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AIRCRAFT NOISE AND METHODS OF ITS REDUCTION

Annotation. Aircraft noise and methods of its reduction are considered. Brief information about noise sources and acceptable value are described. Regulatory documents, the noise standard established by ICAO are also considered. Recommendations for reducing aircraft noise are presented.

All living organisms are susceptible to noise. Even at a relatively low level, but constant noise, a person may experience discomfort, irritability, headaches. The most harmful is sudden noise that violates the psychological comfort of a person (takeoff and landing of an aircraft, areas and routes for supersonic aircraft).

After prolonged exposure to noise on the human body, in particular on hearing, sensorineural hearing loss may appear, which is manifested by hearing loss. Frequent and regular noise is a source of sensorineural hearing loss.

Pilots are exposed to this noise level, the noise level fluctuates in the range of 90-109 dB, and in the cockpits of helicopters - in the range of 100-118 dB.

Aircraft noise affects the entire spectrum that is in the vicinity of the airport, including the residential area. If the residential complex is located close to the airport, the impact factor to aircraft noise increases. Noise creates discomfort to the human body.

Keywords: aircraft noise level, aircraft noise certificate, ICAO, equivalent sound level.

Introduction.

Air transport is the most efficient due to the ability to cover long distances in a relatively short time, this indicator gives a great advantage in the modern pace of life. The demand for air transportation is growing every year in all countries of the world.

To meet this demand for air transport services, aircraft fleets are expanding, new airlines are being created, new airports, airfields and additional runways are being built.

One of the main reasons for the increase in noise was the growth of air travel and the opening of new routes. This led to the emergence of a new problem, as harmful noise levels, which took second place after flight safety.

The source of noise is the disturbance of air and gas flows created by a running engine, and a jet engine has worse noise characteristics compared to other types.

Additional sources of noise are intense noise during the preparation of aircraft for departure, it can also be attributed to noise at special sites during engine testing.

Aircraft noise is harmful to the entire ecosystem, which includes people, plants and animals.

The main characteristic of noise when exposed to the body is its intensity. The risk of harmful effects increases with intensity and is measured in dB. Loud and prolonged noise increases the intensity of the noise and increases the harmful effects that can lead to hearing loss in humans. The main indicator is the duration of the noise, the longer the exposure, the faster the damage occurs.

A value of 20-30 dB is an acceptable level and is considered harmless, an example of such an indicator would be background noise that occurs in everyday life. Permissible noise level in production is 80 dB. At a noise level of 130 dB, a person has headaches, a sound level of 140 dB or more becomes unbearable for a person.(fig.1).

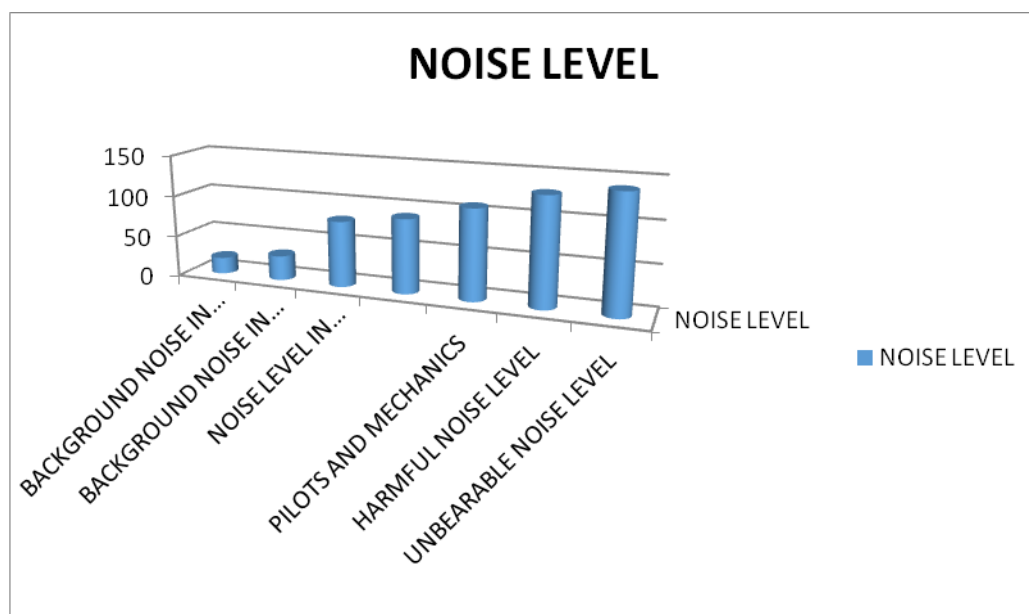


Figure 1 - Noise level diagram

ICAO was established on December 7, 1944 as a result of the signing of the Chicago Convention jointly with the UN. It contains 19 annexes, and one of them is annex 16. During the development process, it was decided to combine all the currently adopted provisions into one document regarding the regulation of aircraft engine emissions. As a result, it was decided to change the title of annex 16 to "Environmental Protection", in which the first volume of this annex contains the current provisions (third edition). As a result, in Annex 16, the second volume is the section "Aircraft noise"; which contains provisions on aircraft engine emissions.

The international document regulating the permissible parameters of aircraft noise was adopted back in 1971 and is still in force. This is Appendix No. 16 (on environmental protection) to the Convention on International Civil Aviation. The standards set out in the first volume of this appendix have been developed by the International Civil Aviation Organization (ICAO) and must be followed by all participating countries that have signed the Chicago Convention. In the creation and compilation of the document, various methods and methods were used to measure noise, methods for certifying aircraft for this factor were studied. , the ability to reduce noise with running engines on the ground and in the air, the reaction of the human body to noise.

Aircraft Noise Certificate.

The Civil Aviation Authority recognizes the Aircraft Noise Type Compliance Certificate issued by the State of the aircraft design or manufacturer in accordance with the applicable ICAO Standards contained in Annex 16 Environmental Protection. Defense, Volume-1 "Aviation Noise".

Recognition of the Certificate of Conformity of the Aircraft Type to Noise Standards issued by the state of the aircraft designer or manufacturer is confirmed in the issuing countries.

The noise certificate is issued for the entire life of the aircraft.

Aircraft noise measurement.

The measurement of aircraft noise is obviously an important type of research not only in the aircraft industry. Already existing airports in the course of reconstruction, and new ones at the stage of project development, must be tested without fail in terms of aircraft noise that will penetrate into the surrounding territory, including settlements of various sizes. In addition, the study of aircraft noise parameters is important in the improvement and construction within the settlements themselves: a change in the building configuration affects the propagation of sound waves, new houses may fall into the zone where the permissible values will be exceeded. Thus, aircraft noise measurement customers are both construction and architectural and design organizations, as well as individuals who, for some reason, doubt the compliance with the standards in their place of residence.(fig.2).

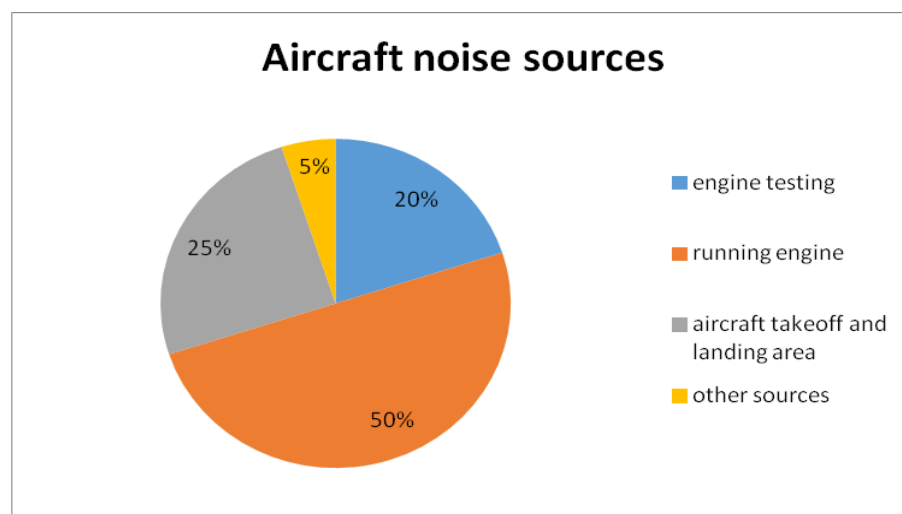


Figure 2 - Aircraft noise sources

Equivalent sound level.

The equivalent sound level is the value of continuous continuous noise which, within a specified time interval, has the same r.m.s. level as the aircraft noise under consideration, whose sound level $L_{A_{ЭКВ}}$ varies with time. The regulated time intervals are 16 hours of the day and 8 hours of the night (from 7.00 to 23.00 and from 23.00 to 7.00).

The equivalent sound level is generally calculated by the formula:

$$L_{A_{ЭКВ}} = 101g \left[\frac{1}{T} \int_0^T 10^{0,1L_A(t)} dt \right], \quad (1)$$

where is the regulated time interval (57600 s in the daytime and 28800 s at night).

Note - Taking into account local conditions, it is allowed to change the boundary time from 7.00 to 6.00 or to 8.00 without changing the total duration of the day and night periods.

When designing and building new airports, the level of aircraft noise should not exceed the established norms.

Experimentally identified and approved the level for the maximum single value and for the equivalent:

- in the daytime (from 07:00 to 23:00) - 75 and 55 dB,
- at night (from 11 p.m. to 7 a.m.) - 65 and 45 dB.

Aircraft noise is measured using special instruments, by specialists of accredited laboratories.

Noise parameters can be defined:

sound level meters
noise analyzers,
combined digital measuring systems.

The main indicator that needs to be recorded during the study is the noise level, measured in decibels. (1dB is 1/10 of the Bell, that is, a unit showing the excess of sound strength by 10 times relative to the minimum indicator for the human ear).

To obtain information about aircraft noise at a particular facility, measurements are taken at least three times, during the day and at night with intensive airport operation, at a height of 10 m above ground level, wind no more than 1 m/s (otherwise a windscreen is required), lack of precipitation, air temperature 2-35C°, humidity 20–95%. Points are selected:

in the contours of the designed building,
close to aircraft flight paths,
in open areas, outside the sound shadow,
at a distance of at least 2 m from sound-reflecting structures.

The obtained indicators are averaged, the equivalent noise is calculated using special formulas.

The results of the study are drawn up in the form of a protocol, where, in addition to the figures obtained, indicate:

the purpose of the measurements,
weather conditions,
used equipment,
information about the organization that carried out the work.

Also, the results of the measurements performed are documented by an act approved by the head of the organization whose specialists carried out the indicated measurements. The act clearly indicates the purpose of the studies undertaken, provides the necessary information about the operating mode of the airport and the types of aircraft in operation, information about the presence of an acoustic passport of the airport and possible recommendations for noise reduction in relation to specific conditions and goals.

Noise measurement locations.

The in-flight noise measurement sites are located on a relatively flat surface, which should not have increased sound absorption characteristics, such characteristics may be in areas of thick, packed and tall grass. The measurement must be made in a conical space above the measurement point with an axis perpendicular to the ground and half an opening angle of 75°, it is necessary to free the space from unwanted objects that will significantly affect the sound field created by the aircraft.

Noise reduction.

It is necessary before the admission into operation of the aircraft, the state where it was registered conducts noise certification. all noise standards and regulations are described in Annex 16 to the Convention on International Civil Aviation.

To reduce the negative impact of aircraft noise in the vicinity of airports, it became necessary to create measures to reduce noise. Due to noise restrictions, it became necessary to apply operational methods to reduce noise levels in the surrounding areas. Several noise reduction methods have been developed, which are listed below:

- the first method was the selection of certain aircraft flight paths during approach and takeoff;
- the second method is to limit the use of the maximum thrust of the engine;

-and an additional procedure was adopted to reduce noise in engine test areas, and some other work at the airport.

In addition to the above noise reduction measures, the following additions can be added:

- it is necessary to plan and use land plots;

-Introduce additional facilities such as acoustic barriers.

Acoustic barriers include the following: from personal protective equipment for human hearing, to soundproofing buildings and other means.

In addition to all this, it is possible to calculate the planting of trees so that they can partially screen out noise from certain areas of the airport. 25-30 dB per 100 m can be the sound absorption value of evergreen trees.

When choosing this sound absorption method, consider the following:

a) the climatic conditions of the airport for planting a tree must be appropriate;

b) trees should have the greatest soundproofing properties;

c) the tree must not create a bird strike hazard;

d) no need for special tree care, not susceptible to disease or pests.

Buildings can be soundproofed to protect occupants from excessive noise. Buildings can be soundproofed to protect occupants from excessive noise.

Conclusion.

Aircraft noise is an indistinguishable part of aviation, making it completely zero remains an impossible task. By reducing aircraft noise, the harmful effects on the environment can be minimized. It is necessary to comply with the established measures a number of rules. Taking measures such as issuing an “Aircraft Noise Certificate” is correct, because knowing a certain type of aircraft, what noise level it creates during takeoff and with the engine running, all noise protection measures can be prepared in a timely manner. When designing an airport, it is necessary to provide for the construction of acoustic barriers and soundproofing of buildings.

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ҰШАҚ ШУ ЖӘНЕ ОНЫ АЗАЙТУ ӘДІСТЕРІ

Аңдатпа. Ұшақтың шуы және оны азайту әдістері қарастырылады. Әуе кемелерінің шуының негізгі көздері және рұқсат етілген мәні қысқаша сипатталған. Нормативтік құжаттар, ИКАО белгілеген шу стандарты да қарастырылған. Әуе кемелерінің шуын азайту бойынша ұсыныстар берілген.

Бүкіл дене шудың әсеріне ұшырайды. Тіпті салыстырмалы түрде төмен, бірақ тұрақты шу деңгейімен адам ыңғайсыздықты, тітіркенуді және бас ауруын сезінуі мүмкін. Әсіресе қауіпті болып адамның психологиялық жайлылығын бұзатын кенеттен болатын шу (ұшу және қону, дыбыстан жоғары әуе кемелерінің маршруттары аймақтары).

Шудың ағзаға спецификалық және спецификалық емес әсері бар. Шудың ерекше әсері есту мүшелеріне әсер етеді, оның нәтижесі аурудың пайда болуы - есту қабілетінің тұрақты жоғалуымен көрінетін сенсорлық есту қабілетінің жоғалуы. Әдетте, сенсорлық есту қабілетінің бұзылуының дамуы өндірістік жағдайларда болатындай шудың ұзақ және тұрақты әсер етуімен байланысты.

Осылайша, әуе кемесінің кабинасындағы ұшқышқа әсер ететін шу деңгейі қозғалтқыш түріне, биіктікке және ұшу режиміне байланысты 90-109 дБ, ал тікұшақтардың кабиналарында 100- диапозонында өзгереді.

Әуежайлар мен әуе жолдарының айналасындағы шудың ластануы тұрғын үйлерді қоса алғанда миллиондаған шаршы шақырым аумақты қамтиды. Әуежайдың осте қаласына жақын орналасуымен халықтың ұйқысы мен демалуына кедергі келтіретін және денсаулыққа теріс әсер ететін әуе кемелерінің шуының әлеуметтік проблемасы бар.

Түйінді сөздер: ұшақ шуы, ұшақ шуының сертификаты, ICAO, баламалы дыбыс деңгейі

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АВИАЦИОННЫЙ ШУМ И МЕТОДЫ ЕГО СНИЖЕНИЯ

Аннотация. Рассмотрен авиационный шума и методы его уменьшения. Описано краткая информация об источниках шума и допустимое значение. Так же рассмотрены нормативные документы, стандарт шума установленный ИКАО. Изложены рекомендации по снижению авиационного шума.

К шуму подвержен все живые организмы. Даже при относительно низком уровне, но постоянный шум, у человека может возникать дискомфорт, раздражительность, головные боли. Наиболее вредным считается внезапный шум, который нарушает психологический комфорт человека (взлет и посадка воздушного судна, районы и трассы для сверхзвуковых самолетов).

После длительного воздействия шума на организм человека, в частности на слух, могут появиться нейросенсорная тугоухость, которая проявляется снижением слуха. Частый и регулярный шум является источником развития нейросенсорной тугоухости слухового органа..

Воздействию такого уровня шума подвержены пилоты, уровень шума колеблется в диапазоне 90-109 дБ, а в кабинах вертолетов - в диапазоне 100-118 дБ.

Авиационный шум воздействует на весь спектр, которые находятся вблизи аэропорта, включая зону жилого комплекса. Если жилой комплекс расположен близко к аэропорту, коэффициент воздействия к авиационному шуму повышается. Шум создает дискомфорт организму человека.

Ключевые слова: уровень авиационного шума, сертификат воздушного судна по шуму, ИКАО, эквивалентный уровень звука.
