designed to provide" the fresh airflow (not requiring the fresh airflow at all times), and allowing an applicant to provide less than the minimum required fresh airflow during phases of flight using low power levels.

JUSTIFICATION:

The intent of our comment is to help EASA accomplish a goal to fully harmonize CS 25.831(a) with FAA 14 CFR 25.831(a) as stated in Item 3 of the NPA summary. To further complete the harmonization effort between EASA and the FAA, EASA should adopt the FAA AC material on this subject, which will allow applicants to use common certification guidance for both regulatory authorities.

response Partially accepted.

AMC 25.831(a) has been updated to include some information that is contained in FAA AC 25-20 (from Chapters 5.a, 5.b, 5.e) and FAA AC 25-22 (from Chapter 36. SECTION 25.831, paragraph 5.c).

General comments p. 1

comment *17* comment by: *Luftfahrt-Bundesamt*

The LBA has no comments on NPA 2018-05.

response	Noted.

Executive summary p. 1

comment	*1* comment by: *Peter Fink* test comment
response	Noted.

comment	*32* comment by: *Bearnairdine BAUMANN* **<u>Regarding: European Aviation Safety Agency NPA 2018-05</u>** **RMT.0673 – regular update of CS-25 NPA 2018-05** **<u>ITEM3: ventilation</u>** The language on providing air free of harm is not specific enough to ensure this. (parts a&b). *Item 3: ventilation. It is proposed to fully harmonise CS 25.831(a) with FAA FAR 25.831(a), and to amend AMC 25.831(a) to add acceptable means of compliance for operations without air conditioning.* The proposed "amendments and rationale" seem to be missing as follows: *“Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors” …. which must not exceed certain concentrations.“* **All substances should be considered in detail in 25.831b not just CO, CO2, Ozone.** *“Carbon monoxide concentrations in excess of 1 part in 20,000 parts of air are considered hazardous.” It is suggested: “For test purposes, any acceptable carbon monoxide detection method may be used.”* **<u>Missing:</u> Onboard sensors are required to ensure clean air „free of harm“ is provided.** in order to comply with CS 25.831(a) with FAA FAR 25.831(a). Therefore in compliance with above mentioned FAA regulations it seems logical to add above mentioned, and issue regulations for adequate sensors, measurement devices and filtration to avoid such air contamination , since any level of CO (and other toxic substances) is not acceptable in breathing air, esp. not in a confined, sealed space.
response	Not accepted.

This comment goes beyond the scope of this rulemaking task on the 'regular update of CS-25'. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a).

Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years.

On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport:

— Study 1: Cabin air quality (CAQ) measurement campaign — study conducted by a consortium of the Fraunhofer Institute for Toxicology and Experimental Medicine and the Hannover Medical School.
— Study 2: Characterisation of the toxicity of aviation turbine engine oils after pyrolysis — study conducted by a consortium of the Netherlands Organisation for Applied Scientific Research and the Dutch National Institute for Public Health and the Environment.

Both reports can be found on the EASA website:
https://www.easa.europa.eu/document-library/research-projects

Based on these results, a causal link between exposure to cabin/cockpit air contaminants and the reported health symptoms has been considered to be unlikely, and the need to amend the certification specifications has not been supported.

As a follow-up activity, further research has started in a European Commission (EC) study, with technical support from EASA. It will take into account the findings and recommendations from the two EASA studies to develop a comprehensive understanding of cockpit and cabin air quality.

The contract award notice was published on 22 February 2017, and can be found here:
http://ted.europa.eu/udl?uri=TED:NOTICE:66334-2017:TEXT:EN:HTML&src=0

A website has been set up to inform stakeholders about this study:
https://www.facts.aero/index.php/approach

EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

3. Proposed amendments for CS-25—new AMC 25.777(c) p. 7

comment *10* comment by: *FAA*

FAA a. Explanation. 25.777 contains requirements for cockpit controls, which include a number of system and flight control aspects. In order to assure full use of all available controls in the event of an engine failure, including on takeoff and including engine failure at low speeds, the control movement of the rudder pedals and brakes should be evaluated.

Suggested by FAA Aviation Rulemaking Advisory Committee (ARAC) Flight Test Harmonization Working Group (FTHWG)

response Noted.

The proposed text is already contained in the first sub-paragraph under '2. Rudder and brake controls'.

comment *11* comment by: *FAA*

FAA: b. Procedures. Use of controls (typically rudder pedals and brakes) should be evaluated by pilots across the range of statures required by 25.777(c) during foreseeable normal and failure conditions. This should include engine failure below VMCG. This evaluation is ideally done in a conforming simulator but may be performed statically in a conforming cockpit. The aim of the evaluation is to ensure that the pilot is always able to apply full rudder and maximum brake pressure on the same side simultaneously (e.g. full right rudder with maximum right brake pressure and vice versa). The pilot should, in each condition, also be able to continue to apply brake pressure on the opposite side.

Suggested by FAA Aviation Rulemaking Advisory Committee (ARAC) Flight Test Harmonization Working Group (FTHWG)

response Noted.

The content of the proposed text is already included in the proposed AMC under '2. Rudder and brake controls'.

comment *19* comment by: *SNPL FRANCE ALPA technical committee*

AMC 25.777(c) Full and restricted movement of cockpit controls

The sentence "this sentence should ideally be performed in a representative simulator, but, it may also be performed statically in representative cockpit" should be replaced by

" **this evaluation should be performed in a representative simulator.**"

in order to cover the prescribed maneuvers (including engine failures below Vmcg).

response Not accepted.

The aim of the evaluation is to assess the anthropometric compatibility of the aircrew with the aircraft. It is typically performed by test pilots, who are normally adequately trained to do that, including performing it in a static environment. It may therefore be performed in a static cockpit, as long as it is geometrically representative of the real aircraft.

CS 25.831(a) p. 8

comment *14* comment by: *FAA*

In general, the FAA concurs with the proposed revision to CS 25.831(a) and AMC 25.831(a). The EASA proposed change to AMC 25.831(a) incorporates regulatory

	guidance for compliance that FAA contains in AC 25-20, Section 5, Ventilation; and, in FAA Policy PS-ANM100-1999-00062, "Airplane Operation with Air Conditioning Packs-Off, Revision to Memorandum of June 28, 1999, same subject", dated September 3, 1999. However, regulatory differences in other portions of CS 25.831 and 14 CFR 25.831 remain.
response	Noted.

comment	*20* comment by: *SNPL FRANCE ALPA technical committee* <u>CS25.831 Ventilation</u> the term "uncontamineted" needs to be clarified : for example, does it cover contamination from engine oil through the bleed system ? AMC 25.831(a) Ventilation 1. a. there should be a means to annunciate to the flight crew that the air conditionning system is selected to "off" : SNPL technical committee supports this statement. A status indication on ECAM as in the Airbus fleet is not sufficient. It should be clearly indicated without having to dig into systems pages.
response	Noted. 1. Comment on CS 25.831(a): the contamination of the engine bleed air is taken into account. This source of contamination is analysed during the certification of the engine in compliance with the CS-E specifications (e.g. CS-E 690(b), CS-E 510(g)). 2. Comment on AMC 25.831(a): on Airbus aeroplanes, when an air conditioning pack is selected 'off', this is indicated on the overhead panel on the corresponding switch with a light showing 'OFF' (in line with the Airbus dark cockpit philosophy). If after the take-off, a pack is still selected to 'off', an alert is triggered in the form of a single chime + Master Caution, and it is indicated on the BLEED SD page. EASA considers that this design is appropriate in terms of a 'means to annunciate to the flight crew that the air conditioning system is selected to 'off'. However, the general point is noted, and EASA will consider proposing a clarification of this sentence in the next regular update of CS-25 in 2019.

comment	*25* Attachment #1 Please see attached file and comments below regarding CS 25.831 a/b & related AMC: On behalf of the Global Cabin Air Quality Executive: GCAQE

Notice of Proposed Amendment 2018-05
Regular update of CS-25 -RMT.0673

Introduction - Rationale:
The certification standards and AMC related to CS 25.831 and ventilation air supply are not specific enough to ensure adequate air quality for crew or passengers. The use of the bleed air system fails to meet the certification requirements for clean breathing air.

Problem description:
The certification standard proposed requires that:

1) The *"system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort."* CS/FAR 25.831a
2) *"Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours."* CS/FAR 25.831b

There are several problems that should be addressed:

A. The ventilation systems utilised in current bleed air aircraft are sourced generally from the engines or APU. The use of the pressurised air from the compressor will in all cases provide low level leakage of oil from the bearing chamber back into the secondary air, including the main core airflow in the compressor, from where the ventilation air is sourced. This occurs as oil seals are not an absolute design and will allow low level leakage past the seals in normal operations, in addition to the less frequent higher levels of leakage in failure or certain operational conditions. **[**1–5**]**

B. Ultrafine particles are generated from oils exposed to high temperatures such as those in compressors and the oil system**.** [4] *"Oil contamination in the compressor will result in a fog of very fine droplets in the bleed air under most operating conditions"*, including *"with very low contamination rates….. development of sensors for detecting oil contamination in aircraft bleed air should focus on ultrafine particle detection and sensing of low contamination levels may require sensitivity to extreme ultrafine particles 10 nanometers and smaller."* [6]

The ventilation and air purity requirements are not specific enough to ensure suitable quality of the ventilation air supply. No guidance is given & various AMC used (e.g: SAE ARP 4418) are used to quantify the concentrations of selected markers for engine/APU generated bleed air contaminants at steady state conditions only in ground level test beds and does not look at health effects.

D. The focus under the standards for ventilation air supply is placed on incapacitation, while ignoring to a great degree impairment and discomfort, degraded performance and reduced efficiency.

E. Sufficient amount of uncontaminated air provides the potential for people to focus on the ventilation flow rate, while ignoring the need to provide air that does not impair/ cause undue discomfort, harm /hazardous conditions or degraded efficiency etc.

F. The requirement to provide air free of harmful or hazardous gases and vapours is often interpreted to refer to CO, CO_2 and O_3 only, yet it ought refer more clearly that this means all substances.

G. The design certification requirements and AMC for the engines/APU require that major failure conditions do not occur more than 10^{-5}/engine flight hour or APU operating hour. The airframe requirements and AMC require that major effects are remote, less than 1 x 10^{-5}/flight hour (fh) - > 1 x 10^{-7}/fh. Major effects include those that *"impair crew efficiency"* or cause discomfort to flight crew or physical distress to cabin crew or passengers. The use of the bleed air system that enables and guarantees low level oil emissions in normal flight is associated with impairment, degraded crew efficiency and is considered harmful and hazardous. This is increasingly acknowledged directly or indirectly. [1,4,7–20]

H. CS 25.831 a) and b) cannot be met using the bleed air system. *"The use of the bleed air system to supply the regulatory required air quality standards is not being met or being enforced as required."* [1,2]

I. Occupational exposure limits and similar threshold limits will not protect against harmful and hazardous conditions from the ventilation supply air. This is widely acknowledged. [4,12,21,22] Harmful and hazardous effects, degraded efficiency and impairment are occurring with repeat (chronic) low level exposure to these fluids/substances and the complex thermally degraded mixtures they create. [4,10,23–25]

J. Aircraft using a bleedless architecture will not meet the air quality standards when the outside air is contaminated by jet engine oils and hydraulic and deicing fluids, such as on the ground or in flight when the outside air contains these substances.

K. There are at present no sensors installed to provide the flight crew with a warning that the air is contaminated. This is required under CS 1309c as the use of the bleed air system and a bleedless system when contaminated by outside air (air other than recirculated) containing the oils and fluids does not meet the required air quality standard of not causing degraded efficiency/ impairment and harm/hazardous conditions.

These concerns are recognized increasingly widely elsewhere. A Few examples include:

German BFU: [26]
· *"Engine certification specifications require air purity. This is a general requirement and does not describe which aim shall be achieved in regard to cabin air. The term "purity" does not include whether the requirement is to eliminate smells, harmful concentrations of substances or the hazard of impairing crew capability to act."*
· *"The BFU is of the opinion that "harmful concentration" should be interpreted solely to mean that health impairments (including long-term) through contaminated cabin air should be eliminated."*

· *"The BFU is of the opinion that a product which has received a type certificate by EASA should be designed in a way that neither crew nor passengers are harmed or become chronically ill."*
· *"During demonstration of compliance in accordance with CS 25, CS E and CS APU, only a limited number of substances are considered."*
· *"For the BFU, it has not become clear, how demonstration of compliance in accordance with CS 25.1309 in regard to cabin air contamination occurs."*
· *"The BFU does not understand how the extensive requirements of CS 25.831 and CS 25.1309 could be met if the certification authority did not conduct a consideration of all substances used."*
· SR No. 07/2014 *"EASA should implement a demonstration of compliance during type certification of aircraft (CS-25), engines (CS-E) and APU (CS-APU) such that the same requirements apply to all these products and permanent adverse health effects resulting from contaminated cabin air are precluded. Aircraft engine and APU type certification should include direct demonstration of compliance of all substances liable to cause cabin air contamination. Certification should be based on critical values which preclude permanent adverse health effects on passengers and crew."*

AAIB:
Safety recommendation 2007-002: *"It is recommended that the EASA consider requiring, for all large aeroplanes operating for the purposes of commercial air transport, a system to enable the flight crew to identify rapidly the source of smoke by providing a flight deck warning of smoke or oil mist in the air delivered from each air conditioning unit."* [[27,28]] Six similar calls for sensors and warning detection systems have been called for by this and additional aircraft investigation bureaus.

Austria:
GZ. BMVIT-86.069/0002- IV/BAV/UUB/LF/2016

EASA: SE/SUB/LF/9/2016 *"The installation of technical monitoring options such as se which determine the composition, or possible contamination of the cabin air, which rc record the air in real-time and alert pilots in time, coupled with appropriate filtering s should be mandatory for aircraft using bleed air from the cabin air power engines."*

<u>Changes required</u>:

CS 25.831 requires very extensive consideration. The standard as it is is no longer suitable for aircraft air supply systems to ensure people remain free of harm, hazards, impairment or degraded performance/efficiency. There are no detection systems to advise crew when the air is contaminated. The same applies to the standards and AMC related to engine and APU generated air supply contamination.

Specific text in the interim should be amended to include the intent of the following points.

- At least one meaningful marker per contaminant is required to meet CS-25 25.831 a) and b) both on the ground and in flight in real time. Minimum contaminants to be covered are engine oil, hydraulic oil and de-icing fluid. Levels selected must use the best available technology to determine when

the air contains such marker compounds at the lowest possible concentration. A warning system must be supplied to the flight deck.
- Part a) should be amended *"to enable the crew members to perform their duties without undue discomfort, impairment or fatigue and without degraded crew performance or efficiency, and to provide passenger comfort with clean air supplied that does not cause adverse effects."*
- Part b) should be amended to *"Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases, vapours and pyrolysed mixtures, including those that cause adverse effects."*
- A clear paragraph on AMC how sufficiently uncontaminated ventilation air supply can be demonstrated must be included.
- If the ventilation air supply cannot be guaranteed to be free of gasses, vapours and mixtures, an alternative system must be introduced or air cleaning technology must be implemented.

Susan Michaelis PhD, MSc, ATPL
For GCAQE
16/9/18

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response Not accepted.

This comment goes beyond the scope of this rulemaking task on the 'regular update of CS-25'. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a).
Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years.
On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport:

— Study 1: Cabin air quality (CAQ) measurement campaign — study conducted by a consortium of the Fraunhofer Institute for Toxicology and Experimental Medicine and the Hannover Medical School.
— Study 2: Characterisation of the toxicity of aviation turbine engine oils after pyrolysis — study conducted by a consortium of the Netherlands Organisation for Applied Scientific Research and the Dutch National Institute for Public Health and the Environment.

Both reports can be found on the EASA website:
https://www.easa.europa.eu/document-library/research-projects
Based on these results, a causal link between exposure to cabin/cockpit air contaminants and the reported health symptoms has been considered to be unlikely, and the need to amend the certification specifications has not been supported.
As a follow-up activity, further research has started in a European Commission (EC) study, with technical support from EASA. It will take into account the findings and recommendations from the two EASA studies to develop a comprehensive understanding of cockpit and cabin air quality.
The contract award notice was published on 22 February 2017 and can be found here:
http://ted.europa.eu/udl?uri=TED:NOTICE:66334-2017:TEXT:EN:HTML&src=0
A website has been set up to inform stakeholders about this study:
https://www.facts.aero/index.php/approach
EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

comment *27* comment by: *European Cockpit Association*

Commented text:
CS 25.831 Ventilation

	(a) Under normal operating conditions and in the event of any probable failure conditions of any system that would adversely affect the ventilating air, the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort. For normal operating conditions, the ventilation system must be designed to provide each occupant with an airflow containing at least 0.25 Kg (0.55 lb) of fresh air per minute. (See AMC 25.831(a).) **ECA proposes amended wording:** (a) Under normal operating conditions and in the event of any probable failure conditions of any system that would adversely affect the ventilating air, the ventilation system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort, **without effects on cognitive functioning or without** fatigue and to provide reasonable passenger comfort. **In order to guarantee uncontaminated air, at least one meaningful marker per contaminant is required to meet CS-25 25.831. Contaminants to be covered are at least engine oil, hydraulic oil and de-icing fluid.** For normal operating conditions, the ventilation system must be designed to provide each occupant with an airflow containing at least 0.25 Kg (0.55 lb) of fresh air per minute. (See AMC 25.831(a).) **Reasoning:** The German BFU concluded in its 'Study of Reported Occurrences in Conjunction with Cabin Air Quality in Transport Aircraft' : "Engine certification specifications require air purity. This is a general requirement and does not describe which aim shall be achieved in regard to cabin air. The term "purity" does not include whether the requirement is to eliminate smells, harmful concentrations of substances or the hazard of impairing crew capability to act. " (BFU, 2014, p.73) The regulations remain completely silent on the means by which these rules must be complied with, neither do they provide a definition of hazardous concentrations of gases or vapours except for CO, CO2 and Ozone (O3) (CS 25.831 (1)-(2) & CS 25.832). From these chemicals only the first two relate to possible bleed air contaminants. The many toxins of concern formed by engine oil, hydraulic or other pyrolised fluids are not covered. The German BFU concluded in its 'Study of Reported Occurrences in Conjunction with Cabin Air Quality in Transport Aircraft' that in addition to the “limited number of substances considered, [it] does not understand how the extensive requirements of CS-25.831 and CS-25.1309 could be met if the certification authority did not conduct a consideration of all substances used” (BFU, 2014, p. 74). For example EASA answered to the BFU “that hydraulic fluids as sources for contaminations are not considered” (p.74). *Reference:* BFU. (2014). Study of Reported Occurrences in Conjunction with Cabin Air Quality in Transport Aircraft. Retrieved from http://www.bfu-web.de/EN/Publications/Safety%20Study/Studies/140507_Fume_Events.pdf?__blob=publicationFile
response	Not accepted.

This comment goes beyond the scope of this rulemaking task on the 'regular update of CS-25'. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a).
Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years.
On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport:

— Study 1: Cabin air quality (CAQ) measurement campaign — study conducted by a consortium of the Fraunhofer Institute for Toxicology and Experimental Medicine and the Hannover Medical School.
— Study 2: Characterisation of the toxicity of aviation turbine engine oils after pyrolysis — study conducted by a consortium of the Netherlands Organisation for Applied Scientific Research and the Dutch National Institute for Public Health and the Environment.

Both reports can be found on the EASA website:
https://www.easa.europa.eu/document-library/research-projects
Based on these results, a causal link between exposure to cabin/cockpit air contaminants and the reported health symptoms has been considered to be unlikely, and the need to amend the certification specifications has not been supported.
As a follow-up activity, further research has started in a European Commission (EC) study, with technical support from EASA. It will take into account the findings and recommendations from the two EASA studies to develop a comprehensive understanding of cockpit and cabin air quality.
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A website has been set up to inform stakeholders about this study:
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EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

comment *28* comment by: *European Cockpit Association*

Commented text:
(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours. In meeting this requirement, the following apply:
(1) Carbon monoxide concentrations in excess of one part in 20 000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.

ECA suggestion for amended wording:
(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours. In meeting this requirement, the following apply:

(1) Carbon monoxide concentrations in excess **of three parts in one million parts of air could suggest an underlying source of contamination and should be investigated and addressed.** For test purposes, any acceptable carbon monoxide detection method may be used.

Reasoning:
In an industry recommended practice currently under draft in an engineering committee, in which both ECA members and EASA take part, 3ppm CO is currently adopted as the value that could be indicative for a bleed air contamination.

response Not accepted.

This comment goes beyond the scope of this NPA on the regular update of CS-25. A change to CS 25.831(b) was not considered.
The proposed change would disharmonise CS-25 and FAA FAR 25. Furthermore, it would be premature to introduce a new value in a certification specification, as the standardisation activity referred to in this comment is in a drafting phase.
See also our response to comment 27.

comment *29* comment by: *European Cockpit Association*

Commented text:
(2) Carbon dioxide concentration during flight must be shown not to exceed 0·5% by volume (sea level equivalent) in compartments normally occupied by passengers or crewmembers. For the purpose of this subparagraph, "sea level equivalent" refers to conditions of 25° C (77° F) and 1 013·2 hPa (760 millimetres of mercury) pressure.

ECA proposal for amended wording:
(2) Carbon dioxide concentration during flight must be shown **not to exceed 0·1%** by volume (sea level equivalent) in compartments normally occupied by passengers or crewmembers. For the purpose of this subparagraph, "sea level equivalent" refers to conditions of 25° C (77° F) and 1 013·2 hPa (760 millimetres of mercury) pressure.

Reasoning:
It is recognized that CO2 levels set by EASA affect cognitive functioning and thus might jeopardize safety of aircraft. Studies have established large and statistically significant reductions occurred in decision-making performance and concluded direct averse effects sarting at exposures above 1000ppm . Many studies have thereofre adopted a recommendation for CO2 of 1000 ppm or 1%.

References:
(a) Carpenter, D., & Poitrast, B. J. (1990). Recommended Carbon Dioxide and Relative Humidity Levels for Maintaining Acceptable Indoor Air Quality. Retrieved from Brooks Air Force Base, Texas 78235-5501:
(b) Allen, J. G., MacNaughton, P., Satish, U., Santanam, S., Vallarino, J., & Spengler, J. D. (2016). Associations of Cognitive Function Scores with Carbon Dioxide, Ventilation, and Volatile Organic Compound Exposures in Office Workers: A Controlled Exposure Study of Green and Conventional Office Environments. Environ Health Perspect, 124(6), 805-812. doi:10.1289/ehp.1510037
(c) Satish, U., Mendell, M. J., Shekhar, K., Hotchi, T., Sullivan, D., Streufert, S., & Fisk, W. J. (2012). Is CO2 an indoor pollutant? Direct effects of low-to-moderate CO2

concentrations on human decision-making performance. Environ Health Perspect, 120(12), 1671-1677. doi:10.1289/ehp.1104789

response Not accepted.

This comment goes beyond the scope of this NPA on the regular update of CS-25. A change to CS 25.831(b) was not considered.
The proposed change would disharmonise CS-25 and FAA FAR 25.
See also our response to comment 27.

comment *34* comment by: *P-CoC*

This is a comment in view of Patienteninitiative Contaminated Cabin Air e.V., P-CoC

www.p-coc.com

We agree with the former value (actual value in FAR´s) of 0,25 kg/ 0,55 of fresh (uncontaminated) air per minute for each occupant.

The still established value according EASA ruling is not strict enough.

Overall the fresh and uncontaminatet air regulation (CS25.831) for large airplane needs more extensive attention and much more strict ruling.

Question:
How can an air safety providing regulator like EASA or FAA establish rulings if the comply to this ruling can not be assured because the lack of constant monitoring and controlling devices on board?

The only way for the future of safe air travel is "bleed free" architecture with filtration devices to get environmental pollution cleaned before the air for air condition and pressurization enters the cabin.

Reason:

a) There is no monitoring system to display the actual amount of fresh air value, neither the exchange rate of fresh air.

b) There is no sensor on board of large airplanes (CS-25) to detect any deterioration of air quality which enters the cabin.
(except the noses of the occupants)

c) There is enough evidence that "Fume Events", a severely deterioration of air quality on board on large aeroplane occurs many times worldwide on a daily basis. That is much more often than the 10/-7 claim the regulators expect incidents or even accidents to happen before health impairments or even casualties are accepted to happen .

d) There is enough evidence that a mixture of chemical substances in form of pyrolosis products, mostly carbon based, entering the cabin due to the unfiltered false architecture of bleed air.

e) The implementation of constant airworthiness maintenance procedure of jet engines helped raising the numbers of incidents.
By the time up to the end of the 90`s jet engines were regulary overhauled. E.g, while assembled after inspection of all disassembled parts, all air or carbon seals of the shaft bearings were renewed to make sure to last to the next overhau interval.

f) There is "NO" preventive maintenance procedure to make 100% sure that if a seal starts to leak due to wear that the occupants will have to inhale the toxic compounds at least **one time** because of lack of build in sensor devices to detect contamination of the bleed air. Btw, the most toxic and harmful to health substances are odorless.

g) Just simply look up the decontamination maintenance procedures by the manufacturers which state:
-identify the source
-eleminate the source (replacement of a leaking seal)
-clean the contaminated parts of the bleed air and air condition systems

h) There is "NO" effective executive power by the authorities available to force the operators to follow these established decontamination maintenance procedures.

i) There is enough evidence that these toxic substances are harmful to the health of the occupants.
(Just ask an independent toxicologist what a human body is experiencing when these toxic mixtures of compounds, carbon based, organophosphates, polyzyclic aromatic hydrocarbons, etc. enter the blood stream directly through inhalation. The Aryl-Hydrocarbon Receptor, mostly in liver cells, will react to these compounds. There is enough worldwide scientific research done about the functions of the AH-Receptor and the Cytochrome P450 enzyme activity. BTW, this enzymatic activity is reduced in hypoxia conditions like on board of large aeroplanes. (maximum certified cabin altitude of 8000ft)

j) There is enough evidence that carbon monoxide development (CO) is a big consideration in "Fume Events" just because the smoking point of e.g. engine oil which is 270 degrees celcius and the temperature of bleed air because of the compression in the compressor section of a jet engine is up to 450 degrees celsius.

k) There is enough evidence of correlating deseases because of these toxic compounds like nerve system damage, including brain strem injury, cognitive impairment and a rare lung dysfunction in a form that there is a degraded capillar perfussion capability.

l) There is enough evidence that these compounds are able to start an autoimmune reaction through t-lymphocytes which are fighting the own nerve system.

m) There is only personal protection available for the flight crew with quick donning mask, if there are educated about the risk to their health. All occupants behind the cockpit door, including the cabin crew which is important in case of a later evacuation

	is forced to breathe these toxic compounds until the cabin is ventilated with fresh ram air in case of a smoke removal procedure. **n)** There is "NO" operational procedure for the flight deck crew which enables them to react correct in a developing "Fume Event". Even when there are procedures established to cope with "smoke, fire, smell or odor" situations there is "NO" effective operational procedure **when** the flight crew has to take action properly. When should the flight crew start action in case of a "Fume Event"? If one of the pilots smells something weird but the other does not? What if the aft galley reports something but the flight deck crew smells nothing. How long should the flight crew wait to take action? After the first smell or should she/he wait until own physical symptoms develop like coughing or itchi eyes? Or should she/he wait until even somebody passes out? Because of this described above the CS25.1309 is **NOT** met. There is no warning system for the flight crew in case of a "Fume Event" and as well no applicable procedure available **when** and **how** to take action correctly in a manner that every different flight crew would act properly in the same way. **o)** There is enough evidence that this worldwide problem occurs in raising numbers even when the ECCAIRS database is only available for selected persons since 2014. The problem gets bigger every day. Until bleed free achitecture and additional filtering for environmental pollution is available for all large airplanes **we demand**: -training for flight and cabin crews according the ICAO Cir 344-AN/202 like the BFU already issued in safety recommendation No. 04/2018 -implement former overhaul intervals for jet engines to replace seals before they wear out -enforce procedures which makes sure that operators comply with established decontamination procedures after "Fume Events" -make it required to install air quality sensors to let the flight crew have a warning when cabin air quality starts to deteriorate -establish procedures so a flight crew can react properly and reasonable to "Fume Events" -make it required to install breathing protection for each occupant of the aircraft cabin like passengers and cabin crew
response	Not accepted. This comment goes beyond the scope of this rulemaking task on the ‘regular update of CS-25’. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a). Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years.

On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport:

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http://ted.europa.eu/udl?uri=TED:NOTICE:66334-2017:TEXT:EN:HTML&src=0
A website has been set up to inform stakeholders about this study:
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EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

AMC 25.831(a) p. 8-9

comment *6* comment by: *FAA*

FAA AC 25-20 states that the 0.55 pounds of fresh air per minute per person is calculated from 10 cubic feet per minute of air at 8,000 feet pressure altitude and a cabin temperature of 75F. In order to ensure harmonization, AMC 25.831(a), should define how the 0.25 Kg (0.55 lb) of fresh air is calculated
In order to ensure harmonization, AMC 25.831(a), should define how the 0.25 Kg (0.55 lb) of fresh air is calculated.

response Accepted.

AMC 25.831(a) has been updated to add this information.

comment *15* comment by: *FAA*

FAA-AMC 25.831(a), subpart (c) is intended to address the time when the environmental control system/air cycle machines or “packs” are turned off. The proposed guidance does not limit the duration that the packs are off. While FAA

	concurs that extreme hot conditions may represent a more significant impact to crew performance, applicants should consider both extremes of temperature i.e., hot and cold in their evaluation. Therefore, FAA requests that EASA consider adding this condition to the associated guidance in AMC 25.831(a), subpart (c), as follows (proposed text shown in bold): c. Furthermore, the equipment environment should be evaluated during those periods to ensure that the reliability and performance of the equipment are not impaired. This evaluation should cover the extremes of ambient hot and cold air temperatures in which the aeroplane is expected to operate. FAA requests that EASA add consideration of cold environmental conditions to the associated guidance in AMC 25.831(a), subpart (c), as follows (proposed text shown in bold): c. Furthermore, the equipment environment should be evaluated during those periods to ensure that the reliability and performance of the equipment are not impaired. This evaluation should cover the extremes of ambient hot and cold air temperatures in which the aeroplane is expected to operate.
response	Accepted.

comment	*16* comment by: *FAA* FAA- AMC 25.831(a), subpart 2 does not provide an applicant with guidance on an acceptable method of showing the environment is not hazardous. In recent certification programs FAA has referenced the U.S. National Research Council (NRC) report in December of 2001 titled "The Airliner Cabin Environment and the Health of Passengers and Crew." In order to ensure flexibilty, FAA recommended applicants use this report or other acceptable standards such as U.S. ASHRAE 161P, U.S. SAE/AIR 4766/2, or E.U. AECMA-STAN for demonstrating acceptable air quality during times when the ventilation system did not provide 0.55 lb/min per person. FAA requests that AMC 25.831(a), subpart 2, include some acceptable standards that applicants could use to establish that during reductions in flow rate below the 0.4 lb/min per person the compartment environment is not hazardous.
response	Partially accepted. Various different international cabin air quality standards exist and are being reviewed. A sentence has been added to recommend the applicant to refer to international cabin air quality standards. EASA will then review the proposed standards during certification projects.

comment	*24* comment by: *The Boeing Company* Page: 8 & 9 Paragraph: *AMC 25.831(a) Ventilation, 2. Loss of one source of air conditioning system* **<u>THE PROPOSED TEXT STATES</u>:** The supply of fresh air in the event of the loss of one source, should not be less than 0.18 kg/min (0·4 lb/min) per person for any period exceeding five minutes. However, reductions below this flow rate may be accepted provided that the

compartment environment can be maintained at a level which is not hazardous to the occupant.

REQUESTED CHANGE:
We recommend deleting this proposed text.

JUSTIFICATION:
Our recommendation to delete this text is based on the intent to harmonize EASA and FAA requirements and guidance material. Boeing recommends that EASA adopt FAA Advisory Circular (AC) 25-20 and AC 25-22 guidance material. FAA AC 25-20 includes guidance for providing fresh airflow during “probable failure conditions” instead of during “loss of one source”, which closer aligns to the proposed regulatory wording.

response Partially accepted.

AMC 25.831(a) has been updated to include some information that is contained in FAA AC 25-20 (from Chapters 5.a, 5.b, 5.e) and FAA AC 25-22 (from Chapter 36. SECTION 25.831, paragraph 5.c).

comment *26* comment by: *GCAQE*

Attachment #2

Please see attached file and comments below regarding CS 25.831 a/b & related AMC:

On behalf of the Global Cabin Air Quality Executive: GCAQE

Notice of Proposed Amendment 2018-05
Regular update of CS-25 -RMT.0673

Introduction - Rationale:
The certification standards and AMC related to CS 25.831 and ventilation air supply are not specific enough to ensure adequate air quality for crew or passengers. The use of the bleed air system fails to meet the certification requirements for clean breathing air.

Problem description:
The certification standard proposed requires that:

1) The *“system must be designed to provide a sufficient amount of uncontaminated air to enable the crew members to perform their duties without undue discomfort or fatigue and to provide reasonable passenger comfort.”* CS/FAR 25.831a

2) *"Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours."* CS/FAR 25.831b

There are several problems that should be addressed:

A. The ventilation systems utilised in current bleed air aircraft are sourced generally from the engines or APU. The use of the pressurised air from the compressor will in all cases provide low level leakage of oil from the bearing chamber back into the secondary air, including the main core airflow in the compressor, from where the ventilation air is sourced. This occurs as oil seals are not an absolute design and will allow low level leakage past the seals in normal operations, in addition to the less frequent higher levels of leakage in failure or certain operational conditions. **[**1–5**]**

B. Ultrafine particles are generated from oils exposed to high temperatures such as those in compressors and the oil system**.** [4] *"Oil contamination in the compressor will result in a fog of very fine droplets in the bleed air under most operating conditions"*, including *"with very low contamination rates….. development of sensors for detecting oil contamination in aircraft bleed air should focus on ultrafine particle detection and sensing of low contamination levels may require sensitivity to extreme ultrafine particles 10 nanometers and smaller."* [6]

The ventilation and air purity requirements are not specific enough to ensure suitable quality of the ventilation air supply. No guidance is given & various AMC used (e.g: SAE ARP 4418) are used to quantify the concentrations of selected markers for engine/APU generated bleed air contaminants at steady state conditions only in ground level test beds and does not look at health effects.

D. The focus under the standards for ventilation air supply is placed on incapacitation, while ignoring to a great degree impairment and discomfort, degraded performance and reduced efficiency.

E. Sufficient amount of uncontaminated air provides the potential for people to focus on the ventilation flow rate, while ignoring the need to provide air that does not impair/ cause undue discomfort, harm /hazardous conditions or degraded efficiency etc.

F. The requirement to provide air free of harmful or hazardous gases and vapours is often interpreted to refer to CO, CO_2 and O_3 only, yet it ought refer more clearly that this means all substances.

G. The design certification requirements and AMC for the engines/APU require that major failure conditions do not occur more than 10^{-5}/engine flight hour or APU operating hour. The airframe requirements and AMC require that major effects are remote, less than 1×10^{-5}/flight hour (fh) - > 1×10^{-7}/fh. Major effects include those that *"impair crew efficiency"* or cause discomfort to flight crew or physical distress to cabin crew or passengers. The use of the bleed air system that enables and guarantees low level oil emissions in normal flight is associated with impairment, degraded crew efficiency and is considered harmful and hazardous. This is increasingly acknowledged directly or indirectly. [1,4,7–20]

H. CS 25.831 a) and b) cannot be met using the bleed air system. *"The use of the bleed air system to supply the regulatory required air quality standards is not being met or being enforced as required."* [1,2]

I. Occupational exposure limits and similar threshold limits will not protect against harmful and hazardous conditions from the ventilation supply air. This is widely acknowledged. [4,12,21,22] Harmful and hazardous effects, degraded efficiency and impairment are occurring with repeat (chronic) low level exposure to these fluids/substances and the complex thermally degraded mixtures they create. [4,10,23–25]

J. Aircraft using a bleedless architecture will not meet the air quality standards when the outside air is contaminated by jet engine oils and hydraulic and deicing fluids, such as on the ground or in flight when the outside air contains these substances.

K. There are at present no sensors installed to provide the flight crew with a warning that the air is contaminated. This is required under CS 1309c as the use of the bleed air system and a bleedless system when contaminated by outside air (air other than recirculated) containing the oils and fluids does not meet the required air quality standard of not causing degraded efficiency/ impairment and harm/hazardous conditions.

These concerns are recognized increasingly widely elsewhere. A Few examples include:

German BFU: [26]
· *"Engine certification specifications require air purity. This is a general requirement and does not describe which aim shall be achieved in regard to cabin air. The term "purity" does not include whether the requirement is to eliminate smells, harmful concentrations of substances or the hazard of impairing crew capability to act."*
· *"The BFU is of the opinion that "harmful concentration" should be interpreted solely to mean that health impairments (including long-term) through contaminated cabin air should be eliminated."*
· *"The BFU is of the opinion that a product which has received a type certificate by EASA should be designed in a way that neither crew nor passengers are harmed or become chronically ill."*
· *"During demonstration of compliance in accordance with CS 25, CS E and CS APU, only a limited number of substances are considered."*
· *"For the BFU, it has not become clear, how demonstration of compliance in accordance with CS 25.1309 in regard to cabin air contamination occurs."*
· *"The BFU does not understand how the extensive requirements of CS 25.831 and CS 25.1309 could be met if the certification authority did not conduct a consideration of all substances used."*
· SR No. 07/2014 *"EASA should implement a demonstration of compliance during type certification of aircraft (CS-25), engines (CS-E) and APU (CS-APU) such that the same requirements apply to all these products and permanent adverse health effects resulting from contaminated cabin air are precluded. Aircraft engine and APU type certification should include direct demonstration of compliance of all substances liable to cause cabin air contamination. Certification should be based on*

critical values which preclude permanent adverse health effects on passengers and crew."

AAIB:
Safety recommendation 2007-002: *"It is recommended that the EASA consider requiring, for all large aeroplanes operating for the purposes of commercial air transport, a system to enable the flight crew to identify rapidly the source of smoke by providing a flight deck warning of smoke or oil mist in the air delivered from each air conditioning unit."* [27,28] Six similar calls for sensors and warning detection systems have been called for by this and additional aircraft investigation bureaus.

Austria:
GZ. BMVIT-86.069/0002- IV/BAV/UUB/LF/2016

EASA: SE/SUB/LF/9/2016 *"The installation of technical monitoring options such as se which determine the composition, or possible contamination of the cabin air, which rc record the air in real-time and alert pilots in time, coupled with appropriate filtering s should be mandatory for aircraft using bleed air from the cabin air power engines."*

Changes required:

CS 25.831 requires very extensive consideration. The standard as it is is no longer suitable for aircraft air supply systems to ensure people remain free of harm, hazards, impairment or degraded performance/efficiency. There are no detection systems to advise crew when the air is contaminated. The same applies to the standards and AMC related to engine and APU generated air supply contamination.

Specific text in the interim should be amended to include the intent of the following points.

- At least one meaningful marker per contaminant is required to meet CS-25 25.831 a) and b) both on the ground and in flight in real time. Minimum contaminants to be covered are engine oil, hydraulic oil and de-icing fluid. Levels selected must use the best available technology to determine when the air contains such marker compounds at the lowest possible concentration. A warning system must be supplied to the flight deck.
- Part a) should be amended *"to enable the crew members to perform their duties without undue discomfort, impairment or fatigue and without degraded crew performance or efficiency, and to provide passenger comfort with clean air supplied that does not cause adverse effects."*
- Part b) should be amended to *"Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases, vapours and pyrolysed mixtures, including those that cause adverse effects."*
- A clear paragraph on AMC how sufficiently uncontaminated ventilation air supply can be demonstrated must be included.
- If the ventilation air supply cannot be guaranteed to be free of gasses, vapours and mixtures, an alternative system must be introduced or air cleaning technology must be implemented.

Susan Michaelis PhD, MSc, ATPL
For GCAQE

16/9/18

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response

Not accepted.

This comment goes beyond the scope of this rulemaking task on the ‘regular update of CS-25’. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a).
Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years.

On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport:

— Study 1: Cabin air quality (CAQ) measurement campaign — study conducted by a consortium of the Fraunhofer Institute for Toxicology and Experimental Medicine and the Hannover Medical School.
— Study 2: Characterisation of the toxicity of aviation turbine engine oils after pyrolysis — study conducted by a consortium of the Netherlands Organisation for Applied Scientific Research and the Dutch National Institute for Public Health and the Environment.

Both reports can be found on the EASA website:
https://www.easa.europa.eu/document-library/research-projects
Based on these results, a causal link between exposure to cabin/cockpit air contaminants and the reported health symptoms has been considered to be unlikely, and the need to amend the certification specifications has not been supported.
As a follow-up activity, further research has started in a European Commission (EC) study, with technical support from EASA. It will take into account the findings and recommendations from the two EASA studies to develop a comprehensive understanding of cockpit and cabin air quality.
The contract award notice was published on 22 February 2017, and can be found here:
http://ted.europa.eu/udl?uri=TED:NOTICE:66334-2017:TEXT:EN:HTML&src=0
A website has been set up to inform stakeholders about this study:
https://www.facts.aero/index.php/approach
EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

comment 30 comment by: *European Cockpit Association*

ECA comment:
It should be understood that uncontaminated air is not guaranteed by meeting limits for CO, O2 and O3 only. Many other contaminants might be present at varying levels in bleed air and cabin air.

CS-25.831 has limits for a very limited set of chemicals. Even when these levels are met, there is no guarantee for uncontaminated air. There are two possible solutions. Either EASA can extend the list to more chemicals (e.g. SAE ARP4418 [Marker Compunds for bleed air quality], + TPP, TBP [hydraulic oil markers], + a de-icing marker or selected chemicals from the AVOIL study [Houtzager 2017], which identified 127 substances in pyrolized enigne oil) or EASA enforces at least one meaningful marker per contaminant. Contaminants to be covered are at least engine oil, hydraulic oil and de-icing fluid.

References:

	SAE Aerospace. (2008). Aerospace Recommended Practice ARP4418, revision A. Houtzager, M., Havermans, J., Noort, D., Joosen, M., Bos, J., Jongeneel, R., . . . Westerink, R. H. (2017). AVOIL Characterisation of the toxicity of aviation turbine engine oils after pyrolysis (AVOIL project Nr. 923642 / 060.18709). Retrieved from https://www.easa.europa.eu/document-library/research-projects/easarepresea20152
response	Not accepted. This comment goes beyond the scope of this rulemaking task on the 'regular update of CS-25'. As explained in the NPA under item 3, the goal is to harmonise CS 25.831(a) with FAA FAR 25.831(a). Regarding the suitability of further amending the certification specifications, this question has been the subject of worldwide debates and investigations for the past few years. On 23 March 2017, EASA published the final reports of two studies that it commissioned with the aim of gaining solid scientific knowledge regarding cabin air quality on board large aeroplanes that are operated for commercial air transport: — Study 1: Cabin air quality (CAQ) measurement campaign — study conducted by a consortium of the Fraunhofer Institute for Toxicology and Experimental Medicine and the Hannover Medical School. — Study 2: Characterisation of the toxicity of aviation turbine engine oils after pyrolysis — study conducted by a consortium of the Netherlands Organisation for Applied Scientific Research and the Dutch National Institute for Public Health and the Environment. Both reports can be found on the EASA website: https://www.easa.europa.eu/document-library/research-projects Based on these results, a causal link between exposure to cabin/cockpit air contaminants and the reported health symptoms has been considered to be unlikely, and the need to amend the certification specifications has not been supported. As a follow-up activity, further research has started in a European Commission (EC) study, with technical support from EASA. It will take into account the findings and recommendations from the two EASA studies to develop a comprehensive understanding of cockpit and cabin air quality. The contract award notice was published on 22 February 2017, and can be found here: http://ted.europa.eu/udl?uri=TED:NOTICE:66334-2017:TEXT:EN:HTML&src=0 A website has been set up to inform stakeholders about this study: https://www.facts.aero/index.php/approach EASA will analyse the results of this EC study and other newly available information, and reconsider the need to amend the certification specifications or other regulations. If a need is found, a dedicated NPA will be published to conduct a public consultation.

CS 25.1441(c) p. 9

comment	*13*	comment by: *FAA*

	In general, the FAA concurs with the proposed revision. The FAA has similar methods of compliance contained in FAA policy PS-ANM-25.1441-02, titled, "Crew Determination of the Quantity of Oxygen in Single-Use Oxygen Supply Sources", dated Nov 22, 2017.
response	Noted.

AMC 25.1441(c) p. 9

comment	*9* comment by: *FAA* This limitation is consistent with previous FAA projects that were design specific as a function of the hazard conditions associated with failure and reliability of the supply source. The AMC should be non-specific as to the number of masks supplied. Instead, justification should be provided by the applicant to substantiate a system safety analysis. Such safety analysis should generally be considered to show compliance to CS 25.1309. FAA recommends that new AMC 25.1441(c), item 6 be deleted. The hazards associated with failure of the single use supply source should be addressed in a system safety analysis per CS 25.1309.
response	Accepted.

CS 25.853(g) p. 9-10

comment	*21* comment by: *Airbus-EIAIX-SRg* Airbus has checked all 5 proposed items for update but we have only a *general* comment on “ITEM 5 - ashtrays in the lavatories”. Based on §25.853(f) “Smoking is not allowed in lavatories. […] “ and based on our experience that the vast majority of commercial flights are performed as “no smoking flights” Airbus would like to propose to de-validate the requirement for ashtrays in the lavatories, i.e. to avoid sub-paragraph 25.853(g) in CS25. Sub-paragraph 25.853(g) should also be avoided in FAR25.
response	Not accepted. Although the grounds for your comment may be considered to be valid, one of the goals of the proposed amendment is to achieve harmonisation with FAR 25.

comment	*31* comment by: *Bombardier* Bombardier is in favour of the proposal to remove the ashtray requirements in CS 25.783 and harmonize with the FAA. Bombardier also proposes to amend CS 25.791d as it mandates a "no smoking in lavatory" placard to be put next to an ashtay which is no longer required with reference to the proposed CS 25.783.

response	Accepted. CS 25.791(d) has been amended in harmonisation with FAA FAR 25.791(d) to require placards to be conspicuously located on or adjacent to each side of the entry door.

comment	*33* comment by: *Bombardier* Bombardier is in favour of the proposal to remove the requirement for lavatory ashtrays from CS-25.853(g). However, the no-smoking placard requirement of CS-25.791(d) should also be updated to reflect this change, as the current text assumes a mandatory ashtray: • CS-25.791(d) Lavatories must have 'No Smoking' or 'No Smoking in Lavatory' placards positioned adjacent to each ashtray. The placards must have red letters at least 13 mm (0·5 inches) high on a white background of at least 25 mm (1·0 inches) high. (A No Smoking symbol may be included on the placard.) Requested action: update CS-25.791(d) to eliminate this inconsistency with the proposed CS-25.853(g). Ideally, CS-25.791(d) would be fully harmonized with 14 CFR 25.791(d).
response	Accepted. Please refer to the response to comment 31.

3. Attachments

CS 25 Comment response document_Michaelis_GCAQE.pdf
Attachment #1 to comment #25

CS 25 Comment response document_Michaelis_GCAQE.pdf
Attachment #2 to comment #26