SLOVENSKI STANDARD

SIST EN 4618:2009

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Aeronavtika - Standardi kakovosti za zrak v kabinah, merila in metode doloļ anja

Aerospace series - Aircraft internal air quality standards, criteria and determination methods

Luft- und Raumfahrt - Qualitätsstandards für Kabinenluft, Kriterien und Messverfahren

Série aérospatiale - Norme de qualité d'air intérieur pour les cabines d'avion, critères et méthodes d'évaluation

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This European Standard was approved by CEN on 8 August 2009.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 4618:2009) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2010, and conflicting national standards shall be withdrawn at the latest by March 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This standard has been prepared in order to specify requirements and determination methods for newly certificated commercial passenger aircraft programmes. It may also apply to current production aircraft, should it be shown to be technically feasible and economically justifiable. The standard distinguishes between safety, health and comfort conditions for passengers and crew under a variety of phases of flight, including embarkation and disembarkation.

The standard is intended for use in design, manufacturing, maintenance and normal operation of commercial aircraft. The standard committee has tried to make the standard performance based. This means that only parameters of direct effect on safety, health and comfort of aircraft occupants are considered. Prescriptive design solutions, such as ventilation flow rates, are not described in the clauses of the standard. Nevertheless, in exceptional cases, current technology is used in notes, appendices and/or recommendations to describe available solutions that may meet the objectives of individual requirements of the standard.

Regulatory bodies may apply this standard or parts thereof.

1 Scope

This standard specifies requirements and determination methods for newly certificated commercial passenger aircraft programmes.

This standard applies to newly certificated commercial passenger aircraft programmes. It may also apply to current production aircraft if it does not carry significant penalties, i.e. if it can be shown to be technically feasible and economically justifiable.

This standard covers the period from first crew embarkation to last crew disembarkation.

NOTE 1 During embarkation and disembarkation, reduced temperatures in the cabin may be desirable due to increased metabolic activity of the occupants. In some ground cases, the aircraft environmental control system (ECS) may not be able to compensate for the external conditions influencing the cabin comfort conditions, such as open doors, extreme hot/cold ground/air temperatures or radiant heat. In this case, external air-conditioning systems, for example conditioned low-pressure ground air or high-pressure supply, may be used to supplement the aircraft ECS. If the temperature range stated in this standard is regularly exceeded (either above or below the stated range), changes to airline and/or airport procedures and/or aircraft design should be introduced.

NOTE 2 During ground operations, the external air quality may adversely influence the air quality within the aircraft cabin. Contamination produced as a result of servicing activities or ground operations vehicles may enter the aircraft directly, for example via open doors, and the ECS may not be able to effectively control contaminant levels in the cabin. Airline and airport operational procedures should be organised so as to avoid direct contamination of the cabin from these pollutant sources. If the contaminant ranges stated in this standard are regularly exceeded, changes to airline and/or airport procedures and/or aircraft design should be introduced.

Outside air quality levels would usually be regulated by national authorities.

The population under consideration – passengers and crew – excludes individuals with pre-existing infirmity or ill health conditions.

All values given in this document are sea-level equivalent (see Clause 4). According to the Air Quality Guidelines WHO 1999, paragraph 2.2.3, 'For gaseous pollutants, no increase in effects over those experienced at sea level would be expected as a result of the increase of the inhalation, as the partial pressures of the pollutant gases will fall in line with that of oxygen.' The limit concentrations at flight altitude can therefore be defined using pressure ratios.

Annex A provides the formula for calculating allowable concentrations at flight altitude.

There are many potential sources of contamination, which could affect the aircraft cabin environment. It would be impractical to set limits for all the chemical constituents of these sources.

The presence of marker compounds in concentrations that exceed the cabin air quality comfort, health or safety limits set in the standard may indicate that maintenance, procedural or operational change or design change is required to bring the air quality back within the limits set in this standard.

Several sources have been considered to identify contaminants produced during normal operation. The possible sources have been analysed to identify which chemical groupings are related to each one. At least one compound from each grouping identified for each potential source has been chosen as representative of that source.

To define the performance of the ECS, maximum contamination limits are given for the selected marker compounds. The marker compounds have been selected to be:

- Measurable;
- Representative of contaminants produced during operation;
- Balanced across the chemical groupings of the potential contamination sources.

The selected marker compounds may occur in several of the selected potential sources. A full list of all compounds considered is given for completeness. Some of the compounds were subsequently disregarded because they were:

- Expected to appear only in very low concentrations, and/or
- Have low toxicity for given TLVs, and/or
- Below the quantification limit of measurement method.

Where this is the case is marked in Table 1. Additionally, while some compounds may be present in many of the identified potential sources, they are only relevant (under the guidelines given above) for some of the potential sources. In this case this is also marked in Table 1.

The potential sources under consideration are described below:

- Bio-effluents – compounds produced by the occupants;
- Cabin Interior – compounds that may be used during cabin servicing and cleaning;
- Solvents – compounds that may be present in the cabin due to, for example, cabin furnishing off-gassing;
- External Conditions – compounds likely to be present in the environment, specifically near the airport, either from natural or man made sources;
- Exhaust – compounds likely to be present in the engine or APU exhaust, which under certain environmental conditions may be ingested into the outside air intake;
- Oils, lubricants and hydraulic fluids – compounds present in these fluids, and/or their thermal breakdown products, that may enter the cabin under certain conditions;
- Fuel – compounds present in fuels that may enter the cabin under certain conditions.

Contaminants indicative of engine/APU lubricant or fuel leaks would enter the cabin through the bleed air system. The bleed air system may also carry ingested exhaust fumes, hydraulic fluid leaks and environmental pollution in to the cabin. On the ground, exhaust fumes and environmental pollution may also enter through open aircraft doors.

Table 1 — Marker compounds and their potential sources in the cabin

Category	Group	Compound	CAS No.	Bio-effluents	Cabin Interior	Solvents	External Conditions	Exhaust	Oils, Lubricants & Hydraulics	Fuel
Inorganic Compounds		Carbon Dioxide	124-38-9	☒			☒ [a]	☒ [a]		
		Carbon Monoxide [a]	630-08-0				☒	☒	☒	
		Nitrogen Oxides [b]	10102-44-0				☒	☒		
		Ozone[a]	10028-15-6				☒			
Inorganic / Organic Particles		Particles, aerosols		☒ [a]	☒ [a, c]		☒	☒	☒	☒
		Micro-organisms		☒ [a]	☒ [a]		☒			
		Endotoxins		☒ [a]	☒ [a]		☒			
Aliphatic Compounds	Alkanes	Methane [b]	74-82-8	☒				☒		☒
	Ketones	Acetone [a]	67-64-1	[d]		☒			☒	
		Methyl Ethyl Ketone [a]	78-93-3			☒			☒	
	Aldehydes	Acetaldehyde [a]	75-07-0					☒	☒	☒
		Acrolein [a]	107-02-8					☒	☒	☒
		Formaldehyde [a]	50-00-0		☒ [e]	☒		☒	☒	☒
	Halogen Derivatives	Methylene Chloride [a]	74-87-3			☒			☒	

continued

Table 1 — Marker compounds and their potential sources in the cabin *(concluded)*

Category	Group	Compound	CAS No.	Bio-effluents	Cabin Interior	Solvents	External Conditions	Exhaust	Oils, Lubricants & Hydraulics	Fuel
Aromatic Compounds		Benzene [a]	71-43-2					☒		☒
		Tricresyl Phosphate [b]	1330-78-5						☒	
		Toluene	108-88-3			☒ [a]		☒	☒	☒
Polycyclic Aromatic Hydrocarbons		Benzo (alpha) Pyrene [b]	50-32-8					☒		☒
		Naphthalene [b]	91-20-3					☒	☒	☒

[a] Identified compound linked to source as marker compound (measured), this may include aerosols, vapour phase and thermal decomposition products.

[b] Identified compound linked to source but not as marker compound (no measurement), this may include aerosols, vapour phase and thermal decomposition products.

[c] If ozone is present in the cabin it may react with plastics in the cabin to form particles; Reference: CONCISE INTERNATIONAL CHEMICAL ASSESSMENT DOCUMENT N° 5.

[d] Acetone is normally produced only in very minor quantities by the human body. Some health problems do lead to significant synthesis of acetone, however this is not considered by this standard (reference to be provided).

[e] If ozone is present in the cabin it may react with plastics in the cabin to synthesise formaldehyde; Reference: CONCISE INTERNATIONAL CHEMICAL ASSESSMENT DOCUMENT N° 5.

Criteria relative to environmental criteria concern:

— thermal comfort;

— pressure rate of change;

— cost of compliance.

Changes in costs related to the need to comply with a new standard may arise from the following factors:

— expenditure on R&D for the development of new technologies;

— non recurring costs for the development of new products;

— recurring costs in the production of new products;

— certification and compliance testing;

— operating costs for new products;

— the residual value of the current fleet.

However, for this proposed standard the programme of measurements in the sky carried out in the EC CabinAir project demonstrated that the values chosen for pollutants and comfort criteria can generally be met by technology currently available. As a result, the only increases in costs are likely to be associated with a limited extension of the certification process and possibly with through-life compliance testing. In both of these cases the overall impact on total costs is expected, at most, to be very much at the marginal level.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 481, *Workplace atmospheres — Size fraction definitions for measurement of airborne particles.*

EN 14181:2004, *Stationary source emissions — Quality assurance of automated measuring systems.*

EN ISO 7730, *Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005).*

EN ISO 16017-1, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 1: Pumped sampling (ISO 16017-1:2000).*

ISO 7726, *Ergonomics of the thermal environment — Instruments for measuring physical quantities*.

ISO 16000-3, *Indoor air — Part 3: Determination of formaldehyde and other carbonyl compounds — Active sampling method.*

ISO 16000-6, *Indoor air — Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID.*

FAR 25, *Airworthiness standards — Transport category airplanes.*

JAR 25, *Large aeroplanes.*

ASTM D6399-04, *Standard Guide for Selecting Instruments and Methods for Measuring Air Quality In Aircraft Cabins.* 1)

ASTM D6699, *Standard Practice for Sampling Liquids Using Bailers.* 1)

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
safety limits
limits for cabin environment parameters that if exceeded would prevent the safe operation of the aircraft

NOTE Where appropriate, limits such as occupational exposure limits and regulatory limits are taken from cognizant authorities.

3.2
health limits
limits for cabin environment parameters that if exceeded would lead to temporary or permanent pathological effects to the occupants

NOTE Where appropriate, limits such as occupational exposure limits and regulatory limits are taken from cognizant authorities.

3.3
comfort limits
limits for cabin environment parameters that if exceeded would not achieve an acceptable cabin environment

NOTE An acceptable cabin environment is defined as one in which a substantial majority of the people exposed would not be expected to express dissatisfaction with the air quality contaminants and/or environmental criteria. Where appropriate, comfort limits are drawn from cognizant authorities that provide indoor environment standards and guidelines.

4 Air quality

4.1 General

All standards and guidelines referenced in this document must be referred to directly to confirm the correct interpretation and applicability.

For the purpose of this standard, the sea-level equivalent reference conditions are 101,3 kPa and 20 °C. This choice is based on the European guidelines for threshold values definition for contaminants in spaces with human occupancy. It should be noted that the ICAO standard conditions are 101,3 kPa and 15 °C, and that current FAR/JAR use 101,3 kPa and 25 °C as reference conditions.

NOTE For any given contaminant and class (Safety, Health or Comfort), where there exist two or more exposure limits defined by cognizant authorities, the most conservative value has been retained.

1) This standard is published by: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA.