MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF AIR NAVIGATION, ELECTRONICS AND TELECOMMUNICATIONS
DEPARTMENT OF AVIONICS

APPROVED
Head of department
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‘___’___________2021

GRADUATION WORK

(EXPLANATORY NOTES)

FOR THE DEGREE OF MASTER

SPECIALITY 173 ‘AVIONICS’

Theme: ‘A system for assessing the quality of crew piloting techniques flight of varying complexity’

Done by: AV-209m group, Jun Liu
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Kyiv 2021

МІНІСТЕРСТВО ОСВІТИ І АУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ АЕРОНАВІГАЦІЇ, ЕЛЕКТРОНІКИ ТА ТЕЛЕКОМУНІКАЦІЙ
КАФЕДРА АВІОНІКИ

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач випускової кафедри
_________С.В. Павлова
«___»___________2021

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА

ЗА СПЕЦІАЛЬНІСТЮ 173 «АВІОНІКА»

Тема: «Створена система оцінки якості техніки пілотування екіпажу польоту різної складності»

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Київ 2021

NATIONAL AVIATION UNIVERSITY

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Specialty 173 ‘Avionics’

APPROVED

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‘___’___________2021

TASK

for execution graduation work

<u>Jun Liu</u>

1. Theme: ‘A system for assessing the quality of crew piloting techniques flight of varying complexity’, approved by order 1945/ст of the Rector of the National Aviation University of 22 September 2021.

2. Duration of which is from 18 October 2021 to 31 December 2021.

3. Input data of graduation work: A safety culture is a collection of beliefs, values and rules - formal or unspoken - about safety that are shared by all people in an organization. It effectively reflects a company's true commitment - from management to employees - to safety in its day-to-day operations and defines how safety is a priority in practice. It includes the following elements: safety management, aircraft reliability, employee responsibilities, management-employee relations, and the structure of a safety management system - or SMS.

4. Content of explanatory notes: List of conditional terms and abbreviations, Introduction, Chapter 1, Chapter 2, Chapter 3, Chapter 4, References, Conclusions.

6. Planned schedule

№	Task	Duration	Signature of supervisor
1.	Validate the rationale of graduate work theme	18.10.2021	
2.	Carry out a literature review	19.10.2021 – 25.10.2021	
3.	Develop the first chapter of diploma	26.10.2021 – 01.11.2021	
4.	Develop the second chapter of diploma	02.11.2021 – 10.11.2021	
5.	Develop the third and fourth chapter of diploma	11.11.2021 – 18.11.2021	
6.	Develop the fourth and fifth chapter of diploma	19.11.2021 – 11.12.2021	
7.	Tested for anti-plagiarism and obtaining a review of the diploma	12.12.2021	

7. Consultants individual chapters

Chapter	Consultant (Position, surname, name, patronymic)	Date, signature	
		Task issued	Task accepted
Labor protection	Ph.D., Associate Professor V.V. Kovalenko		
Environmental protection	Ph.D., Associate Professor T.I. Dmitrukha		

8. Date of assignment: ‘___ ‘ ____________ 2021

Supervisor ______________ Y.V. Grishchenko

The task took to perform ______________ Liu Jun

(signature) (surname, name, patronymic)

ABSTRACT

Explanatory notes to graduation work ‘A system for assessing the quality of crew piloting techniques flight of varying complexity’ contained 92 pages, 14 figures, 6 graph, 25 references.

Keywords: AIRCRAFT, PILOT, UNIT, MAINTENANCE, HUMAN FACTOR, ERROR, VIOLATION.

The object of the research - Flight technology quality assessment method and process.

The subject of the research - The attitude of the pilot during training and flight; the pilot's own state.

Purpose of graduation work –Analyze human factors in air flight accidents and improve flight safety accidents caused by crew factors.

Research Method –Starting from big data, make an assessment by observing the distribution of flight attitudes

Scientific novelty –Starting from the pilot, improve the quality of the pilot to ensure flight safety.

CONTENTS

LIST OF ABBREVIATIONS

YAPDS is a phenomenon of strengthening a dynamic stereotype

ν- pitch angle
γ- roll angle

θ- the angle of the trajectory

ψ - course

IMA is an integrated avionics module

BP - flight safety

INTRODUCTION

Actuality. INTRODUCTION

Determining the totality of erroneous actions of aviation specialists is an essential and noticeably important process in the implementation of the principles of a high degree of flight safety. Ensuring the localization of erroneous actions of aviation specialists can be done using many tools and methods. Among them - the method of training operators to counteract factor load in anti-stress training in order to improve their psychophysical qualities. Determining the psycho-physiological qualities of a person during the selection and training of aviation specialists is one of the ways to improve safety, reliability and efficiency, as well as change for the better the number of aviation accidents.

The process of psychophysiological selection in civil aviation is the identification of a set of processes aimed at assessing the degree of development of professionally significant abilities and efficiency of work in the cabin. The nature of psychophysiological selection arises from predicting the effectiveness of training and professional functioning of operators on the basis of their personal psychophysiological characteristics. Then, depending on the requirements for anti-stress training, during psychophysiological selection are:

- selection of persons who have such qualities that allow the implementation of professional obligations with a high level of reliability in extremely difficult and responsible conditions;

- identification of persons on their psycho-physiological characteristics and mental state, incapable of training and activities in civil aviation and who pose a serious threat to flights;

- training of the operator to function under the simultaneous influence of several failures for anti-stress training;

- advanced training of aviation specialists due to the development of anti-aircraft skills;

- creation of material support that will allow to predict the appearance of YAPDS;

- creation of material support that will allow to determine the level of efficiency of the aircraft crew members.

As a result, the aviation specialist's entry into the information frontiers leads to negative processes in the COM. A person without organized counteraction performs reflected movements (which in the case of COM is a critical error) and errors. The possibility of such information boundaries, which lead to great danger and uncertainty and as a result - this leads to an aviation event (in the case where pilots are not trained to counter). However, each operator has its own information limit, which depends on training, psychophysiological properties. To create conditions for changes in the level of efficiency, which will positively affect the potential of the operator.

The problem of the phenomenon of enhanced reflected movements has been influenced with the advent of systems that require a controlled load level from the human operator. Consideration of this issue began with the research and work of IN Sechenova, IN Sechenov applied a dialectical way of thinking and thus was able to reflect the process of management movements of the human operator . Other scientists in their attempts to understand the work of IN Sechenov made mistakes and therefore misinterpreted the results of research. Modern scientists have not been able to find the right approach in the field of control movements under the influence of load factors. Under the conditions of loading of factors there are dangerous processes of interactions in SOMS.

Due to the use of research results IN Sechenov and the formulated phenomenon of dynamic stereotype (DS - a system of integrated and habitual conditioned-reflex responses, which is the answer signal, sequential and temporal characteristics of the stimulus, this explanation was introduced by IP Pavlov in 1932.) IP Pavlov, came to the conclusion about the existence and impact of the phenomenon of enhanced dynamic stereotypes (IPSD), which occurs during emergencies.

It should also be noted that the reduction of the share of the human factor (HR) in aviation accidents is not observed. Currently it is in the range of 70-90%. Experts on the human factor point out that the basis of these unlikely events is the lack of ability of pilots to withstand overlapping factors (LF - parallel action on pilots more than two negative factors, including simultaneous failures of equipment operating in one period)

CHAPTER 1 Analysis of systems operator-machine-environment

1.1. ICAO documents on the problem of flight safety

With the gradual development of technology, aviation technology gradually matures. More and more people choose airplanes as their main means of transportation. The advantage of air transportation lies in its convenience and speed. The aviation safety issue has always been the biggest issue in air transportation. In the early days of the development of air transportation, the technology was not mature enough. The flight accident caused by the mechanical failure of the aircraft itself is the main factor in the accident during air transportation. However, with the gradual development of science, automation has gradually replaced manual operation, and the problem of human factors has become the biggest obstacle restricting aviation safety.

The International Aviation Organization (ICAO) is a specialized agency established by the United Nations in 1994 to promote the safe and orderly development of civil aviation around the world.

The "Global Aviation Safety Statement" is ICAO's most basic guiding strategic goal. ICAO has always been committed to improving aviation safety through the detection of major safety trends and indicators, safety analysis, policy and standardization measures, and implementation of safety problem resolution coordination activities. At the same time, global safety indicators form the basis of risk analysis and provide a good environment for the continuous improvement of global aviation safety.

The global accident rate is the primary indicator of the overall safety status of the global air transport sector. The following is the 2020 global safety report:

The total number of accidents decreased from 52 in 2019 to 38 in 2020.

The total number of fatal accidents decreased from 8 in 2019 to 5 in 2020.

The total accident rate is 1.71 per million flights. Higher than the 5-year (2016-2020) average accident rate, that is, 1.38 accidents per million flights. The accident rate of IATA member airlines is 0.83 per million flights, which is lower than the 5-year average accident rate (0.96). In 2020, the total number of flight operations will be reduced by 53% to 22 million flights. Compared with the five-year average (0.13), the fatal risk remains unchanged. The fatal risk of air travel is 0.13 on average,

If a passenger has to travel by air every day, it will not be possible until at least one fatal accident in 461 years. On average, a passenger travels every day, and 100% of them will experience a fatal accident in 20,932.

At the same time, 2020 is the first time in 15 years that there has been no loss of control in the air. In the past, most of the air crashes were due to this reason.

Of course, although the probability of flight safety accidents is gradually decreasing, the factors that trigger aviation safety are also gradually decreasing. However, absolute safety has not been achieved. Aviation safety is still the most important issue in air transportation.

1.2. The aircraft's man-machine environmental system

1.2.1. Introduction of aircraft man-machine environmental system

The system composed of the three elements of man, machine, and environment is called man-machine environmental system. In the man-machine environmental system of an airplane, man mainly refers to the pilot, machine refers to the airplane itself, and environment refers to a series of external environmental factors in flight. From takeoff to landing, the safe driving of the aircraft is operated by the aircraft's human-machine environment system. The human-machine environmental system is divided into human subsystem, machine subsystem, and environmental subsystem. In comparison, the importance of the human subsystem occupies the first place. In fact, in the human-machine environmental system, all functions of the system are completed by humans. Among the causes of accidents in the human-machine environmental system, human factors occupy the first place. first place. Many complex system accidents are directly related to human error. In aviation, nuclear power and other fields, system failures caused by human error account for 70% to 90%. With the gradual improvement of the automation hardware level, the importance of the human subsystem is relatively more important.

1.2.2. Reliability analysis of human subsystem

In the aircraft's human-machine environment system, the aircraft piloted by pilots are becoming more and more complex, and the increasing number of modern electronic instruments increases the load of information received by the pilots during flight. Theoretically, the human subsystem has a degree of functional freedom, which enables it to be capable of strain processing in various situations, but at the same time it also makes the human subsystem unstable and makes the system have the possibility of analysis errors. In severe cases, the reliability of the entire system is greatly reduced. In crisis of flight safety, human reliability is related to human's ability to resist stress and flight quality. Working in a good human-machine environment system usually does not make mistakes, but when the overall reliability of the system is low, it is easier for people. Therefore, it is very necessary to improve the human-machine environment system based on human characteristics through the analysis of human reliability.

1.2.3. Reliability analysis of machine subsystem

The reliability of the aircraft is not only related to the onboard equipment, but also to the maintenance personnel of the aircraft equipment, the pilots, and the environment in which it is used. The reliability of the machine subsystem is composed of the "inherent reliability" established in the planning, design, and manufacturing process stages and the "use reliability" determined by the use method based on the maintenance level of the field. Of course, the reliability of the machine itself should also be considered. On the basis of its own design, the aircraft must also consider precautions against unreliability caused by pilot errors. The design goal of the aircraft is to prevent human operating errors and ensure flight safety.

The "intrinsic reliability" of an aircraft refers to the reliability of the onboard equipment. "Reliability in use" is maintained by the maintenance activities of the aircraft mainly by the maintenance personnel and the correct driving of the pilots. It is affected by people and the environment. Under normal circumstances, the reliability of the machine subsystem is affected by the environment and people and will not affect its own reliability.

1.2.4. Reliability analysis of environmental subsystem

The reliability of the environmental subsystem is mainly determined by two factors, the flight environment and the cockpit environment of the aircraft. They can all have an important impact on the reliability of the human-machine environment system. The reliability of this subsystem mainly depends on the analysis of the route environment and the reliability of the aircraft.

1.2.5. Human-machine environmental system related factors affecting flight safety

Unpredictable weather and other natural factors

The aircraft is often affected by meteorological conditions during the flight. The height and thickness of the cloud bottom can directly affect the visual range of the flight and the take-off and landing of the aircraft. When an aircraft is flying in the air, it may be affected by sudden changes in the weather at any time. The sudden bad weather often endangers the flight safety of the aircraft. Stabilize the ground and cause a flight accident. To deal with the hidden flight safety hazards caused by the instability of the environmental subsystem's reliability, because of the uncontrollability of the environmental subsystem, the only way to deal with the sudden instability of the system is to improve the reliability of the man-machine subsystem. If the aircraft itself is not faulty and the pilot does not operate incorrectly, then the aircraft can cope with unexpected uncontrollable factors.

Human Factors

With the continuous development and progress of science, the human subsystem will become more and more important in the human-machine environment system. Therefore, it is very important to ensure the reliability of the pilot. This is closely related to the pilots psychological factors. The pilots mental health level must be Need to be taken seriously. Flight ability is a combination of various psychological qualities. To improve flight ability, we should start with the psychological qualities of pilots to ensure flight safety.

Divided on the basis of pilots, it can be roughly divided into internal factors and external factors

Internal factors:

Physiological factors, such as hypoxia, loss of pressure, illusion, etc., cause excessive physical exertion of the pilot, leading to mental distraction, which affects the normal flight of the aircraft.

Emotionally fluctuating, bad things happen to make the pilot feel depressed.

Technical factors, flight skills degradation caused by prolonged non-flying.

External factors:

Environmental factors; high or low temperature that the human body does not adapt to, air humidity, noise, etc.

The aircraft itself; the probability of failure of the aircraft is unpredictable, and the failure of any aircraft equipment or component may affect flight safety, thereby affecting the working status of the pilot.

Generally speaking, internal factors determine the final outcome of things, and some external factors can be relieved by internal factors. This is an indisputable fact. However, a well-trained pilot should be able to quickly find a pilot under the constraints of various internal and external factors.

A balanced support point, so as to quickly solve the problem. However, one of the essential elements to become such a pilot is: good psychological quality. The general psychological activities of pilots in flight activities can be briefly summarized as: motivation and purpose of completing the task→perception and discovery→information processing → judgment or decision → execution → feedback → evaluation. The above-mentioned psychological activities are achievable for most pilots during normal flight. However, once there is a special situation in flight, this is the situation that challenges the pilot's psychological quality, because when people are at high altitude, especially when they hear the roar of aircraft engines, they will become nervous. Problems, such as flying skills

Descend, make the wrong decision. Through research, safety experts discovered a very intriguing problem: once some unexpected difficulties arise in flight, some pilots lose the motivation and purpose of completing the mission, while some pilots are sober and calm. As everyone knows, under special circumstances, the mental activity process of a well-trained pilot is still based on normal flight mental activity.

1.3. Factors affecting flight control

1. The influence of angle of attack on lateral maneuverability

The angle of attack increases and the lateral maneuverability deteriorates. When the angle of attack is small, the difference between the resistances of the two wings is very small, the sideslip angle caused is not large, and the longitudinal performance becomes worse. When the critical angle is approaching, serious airflow separation occurs on the wing. Not only is the aileron in the vortex zone, the lift difference between the two wings is reduced after the deflection of the aileron, and the resulting control torque is small, and because the difference in resistance between the two wings is large, the sideslip effect Strong, it produces a large moment to stop the aircraft from rolling to the right, so the lateral maneuverability is obviously deteriorated, and the phenomenon of pressing the plate to the right and the aircraft rolling to the left will occur, and the phenomenon of lateral reverse control will occur. In order to change the lateral maneuverability and eliminate the phenomenon of lateral revising maneuvering at high angles of attack. The pilot can use the rudder to help the aileron maneuver, correct the left bank of the aircraft, press the plate to the right while avoiding the right rudder, or use the right rudder only.

2. The influence of the front and back movement of the aircraft's center of gravity on the maneuverability and the front and rear limit positions of the center of gravity.

The forward and backward movement of the center of gravity will cause the elevator deflection angle and lever force to change in level flight. As shown in Figure 1.3.1 and Figure 1.3.2. It is the relationship curve between the elevator deflection angle and the lever force and the level flight speed when a certain aircraft is at different positions of the center of gravity. Under the same level flight speed, the center position is different, the required elevator deflection angle and lever force are also different. When the center of gravity moves forward, the required elevator upward deflection angle increases or the downward deflection angle decreases, and the required pull rod force increases or the push rod force decreases. As the center of gravity moves forward, the lift of the aircraft forms an additional pitch moment to the center of gravity. In order to maintain the balance of the aircraft, the pilot must pull the rod backwards and tilt the elevator upwards to generate an upward control moment to balance the additional torque formed by the forward movement of the center of gravity, while the flight speed does not change, but the elevator deflection angle and pull rod force are not. Enlarged. The more the center of gravity moves forward, the greater the additional down-pitch moment formed by the lift force, and the greater the elevator deflection angle and tie rods required. Moving the center of gravity forward, increasing the same angle of attack, the required elevator deflection angle increases. If the center of gravity is moved forward too much, the higher the deflection angle of the elevator will be required. However, the deflection angle of the elevator is limited by the separation of structure and air flow. It cannot increase indefinitely, and the center of gravity moves forward too much. Even if the steering wheel is pulled to the bottom, the angle of attack cannot be increased to the required angle of attack.

Through analysis, it is known that the position of the center of gravity must have a front limit, so it is stipulated that small low-speed aircraft:

(1) When landing, the aircraft is pulled to the ground attack angle, and the elevator deflection angle does not exceed 90% of the maximum deflection angle to be accurate.

(2) For the aircraft at the first three points, the elevator deflection angle during take-off is to be able to lift the front wheels at the specified speed. (3) When landing into the field, the rod force does not exceed the specified value.

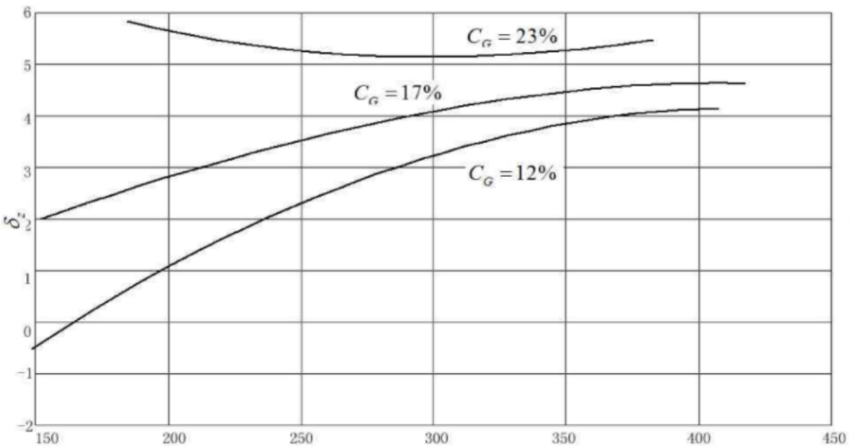


Figure 2.1 The influence of the position of the center of gravity on the deflection angle of the elevator in level flight

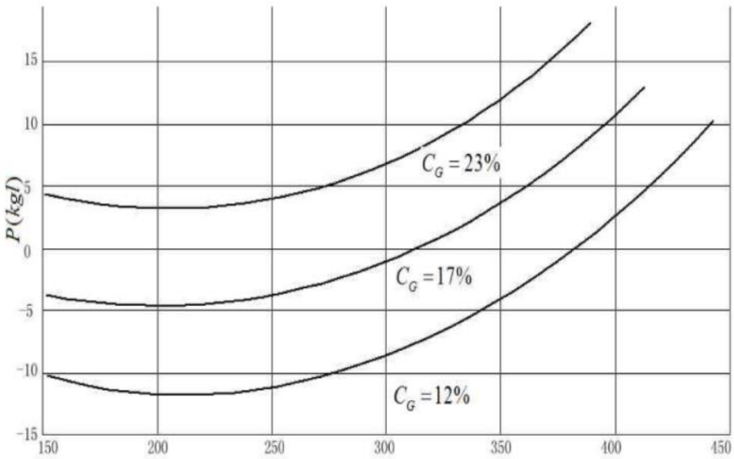


Figure 2.2 The influence of the position of the center of gravity on the force of the leveling rod

In order to ensure sufficient stability and good maneuverability of the aircraft, the center position of the aircraft should be within the range specified by the front and rear limits. At the same time, if the center of gravity of the aircraft is in the forward or backward position within the specified range, on the one hand, the elevator deflection angle required for level flight will be large and too deviated from the neutral position, and the drag of the aircraft will increase, which will affect the performance of the aircraft; on the other hand, it will change At speed, the pilot will feel that the lever force is too large or too small, causing inconvenience in maneuvering. In order to improve flight performance, in addition to the front and rear limits of the center of gravity, the aircraft also specifies the favorable center of gravity range. For example, the front and rear limits of the center of gravity of an aircraft are 16% and 32% of the average aerodynamic chord respectively, and the favorable center of gravity range of the aircraft is 25%-28% of the average aerodynamic chord. The position of the center of gravity of the aircraft moves left and right, which affects the lateral maneuverability of the aircraft. The position of the center of gravity of the aircraft moves to the left, which is equivalent to an increase of a rolling moment of the aircraft to the left. To maintain the level of the two wings, the pilot must often press the plate to the right. This will reduce the travel of the steering wheel to the right and limit the ability to roll to the right. At the same time, the pilot will be distracted and prone to fatigue. Therefore, the right and left movement of the center of gravity of the aircraft must be strictly restricted.

3. The influence of flight altitude on maneuverability

When flying at high altitude at the same true speed, the dynamic pressure is reduced, and the force required by the pilot to keep the rod and navigation in a certain position is reduced. At different altitudes, maintaining the same true speed for level flight, as the altitude increases, the dynamic pressure decreases, and the angle of attack corresponding to the true speed of each level flight generally increases. Compared with the low altitude, the high altitude flight steering wheel position is a bit back, and the elevator deflection angle is larger. When flying at high speeds, the push rod force will decrease. If you maintain the same true speed and fly at different altitudes, the altitude increases, the air density decreases, and the energy surface deflects the same angle, the control torque generated by the vacuum is small, and the angular acceleration decreases, and the aircraft reaches the corresponding angle of attack, sideslip angle or slope. The increase in the required time indicates the slow response of the aircraft. In summary, the rods and rudders become lighter in high-altitude flight, reflecting the phenomenon of slowness.

4. The influence of flight speed on aircraft controllability

In terms of pitch and direction maneuverability, comparison is made with the same lever and matching stroke. In the case of a relatively high flying speed, the time required to balance the angle of attack or the angle of sideslip is relatively short. In terms of lateral controllability, if the pressure plate stroke, that is, the aileron rotation angle, is the same, the flight speed is high, the lateral control moment is large, and the angular velocity is also high, and the time for the aircraft to reach the same slope is short. The flight speed is high, the aircraft responds quickly, and the aircraft controllability is good; the flying speed is low, the aircraft responds slowly, and the aircraft controllability becomes worse.

1.4. Existing safety system

1.4.1. Pilot-based flight safety issues

With the continuous improvement of technology, in air transportation, flight safety accidents caused by the failure of the aircraft itself have gradually disappeared. In the current flight accidents, it is mainly necessary to improve the flight accidents caused by people.

There are many factors related to people in flight, such as people themselves, people and the environment, people and hardware, people and software, people and people, and so on. Improper handling of these factors may cause safety accidents.

When flying in the air, an airplane is different from land transportation tools such as trains and cars. There is no easy-to-identify fixed reference to identify its situation. It moves quickly in a large-scale three-dimensional space. Therefore, pilots must conduct flight space orientation in a timely manner, that is, make judgments on location, space, and time to ensure flight safety. With the increase in flight altitude and changes in meteorological conditions, it is only the flight instruments that can correctly reflect the changes in the aircraft's space state. The instrument displays a large amount of information that changes rapidly during flight. Pilots must monitor, identify, make correct judgments, and process this information in an orderly manner in order to ensure their good sense of situation and ensure safe flight.

The whole flight process is that "people" and "machines" are in a "non-stop" state. An aircraft is an aircraft that runs at high speed in the air. Once it starts flying, it is not allowed to stop, let alone stop in the middle. The operation of the aircraft's engine and other systems is not allowed to have any gaps in order to ensure the aircraft's flight speed and continuous lift. Correspondingly, the physiology and psychology of the pilots in control of the aircraft must always be in a continuous state of "non-stop", otherwise the flight safety will not be guaranteed.

Health status:

China's civil aviation regulations require pilots to undergo regular medical examinations, and the physical condition of pilots performing flight tasks must meet the flight requirements, which is also one of the requirements for continuous airworthiness of pilots. In an unhealthy or sub-healthy state, the body's functional status will be reduced, and the possibility of errors will increase.

There are many factors that cause flight fatigue, but the most important ones are the lack of sleep and the disturbance of circadian rhythms, which are important factors affecting flight safety. Aircrews performing international flights must respond passively to rapid time zone changes when flying across time zones. Pilots performing night flight missions have broken their original sleep habits, which will cause the human body"

The "biological clock" time is not synchronized with the time of the external environment, causing sleep rhythm disturbance and lack of sleep. Flight fatigue is also manifested as mental fatigue. Mental fatigue is caused by mental energy exhaustion and decreased work ability caused by excessive mental work and emotional factors. Phenomenon. At this time, the pilot has physiological distraction, decreased judgment and inability to perform flight skills normally. Cockpit distraction is an important reason and main manifestation of reduced cockpit situation awareness, which seriously affects flight safety.

As mentioned earlier, the health of pilots may also be injured by the complex and special flight environment and work environment, which affects flight safety.

Cultural quality, professional knowledge and skills:

Pilots generally acquire basic science and aviation professional knowledge by studying in professional schools, and receive preliminary training in flying skills. After entering the pilot team, through flight practice and various levels of professional training

Training, aviation professional knowledge and skills have been promoted by vertical and horizontal migration and expanded by horizontal and horizontal migration. This is a process of improving and perfecting through repeated cycles from practice to knowledge and then from knowledge to practice. It is important to know that solid aviation theoretical knowledge and flight skills are the basis for the crew's judgment and decision-making, and are an important prerequisite for establishing a sense of situation in the cockpit. Pilots with solid professional theoretical knowledge, rich operating experience, and excellent flying skills can analyze problems in a forward-looking, comprehensive and correct manner, find problems in a timely and accurate manner, make correct judgments and assessments on the development and risks of problems, and can solve practical problems. The right decision.

Pilots need to improve their comprehensive cultural qualities. Cultural quality refers to the general manifestation of a person's knowledge, talents, and cultivation of cultural attainments or accomplishments. The main contents are: language accomplishment, scientific accomplishment, artistic accomplishment and philosophy accomplishment. A pilot with a higher educational level has high adaptability, good psychological quality, strong affinity, and high awareness of situations in flight, and can better fly safely.

Technical disposal capacity:

Proficient flying skills is one of the necessary conditions for a mature pilot, especially a captain. Flight skills refer to the perfect combination of brain thinking and body action output when successfully completing flight tasks, so as to complete the ability to operate and control aircraft.

The professional thinking ability of pilots is mainly embodied in flight activities, manifested as being able to make use of existing knowledge and experience, and for specific situations and various other situations, to accurately and quickly conduct analysis, comprehensive comparison, classification reasoning, and decision-making.

Flight action skills are mainly: 1) Action reaction time, which refers to the reaction time from the pilot's perception of the stimulus to the completion of the action during flight; 2) The accuracy of the action, refers to the appropriate combination of the three elements of the action form, speed and strength . The pilot's action response speed is one of the essential qualities of the flight profession. It has special significance for ensuring flight safety, especially in the take-off and landing phases and special situation processing."

Non-intellectual factors:

Intellectual factors and non-intellectual factors are two important factors for a person's all-round development. Intelligence refers to the ability of people to recognize and understand objective things and use knowledge and experience to solve problems. It includes memory, observation, thinking, attention and imagination. Non-intellectual factors mainly include motivation, interest, will, emotion, and character in the sense of psychology; ideals, beliefs, spirit, sentiment, and personality in the sense of sociology; and ideology and morality in the sense of education.

Pilots' low non-intellectual factors are mainly manifested as: flight safety only stays on theory and verbal, and does not operate according to the rules in actual flight, knowingly commits intentional violations; cannot concentrate on flight, and is easily distracted; personality is too introverted and not good at communication; personality is impatient Unstable; not serious, unreliable, impetuous mentality; lack of interest in learning, lack of motivation; no lofty ideals, ambitions, etc.

1.4.2. Safety system

The safety systems on the aircraft can be divided into active safety systems and passive safety systems. The active safety systems are actively operated by humans, such as seat belt systems, etc. During the flight of the aircraft, the active safety systems have more to mention safety guarantees in advance. In order to prevent the aircraft from safety hazards when encountering unexpected safety problems.

Passive safety system is a safety measure that occurs when the aircraft itself encounters flight safety problems, such as aircraft robots, aircraft smoke, etc., safety rescue measures that can control walking by the aircraft itself

CHAPTER 2 Evaluation of the quality of piloting technique

2.1. Existing programs and models for training crews for flights

2.1.1. Standard Flight Training Program (FTS)

The standard flight crew training program (hereinafter SPPLS) is the basis of professional flight crew training. At the heart of SPPLS: a set of standard methods of studying theoretical material and consolidation in practice, the use of unified methodological support, organization and training according to the templates enshrined in the instructions, regulations and regulations of ICAO [45]

Characteristic

Training methods are methods that allow the training of flight crew with the help of theoretical material, which is taught in one form or another to develop the skills and abilities necessary to fly.

The following teaching methods are used:

oral presentation (lecture, story, explanation);

conversation;

group exercise and quick test of knowledge;

demonstration and demonstration;

work with the simulator;

work with a book;

independent exercises;

observation.

The organization of the theoretical component of training is using:

planning;

control and verification of knowledge;

providing theoretical material (instructions, guidelines, etc.);

providing the necessary materials (training places, training facilities, etc.);

work of managers of educational process (motivation, orientation on result, maintenance of educational process);

The training program is designed for several years (2-4 years)

2.1.2. Additional flight training programs

The purpose of the IR (A) modular courses is to train licensed pilots to perform instrument flight (IFR) flights in difficult weather conditions (IMC).

The purpose of the MEP training course is to train licensed pilots to provide them with the knowledge and skills necessary to work on a multi-engine aircraft, followed by qualification for piloting multi-engine aircraft.

Characteristic.

For modular IR courses (A):

1. The practical part of the training:

valid PPL (A) or CPL (A);

50 hours of independent route flight (PIC);

2. Theoretical training:

Knowledge of English.

Program of the modular training course on the qualification "Flights on IR devices (A)"

3. Theoretical training:

The theoretical part of the course consists of 8 disciplines, about 200 hours.

Theoretical training program:

-Air law and procedures;

-Aircraft design;

-Flight planning;

-Human factor and limitations;

-Meteorology;

-Navigation;

-Operating procedures;

-Rules of radiotelephone communication and phraseology.

Providing the theoretical part.

-51 hours - instrument flights (IFR);

-5 hours - night visual flight (NVFR)

2.1.3. Characteristics of the training system for the crew optimization program in the cabin (MCR)

CRM training is a field of practical use of the human factor. Solving CRM implementation problems belongs to a group of different ways that are justified according to some important provisions. The first of which - the question of preparation is formed based on interests and actions of the entire flight crew as a single team, technical competence for an individual crew member is not enough to work in a team, so the main thing is to practice skills for joint action in flight and the possibility of implementing such actions in the flight process. The second is to teach the crew how to conduct flights so that personal qualities help to conduct a flight with high efficiency of the crew. Third, to lead the crew to believe that behavior under normal conditions affects the degree of efficiency under conditions of overload and stress.

Characteristic:

CRM - training system focuses on a range of characteristics that can be improved for higher crew performance.

CRM affects the entire flight crew.

CRM aims to change the human factor to ensure flight safety and minimize the impact of factors that can change the level of reliability in flight.

CRM - a system that can be used for change in all training systems.

CRM provides an opportunity for individual crew members to analyze actions and make changes in the process of interaction with other crew members to create conditions for more coordinated work in the cabin.

CRM creates the conditions for training the crew as a whole.

Disadvantages of CRM:

Not suitable for accelerated training and release of pilots.

It aims to train pilots for a limited range of actions and situations

stressful conditions.

It is not a system of actions operating separately from other training systems.

This system is not one that provides a specific procedure in the cabin of the aircraft.

Does not provide specific recommendations for optimizing the work of the crew on the aircraft.

2.1.4. Characteristics of the training system in conditions close to real (LOFT).

Flight training in near real conditions has been implemented on a regular basis in nine airlines and in two airlines on a periodic basis. The essence of LOFT (or PUBR) is that each crew member performs all the preparations for the flight and carries out the flight on the simulator as in a real flight on a given route without any discounts and without assistance. Existing training programs do not require crew members to perform their professional skills and abilities in normal flight conditions. While statistics show that it is in such conditions that the causes of flight accidents arise. The role of the instructor in such training is limited to monitoring the performance of the flight, data entry, video recording of the flight, the marks of defects, and then the flight analysis and conclusion. Such training (usually no more than 2 hours) puts the crew in real flight conditions, starting with the flight training, the flight itself and the flight analysis and reveals their strengths and weaknesses. It allows you to identify shortcomings in the implementation of flight rules and procedures, in the performance of crew members of their functional responsibilities (human factor). Detected shortcomings, as they are manifested in a normal flight, then disassembled by the inspection instructor in the "post-flight" analysis. Some airlines have put video into practice

such training that allows you to clearly show the crew members their shortcomings.

Careful development of scenarios for such flights is considered essential in order to give the crew the opportunity to express themselves in decision-making, action, as well as the ability to make mistakes that occur in real flight, especially in heavy traffic and stress. Some airlines see the need to develop more realistic scenarios with a strong emphasis on real situations that may occur during the approach and landing stages.

Creating a sufficient number of scenarios to better cover all the tasks of flight crew training and regular repetition is a problem that airlines are working on. Airlines and especially the flight crew note the huge benefits of such training. However, such training does not replace the usual regular training to practice actions in special flight conditions.

In the development of scenarios, special attention is paid to the use of standard operating procedures and the strict application of the checklist of operations. It is believed that such procedures relieve pilots of part of the workload and allow them to pay more attention to other tasks that require their professional knowledge. Proper practice of such actions ensures continuous and complete performance of the necessary functions in cases where the normal operation of the crew is interrupted by emergencies and difficult situations.

LOFT is related to flight training systems, which is associated with simulated situations

2.2. Means for assessing the quality of piloting techniques and fixing avionics failures

2.2.1. flight quality

The formulation process of aircraft flight quality specifications is an iterative process of practice-theory-practice. There were no flight quality specifications in the early aircraft design. In actual use, it was discovered that certain flight quality requirements must be met, otherwise the aircraft would be difficult to control and stabilize, and accidents might even occur. In 1903, the Wright brothers' aircraft was longitudinally unstable and extremely difficult to control. Later flight practice and research found that the static stability of the aircraft is not enough, and a series of requirements such as dynamic stability and control gradient are also required. In order to provide specific basis and guidance for flight quality design and verification, based on early flight experience, in 1942 and 1943, the U.S. Naval Aviation Administration and Army Aviation issued SR-119 and AAF-C1815 flight quality specifications, respectively, and proposed aircraft Open loop response to the requirements, supplemented by the test pilot's subjective feeling evaluation. After World War II,

The United States began to carry out system flight quality research, especially ground and air flight simulation research, and formed the 1954 MIL-F-8785 flight quality specification, which put forward system stability and maneuverability requirements. The MIL-F8785B promulgated in 1969 was revolutionary. It first proposed new concepts such as Cooper-Harper pilot evaluation criteria, aircraft status, performance envelope, and control stability. MIL-F-8785C promulgated in 1980 further reflects the influence of flight control systems, especially fly-by-wire control on flight quality. Due to the rapid development of aviation technology, the functional and performance requirements of various types of aircraft are very different. In 1997, the official draft of MIL-HDBK-1797 was issued. The method of filling in the blanks was adopted, and the purchaser selected the appropriate flight quality requirements according to the characteristics of the purchased products. , And various flight quality specifications and criteria are used as background materials for purchasers to choose. This document became the main supporting document for the flight quality part of the JSSG-2001A specification for the joint use of aircraft in the three services in 2001.

Combining the descriptions of various flight qualities and control qualities, the basic meaning of the flight quality requirements is: those aircraft characteristics that can ensure the safe, smooth and easy completion of the control tasks for the pilot operator. This requires: ①The aircraft is continuously controllable under the condition of the aircraft's closed loop; ②The response of the aircraft is stable, fast and accurate; ③The pilot workload is small enough.

Flight quality is essentially a closed-loop loop characteristic, and every link in the loop affects the flight quality of the aircraft.

Flight quality is essentially a human-machine closed-loop loop characteristic, each item in the loop will affect the flight quality of the aircraft

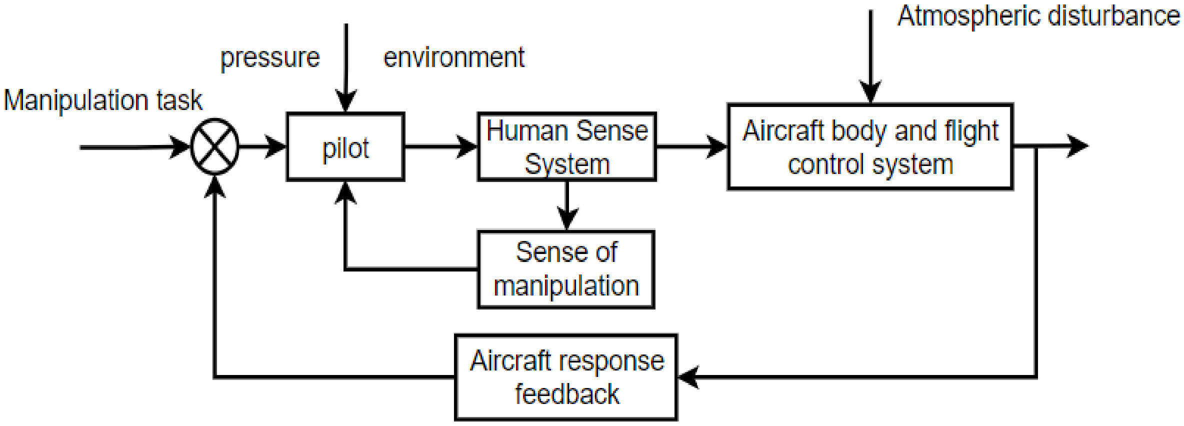


Figure 2.1.1 Man-machine closed loop

The driver is the most complicated link, he is an integrated body of sensors, processors and actuators. As a dynamic link, it can be abstracted as:

$$Y_P = \frac{K_P e^{jw\tau_e}(T_L jw + 1)}{(T_l jw + 1)(T_N jw + 1)}$$

In the formula, Y_p is the driver's frequency characteristic; K_p is the gain;τ_e is the time delay from decision to implementation; T_L is the lead compensation time constant; T_l is the lag compensation time constant; T_N is the muscle lag time constant.

The characteristics of the pilot can be optimized through training and practice. For a good aircraft flight quality, the pilot needs little lead or lag compensation, T_L and T_l end to 0, that is, the workload is small. Work load is an important parameter to measure flight quality.

The human-sensing system provides the driver with the feeling of control force and displacement, which has a very important influence on the flight quality. If the design of the human-sensing system is ignored, it is impossible to obtain satisfactory flight quality.

The characteristics of the human-sensing system can be described by the following mathematical models:

$$F_P = m\ddot{X}_p + C\dot{X}_P + KX_P + f_b$$

In the formula, F_p is the control force; X_p is the control displacement; m is the equivalent mass; C is the equivalent damping; K is the load stiffness; f_b is the starting force. Static control force, dynamic control force and starting force all affect flight quality.

These two items are combined and stated because the flight quality of modern aircraft not only depends on the natural characteristics of the aircraft itself, but also largely depends on the flight control system, especially for aircraft using fly-by-wire control systems, as shown in Figure 2.1. 1.2 shown

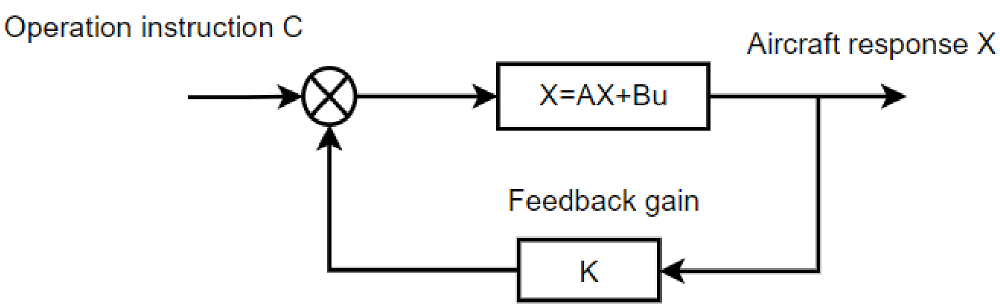


Fig 2.1.1.2

Suppose the motion equation of the aircraft body is:

$$\dot{X}_a = A_a\dot{X}_a + Bu$$

After introducing the feedback K_a and X_a, the equation of motion becomes:

$$\dot{X}_a = (A_a + BK_a)X_a + Bu$$

In the formula, X_a is the aircraft response vector ; u is the aircraft control vector; A_a is the aircraft characteristic array; B is the aircraft control array; K_a In order to respond to the feedback gain matrix.

The feedback gain K_a has a significant impact on the dynamic response of the aircraft. The statically stable body can be increased to be stable, and the under-damping can be increased to satisfactory damping.

In dynamic flight, the pilot mainly controls the aircraft based on feeling and experience, and the pilot's response to the aircraft is felt through vision and touch, of which vision is more important. The driver's diagonal motion is more sensitive than linear motion, and the attitude of the aircraft Poor control directly affects attention to speed and height. When the weather conditions permit, the pilot uses the heaven and earth line as a reference to control the aircraft; in special flight conditions or poor weather conditions, the pilot uses the seat | cabin display to control the aircraft, so the cockpit display, especially under severe weather conditions The cockpit display is extremely important. In any case, the key status display must be clear and stable.

2.2.2. Methods to assess the quality of pilot technology

The flight safety of an airplane is closely related to the flight quality of the airplane, and it involves the pilot's experience of whether it is easy to drive the airplane in a steady or maneuvering process. From the aircraft itself, the quality of flight technology mainly refers to the stability and maneuverability of the aircraft. The evaluation of the quality of flight technology is carried out by evaluating the degree of completion of various flight tasks performed by the pilots. Good flight technology quality means that all flight missions have been completed without errors. Generally speaking, misbehaviors that deviate from the mission during the air flight are very common. And judging the overall situation of the pilot's wrong behavior during flight is an indispensable and very important process in implementing flight safety. There are many ways to reduce pilots' wrong behaviors in the air and ensure the safety of air flights. You can start with the pilots themselves, improve their technical literacy, and train them to fly in harsh and extreme environments. Improve the pilot's stress resistance and psychological quality from training to ensure the reliability of air flight.

In the conditions of pilot selection, relevant restrictions are established. The civil aviation psychophysiological selection process is the identification of a set of processes designed to evaluate the development of important professional capabilities and cabin efficiency. The essence of psychophysiological choice is to predict the effectiveness of the operator's training and professional functions based on the operator's personal psychophysiological characteristics. The following requirements can be formulated:

-Choose a crew member who has excellent professional abilities and excellent psychological quality, and can complete tasks with high reliability under extreme conditions.

-According to psychological characteristics and mental assessment, identify personnel who cannot perform flight missions and pose a huge threat to flight.

-Train professionals to cope with various pressures or failures.

-With the development of air transportation, timely update and training of pilots on the technical level.

-Create a database to predict the flight crew efficiency level and flight. During the flight, when unexpected accidents or unfavorable factors occur, a pilot with a low level of psychological quality may make conditioned reflex actions, which may worsen the situation or even make the situation uncontrollable. The information possibility of this kind of boundary will produce great danger and uncertainty. May eventually lead to aviation accidents. Therefore, database integration prediction can reduce or prevent the occurrence of such accidents. But the pilot's psychological training is the most important and fundamental solution to the problem.

-Discover the mental load reserve of the aircraft crew, and reduce the unbearable load problem by improving the human-computer interaction.

-Determine the crew's work direction, including work when the actual special situation occurs. According to its working model, formulate relevant training methods and quantities, working time specifications, fitness equipment training efficiency evaluation and fitness equipment characteristics

-Concentrate analysis of actual work and psychological stress evaluation in a flight accident, and use it as an example for subsequent evaluation.

The concept of "workload" currently does not have a generally accepted clear definition. Suppose this is a complicated concept. It includes the load related to the mechanical activity when the operator interacts with the controlled object and the psycho-physiological load related to the operator's information perception, as well as the psycho-physiological load related to the mental activity of its information analysis and decision-making-production. The analysis of existing methods for determining operator workload allows them to be divided into two broad categories: subjective and objective. The first involves the use of subjective criteria, pre-established on an evaluation scale, and the second uses the measurement of physical and physiological parameters. In practice, the combination of subjective methods with physiological and other dimensions gives positive results.

In order to be more objective and more direct analysis needs to count the previous data to create a template of the best flight technology in the task that may be encountered, and put forward the problem of determining the best flight technology.

Because the personal flight characteristics of each pilot are not exactly the same, all the best flight techniques need to be created separately for each pilot. This template allows an objective and quantitative assessment of each pilot's personal driving skills. Here, choose the following methods to score the pilot's flight:

When decoding flight information, the computer program information recorder records the physical value of the parameter at the selected control point of the entire flight profile and its deviation level from the optimal value. Deviations are deducted by level, zero points are deducted for no deviations, one point is deducted for deviations, three points are deducted for second-level deviations, and six points are deducted for third-level deviations. The sum of the scores of all control points gives the final score of the flight, which serves as a quantitative assessment of individual driving skills. On this basis, conclusions can be drawn to improve the quality of work.

However, when this evaluation method was introduced to airlines, it caused a human problem. When the score is displayed, the flight status of all pilots is clear at a glance based on the score. The lower-ranked pilots disagree, feel offended, feel that the evaluation of the machine is substandard and biased, and that his flight is perfect, and it does not cause any flight problems. Checkpoint boundaries and deviation levels are not properly assessed. On the computer, it is obvious that the more capable and correct boundaries are placed on the level of deviation, the more accurately the technology reflects the actual situation through the quantitative evaluation of the flight. In the first phase of the work, under the guidance of FOM (RLE), we guided the types of aircraft studied and the opinions of the command and teaching personnel of the flight force. However, an interesting decision soon matured: use known statistical analysis methods to process the accumulated flight information array. In the continuous PI process, we obtained the physical values of the 78 control points of the Boeing 737 each flight and the 81 control points of the DHC-8. So far, about 4000 Boeing 737 flights and 1500 DHC-8 flights have been processed. All these information arrays are placed in a relational database. Choose one-way analysis of variance method for data processing. Statistical analysis of control points to determine the deviation between actual speed and calculated landing speed. Objective statistics:

Check the methods of all control points involved in flight point calculations. Consider the example of a control point, which determines the deviation of the actual landing speed from the calculated value (Vpos.-Vref), and also considers the data of the 2367 Boeing 737 flight. Figure 2.2.2;

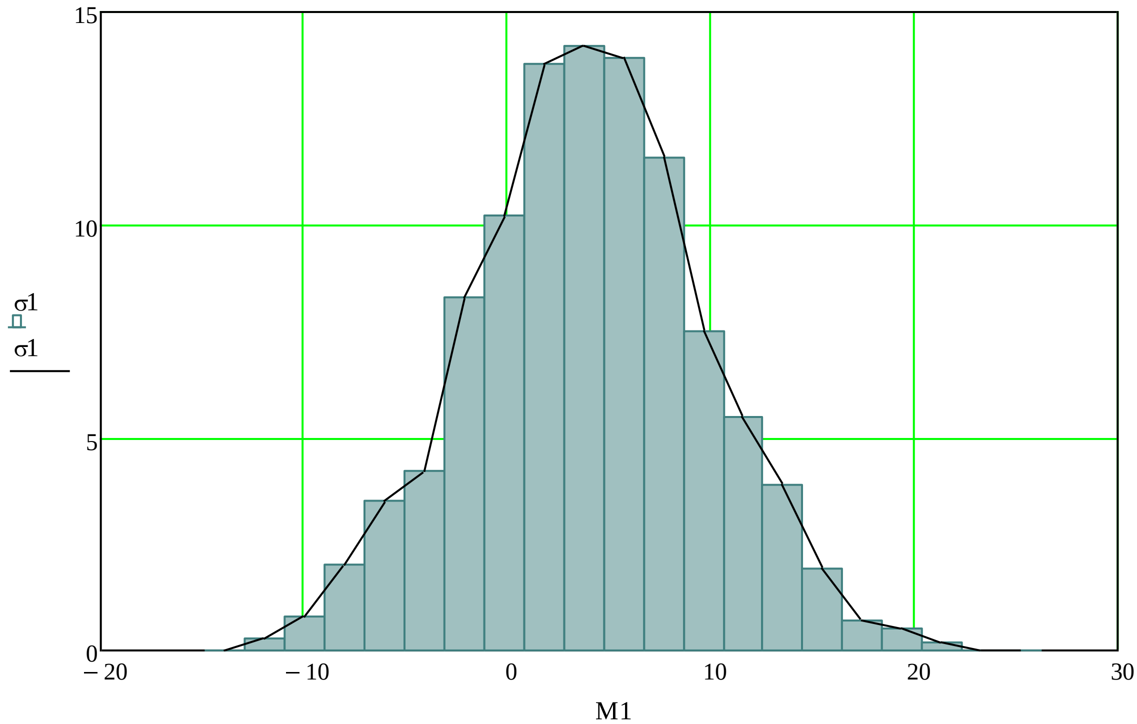


Fig 2.2.2 The statistical analysis of the control points determines the deviation of the actual speed from the estimated landing speed.

It should be noted that the original data is not revised manually, the report is automatically generated, and it can only be through software. It can be seen (see Figure2.2.2.) that the probability distribution density is very close to the normal (Gaussian) distribution. As we all know, the normal distribution has two parameters: maturity, which is the arithmetic mean of random variables, and variance, which is standard deviation.

After determining the distribution law and calculating the expectation and variance of a specific flight control point in the entire sample range, we can introduce deviation levels based on the statistical characteristics of the distribution and designate these deviations as points. The first level, which we classify as optimal control, will be regarded as the subject’s deviation

If the parameter can only be biased in one direction, the difference between the parameter and its beads (average value) does not exceed 1 variance value, or plus or minus 0.5 variance value, if the parameter can deviate more or less from these two Value (that is, this happens when the actual landing speed deviates from the calculated value). Therefore, under optimal control, the actual value of this parameter should fall within the range not greater than the variance value 1.

For the first-level deviation, we take the range width of 2 variance values, the second-level -2.6 variance values, and the third-level deviation (sometimes equivalent to a violation) -4 variance values.

The calculation of all normalized flight control points shows that the average value of the parameters obtained through statistical processing is the same as expected, very close to the best value recorded in the RLE. At the same time, the calculated statistical characteristics of the distribution (mathematical expectation and variance) allow a clear limit on the level of deviation, which has been verified theoretically and empirically. Therefore, it can be concluded from the above facts that when the best flight technology based on the pilot's typical training is used in the driving technology quality assessment system, any problem of the scoring system deviation can be eliminated, and the best driving technology is also considered the best. Comply with the law of normal distribution (as reflected by relevant standard parameters in flight training)

2.2.3. The process of assessing the quality of piloting techniques

It should be noted that each pilot has his own handwriting of piloting and in order to inform him about the occurrence of enhanced reflected movements, it is necessary to analyze the amplitude increase in the values of flight parameters at low frequencies, compared with flights under normal conditions.

A significant factor that has a significant impact on the technique of flight, the interaction between crew members in the cabin. An exceptional position here is played by the relationship between the KPS (commander of the aircraft) and his subordinate crew members, this is sometimes called the "atmosphere" or "climate" in the cockpit. Sufficient competence of the KPS should not constrain the initiative of other crew members. However, it is emphasized that the KPS is committed to creating an atmosphere of mutual respect and integrity. as well as demanding and professionalism in the performance of duties by members

crew. KPS creates conditions for the professional realization of each crew member during the flight, reproduction of sufficient preparation for the flight, so that during takeoff and landing there is sufficient detail, as if the crew implements actions or sees diagrams for the first time, despite previous acquaintance (if any).Ensuring the assessment of the quality of piloting equipment can be done using many methods.

2.2.4. The process of assessing the quality of piloting in the cockpit on the Grid scale.

To begin with, consider the quality of the pilot by the method of "Grid Scale" (CRM preparation method)

GRID grid, managerial grid gives a description of attitudes and behavior. This is not an assessment of personality, but a description of options for one or more of our behavioral roles (or management styles).

In training, the cockpit is like an office, the commander plays the role of managing director, who proposes the solution № I, the co-pilot - № 2, the flight engineer - №.3. The challenge is to find a solution № 4 and evaluate it as a collective better than individual solutions. The main goal is to show how a commander can make decisions based on maximum information. At the same time, the commander is at a new quality communication level. At the heart of the program is a management network developed in I965 by two psychologists from the University of Texas, R. Blake and D. Mouton. A grid is a description of attitudes and behaviors. It is not a means of personality diagnosis or psychological testing. We will give some explanations of a managerial grid (lattice), its basic positions. In general, the grid reflects the principles of autocratic and democratic management of the organization (group, crew). In the horizontal direction, the expert assigned points corresponding to the goals of the organization, the executive discipline is reflected, in the vertical direction - points relative to personal goals [68].

Minimal management. This is an assessment of the minimum effort of the subject to perform the task and maintain organizational condition. His motivation for people is also low.

Club management. It means maximum democracy in the performance of work, a friendly atmosphere, but efforts to perform tasks are minimal.

Silent execution. Means that people are completely subordinate to the goals of the organization. This is an example of autocratic rule.

Organizational management. This means a balance of effort for tasks and for people.

Independently organizing management. This is a case of a highly adapted to the external environment, affective and reliable system or individual. Real estimates rarely reach this combination. Scores I, I and 9.9 also show the polar positions of people in leadership. With the help of the lattice on the points assigned to all exercises, the crew members evaluate their own attitude to the leadership in the cabin and the impact of their own behavior on the results. Each subject answers a series of questions divided into five groups.

Curiosity - the degree of activity in gathering facts.

Persuasion is the degree of persistence in defending one's point of view.

Conflict resolution is a way to find a solution when working together.

Criticality - professional self-esteem and evaluation of others.

Decision making - the degree of determination in decision making.

Human resources are a system of personal, professional, educational, managerial characteristics of a person.

Styles are attitudes, systems of beliefs about the course of action to achieve goals. Each manager has a dominant style and related styles, which he uses in different roles and in different settings.

Optimal style. Corresponds to style 9.9 is almost completely balanced ideal of behavior - the focus on work is combined with the interests of the team.

Business style corresponds to style 9.1, full focus only on work, and the interests and opinions of other people are largely ignored. FAC is focused on achieving maximum results. Authority is used for tough leadership.

Collegial style corresponds to style 1.9, the general focus on achieving good relations in the team, often to the detriment of work. Such a FAC is always ready to listen to the opinions and opinions of other members and support their actions.

Conformist style corresponds to style 5.5 This is a compromise style, which takes into account the interests and work of both the team and their own. It is common, so it is the style of behavior of an ordinary intelligent person who is not burning with enthusiasm.

Hard-rational is close to business style, but in strength corresponds to the optimal style. Such a person may look less cold and formal than a representative of business style. He does everything for his own benefit, people are the tools to solve his personal problems.

Manipulative style is close to the collegial style. He gets along well with everyone. However, the selfish character trait indicates a tendency to manipulate people in their interests, but still the opinion of the team, he values and strives to look good in his eyes. With this style of behavior, a person believes that if he is satisfied and happy, then everyone around is also good.

Reasonable and selfish style corresponds to the style of careerism (to achieve their goals, all means are good) selfish trait indicates a general indifference, both to the case and to the team, if it does not concern personal interests. Because his selfishness is reasonable he is rather at the level of a person with a business style of behavior. He is respectful of authoritative persons, seeks to reach an agreement with persons of equal status, demanding and for those whom he perceives as subordinates, but by and large he does not care about those, and others, and the third. Such a person adapts to any situation to get the most out of it.

Workaholic style - super style 9.1 You can't say that such a person is cruel to people - he just doesn't see them. Not striving for career growth,

complete disregard, both for the interests of the team and their own.

Altruistic style - super 1.9 style complete disregard for the interests of the case and their own. "Wasteland in the clouds", such a combination would have long led such a person to dismissal.

Egocentric style "Slope" This person makes a minimal contribution to the work. Such a person works to retire, relies on existing instructions, and is not responsible.

2.2.5. Means for fixing avionics failures

The tremendous progress made in the performance of aviation aircraft in recent years has benefited from more and more advanced avionics. Compared with the original aircraft that used more mechanical structures for control, aviation aircraft are currently increasingly dependent on on-board electronic equipment. However, although airborne electronic equipment is sophisticated and sensitive, it is extremely prone to failure and safety issues. Therefore, regular inspections of the onboard electronic equipment during the use of aviation aircraft and timely troubleshooting can eliminate potential safety hazards and protect the lives and property safety of relevant personnel to the greatest extent

The current market has more stringent requirements for the performance and use of aviation aircraft, which are achieved by equipping the aircraft with advanced on-board electronic equipment. In order to accomplish this goal, the onboard electronic equipment of aviation aircraft is extremely complicated and the system composition is diversified. For example, a complete set of aircraft onboard electronic equipment includes power supply systems, transmission systems, lighting systems, pressure systems, flight attitude systems, flight navigation systems, vacuum systems, wireless communication systems, navigation systems, and fire control systems. Therefore, even if only the overhaul and investigation of the aircraft's onboard electronic equipment are carried out, it is a complicated and time-consuming task. In addition, nowadays, manual maintenance and inspection of electronic equipment on aviation aircraft are generally performed by personnel. Not to mention the low efficiency, it is also prone to missed inspections or false inspections. The use of manual maintenance and inspection of the onboard electronic equipment of aviation aircraft is also likely to cause the situation of relying more on experience than on the process, resulting in relatively inexperienced maintenance personnel who are unskilled and difficult to solve problems when participating in the maintenance and inspection of aviation aircraft onboard electronic equipment. Condition.

After years of development and progress, the aviation aircraft electronic equipment fault detection and elimination industry has formed a complete system and a complete platform, and there are complete industry information. Through the analysis of these valuable data, it is not difficult to find that in addition to the defects of its own materials and design, the failure of the aviation aircraft electronic system is also related to the operating environment of the aviation electronic equipment, driving habits, equipment working hours and other external factors. Through the analysis and classification of the aircraft’s performance impact, the frequency of failures, the hazard levels and common failure causes after the occurrence of aircraft electronic equipment failures, these factors are input into the computer, and the computer is used for modeling to construct a digital model. , And update it in real time according to the case. When a similar aviation aircraft electronic equipment failure occurs, the personnel who conducts fault detection and maintenance can analyze and solve the problem based on the database and model. Aviation aircraft onboard electronic equipment can be roughly summarized into the following categories.

1.Aviation aircraft onboard electronic equipment system failures.

Aviation aircraft onboard electronic equipment systems are usually arranged and distributed in layers of digital or electronic signals. If there is a problem with the layered arrangement of the electronic equipment system, it will lead to the failure of the entire onboard electronic system. The failure directly affects the overall performance of the aircraft. For example, a certain function of airborne electronic equipment requires two or more components to cooperate together. If one side is intact and the other side fails, the intact side cannot receive complete information and malfunctions, and the internal equipment of the system needs to be checked. Hierarchical connection

2. Material hardware failure of onboard electronic equipment of aviation aircraft

The most advanced airborne electronic system is also composed of materials and countless parts. If the electronic components or transmission lines of the onboard electronic equipment are physically damaged due to various reasons, it will also directly cause the onboard electronic equipment to fail to perform normal operations. If the onboard electronic system fails, the normality of the electronic components of the onboard electronic system and the integrity of the transmission line should be checked first.

3.Logic failure of onboard electronic equipment of aviation aircraft

Because the calculation and operation of the onboard electronic equipment is mainly controlled by the onboard computer, and the instructions issued by the computer are programmed in the form of code in advance. It may lead to logic errors in the design or installation of the calculation, and incorrect instructions to the on-board electronic equipment, resulting in the failure of the on-board electronic equipment. It may also be because the specifications and formats used by the input and output devices are different, resulting in the inability to transmit information normally, causing data mismatch, and causing the onboard electronic equipment to malfunction. This type of problem mostly occurs in the early design of airborne electronic equipment and when the wrong parts are used during equipment replacement. The probability of occurrence is small in normal times, and they are often found and corrected during flight test experiments.

4.Software failure of onboard electronic equipment of aviation aircraft

If the onboard electronic equipment of an aviation aircraft fails but is not caused by the above factors, it is mostly a software system failure. The software used in the onboard electronic equipment directly caused the failure of the onboard electronic equipment of general aviation aircraft due to virus infection or BUG. Since software faults are invisible to the naked eye, it is necessary to use related detection systems to detect and troubleshoot.

Compared with physical faults, it is more forcing and difficult to handle. When a software failure occurs, you can try to restart the system and observe the response after the restart. If the failure still occurs, you need to let professionals use professional equipment to detect and eliminate the failure.

2.3. Mathematical assessing of flight quality

For single-channel compensatory tracking, mental load is almost the only process, especially in visual flight. In this case, the only information processed by the pilot is information about the deviation from the set value of the stabilized parameter, and is the tracking error signal. The pilot's activity is aimed at minimizing the entropy of the tracking error. Indeed, the pilot tries to bring the system to a state where the tracking error has a definite value, when the entropy of the tracking error is zero, which means that the less information the tracking error contains, the better the result. On the other hand, the more information a pilot has to process per unit time, the more difficult the task. Therefore, the amount of information per unit time contained in the tracking error, ie by tracking error, can be used as a criterion for stability, controllability, piloting technique and level of turbulence in the evaluation of the achieved result. Practically for calculation of information productivity of a tracking error sampling, a signal on level of unit in time is necessary.

Evaluation of piloting techniques is done on one implementation. So it is necessary to assess the statistical characteristics of a random process for one of its implementation, averaging over changes in the parameters of information over time, ie the process must be ergodic.

Almost all stationary random processes are ergodic. In particular, a normalized (Gaussian) process with zero mean value can be considered ergodic. Turbulence is a locally normal process. The normal process at the input of the linear system remains normal at the output.

Thus, the simplest information performance of the tracking error is calculated. case when the process is stationary, ergodic and normalized, and the system is linear.

In addition, in the conditions of the above, it is in good agreement with the practical ideas of the pilot about good piloting techniques (good is considered piloting technique, when the pilot notices in time and correctly corrects the observed deviations from the specified flight mode.

To assess the piloting technique and controllability of the Armed Forces on the work performed, the author proposes the following approach. When implementing a tracking error in controlled (K) and uncontrolled (H) flight under the same conditions. The work of the pilot is to bring the error of tracking the state (H) to the state (K). The greater the difference between the implementation (H) and (K) in terms of information performance, the better the piloting technique (or controllability of the aircraft). Naturally, the more information a pilot does per unit of information processing per unit time, the more difficult this task is for him. Therefore, the author proposed to use as a criterion for assessing the technique of piloting or controllability H the difference between the information performance of the tracking error in unguided and controlled flights under the same conditions.

An experiment was conducted to determine the assessment of the quality of piloting techniques using the information method.

As a result of the experiment, using criterion (I), a correlation coefficient was obtained between the calculated values of the criterion and the estimates of the pilot 0.612, and when applying criterion (I), the modulus of the correlation coefficient was 0.826 at Rdov = 0.9. At the same time, the correlation coefficient between the variance of the tracking error, which is used as a criterion for the perfection of technical systems and the assessment of the pilot, was 0.729 at Pöag = 0.9. In the experiment, the experienced pilot minimized the oscillations of the controls on the roll.

The experiment evaluated the accuracy of maintaining the speed on the plane AS - 18 by a group of cadets of three people. The flights were performed at a barometric altitude of 200 m and a speed of 150 km / h. A total of 57 experimental recordings lasting 40 s were obtained.

The records were presented to three experienced pilot instructors for analysis and evaluation. Entries were presented at random. The instructor did not know which cadet the record belonged to, at what stage of the flight program it was made. According to the received estimations of pilots - instructors the average estimation was calculated [69].

Experimental records were processed in the following order:

1. Analog recording was changed to digital by sampling according to Kotelnikov's theorem [70]. Samples were taken at intervals of 1.6 s, which allowed to save information at a frequency of 0.3 Hz.

$$\mathrm{x(t)} = \sum_{k=-\infty}^{\infty} x(\mathrm{k}\Delta)\, sinc[\frac{\pi}{\Delta}\ (t - k\Delta)\ ]$$

Where sinc(x)=sin(x)/x sinc function. The sampling interval satisfies the constraint 0 $< \Delta \leqslant 1/(2f_c)$ The instantaneous values of this series are discrete signal samples x(k Δ)

sinc (from the Latin sinus cardinalis - "cardinal sinus") - a mathematical function. Denoted by sinc (x). It has two definitions - for normalized and non-normalized sinc function, respectively:

In digital signal processing and communication theory, the normalized sinc function is usually defined as

$$\mathrm{sinc}\,(x) = \begin{cases} \frac{\sin(\pi x)}{\pi x} & ; \quad x \neq 0 \\ 1 & ; \quad x = 0 \end{cases}$$

In both cases, the value of the function at a particular point is explicitly set equal to one. Thus, the sinc function is analytic for any argument value.

2. There was a mathematical expectation of the parameter

$$m_X = \lim_{T\to\infty} 1/T \int_{-T/2}^{T/2} X(t)dt$$

3.The record was centered.

$$R_X(\tau) = \lim_{T\to\infty} 1/T \int_{-T/2}^{T/2} X(t)X(t+\tau)dt$$

According to the auto correlation function (Autocorrelation is a statistical relationship between random variables from one series, but taken with a shift, for example, for a random process - with a time shift)

In signal processing, the autocorrelation function (ACF) is determined by the integral

$$\Psi(\tau) = \int f(t) f(t-\tau) \mathrm{d}t$$

and shows the relationship of the signal (function) with a copy of itself, shifted by

There was a variance of the record V (t). Knowledge of variance was useful to control the results obtained

$$D[X] = M[|X - M[X]|^2]$$

The normality of the distribution of values was checked. S

tationarity and ergodicity of implementations were checked (by means of the analysis of auto correlation function

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}},$$

6. To determine the spectral composition of the implementations was studied by Fourier series decomposition. As a result of spectral analysis of variance, the values = 0.15 Hz were adopted

$$x(t) = \sum_{k=-\infty}^{\infty} x(k\Delta) \prod_{n=1}^{M} \operatorname{sinc}\left[\frac{\pi}{a^{n-1}\Delta}(t - k\Delta)\right]$$

where the parameters a, M satisfy inequalities (3.9), and the sampling interval

$$a^{M-1}(a-2) + 1 > 0$$

The size was calculated by numerical integration according to Parseval's theorem. In discrete form, the theorem is written as formula

$$\sum_{i=0}^{N-1} |x(i)|^2 = \frac{1}{N} \sum_{k=0}^{N-1} |X(k)|^2$$

For the proposed method, a correlation coefficient of 0.907 was obtained, while according to the official method 0.750 (P = 0.999). The spectral composition of implementations depending on the assessment of the pilot - instructor was also analyzed

CHAPTER 3 Aircraft Maintenance

3.1. Aircraft maintenance process and methods

3.1.1. Aircraft maintenance process

Maintenance is the basis of safe flight and must be managed systematically, scientifically and effectively. At present, the domestic airline maintenance system has different calendar models due to the size, management method and development level of the airline. The contradiction between the existing management model and the rapidly expanding market demand of the airline is becoming more and more obvious. The occurrence of production safety accidents ultimately reflects that there are many deficiencies in the methods, means and models of locomotive management.

The aircraft maintenance department is an important guarantee unit for the normal operation of civil aviation and is responsible for keeping the aircraft in an airworthy and "intact" state and ensuring that the aircraft can operate safely. "Airworthiness" means that the aircraft complies with the relevant airworthiness standards and regulations of the civil aviation authority. "Intact" means that the aircraft maintains a beautiful and comfortable internal and external image and decoration. Generally speaking, the aircraft maintenance department is divided into two levels; the first level is the maintenance base for in-plant maintenance. The maintenance base is a maintenance factory, which has large maintenance tools and machinery and a maintenance workshop responsible for regular maintenance, overhaul, replacement of large parts and modifications of the aircraft.

The second level is line maintenance, which is also called outfield maintenance. Aircraft generally do not enter workshops. Maintenance and repair of aircraft in operation are carried out on the route. This type of route maintenance includes pre-voyage, post-voyage and over-station maintenance.

The influence of aircraft maintenance team on flight safety has many aspects, and the influence of many aspects is nothing more than the influence between people and aircraft. Human errors generally include the following five situations: failure to perform the functions assigned to him; incorrectly performing the functions assigned to him; performing extra functions not assigned; performing functions according to the wrong procedures or at the wrong time; execution The functions are not comprehensive. Human error in aviation maintenance means that the result of human behavior deviates from the specified target and produces adverse effects. It is manifested as an unintentional aircraft defect caused by the behavior of maintenance personnel. The severity of the defect is determined. The severity of the maintenance error has been affected.

3.1.2. Aircraft maintenance methods and maintenance techniques

(1) Based on the tradition, draw on the maintenance concept and maintenance experience

In the past, when performing aircraft maintenance, there was no current advanced science and technology and information equipment. Maintenance personnel mainly relied on their own experience and proficient skills in long-term work practice to carry out maintenance work. These valuable experiences are still available for learning and reference today. the value of. Traditional aircraft failures are nothing more than the aging of aircraft materials and mechanical wear. Since the aircraft manufacturing technology was relatively backward at that time, the safety and reliability of aircraft are mainly related to the use time of aircraft parts. In view of this, people have found that the time interval for aircraft maintenance can be used to ensure the normal operation of aircraft systems and the safe driving of aircraft, and then summarize a set of scientific and complete aircraft maintenance concepts: regular repairs are the core, with frequent inspections and repairs.

(2) Based on modern times, make full use of maintenance technology and maintenance methods

1) Use digital technology to accurately analyze aircraft failures. If you want to improve the maintenance technology and maintenance level of civil aviation aircraft, you must summarize and analyze the failure problems that occur during the operation of the aircraft, especially some of the more common problems. Relevant data are summarized and researched to find out the cause of the failure and propose solutions to reduce the probability of failure. At the same time, comprehensive ability evaluation and technical evaluation of maintenance personnel are also required, and maintenance personnel are strictly required

The professional ability of the repair personnel, observe the repair effect through the frequency of failure, and eliminate unqualified repair personnel. In addition, different aircraft maintenance plans need to be formulated according to different flight seasons to lay a solid foundation for the next stage of maintenance work. In short, the use of fault data in the maintenance of modern civil aviation aircraft is extremely wide, and the maintenance personnel can establish a corresponding fault database, and update and maintain it in time.

2) Use information technology to establish a dynamic information system

In the actual maintenance process of civil aviation aircraft, three main elements are mainly involved, namely maintenance personnel, maintenance aviation materials, and maintenance equipment. Based on this, we can use modern information technology and computer technology to integrate information on support resources, aircraft flight, technology, expert systems, manufacturing plants, operators, airworthiness authorities, maintenance experience, maintenance skills, etc., to establish a multiple Type, multi-platform, diversified, multi-source dynamic maintenance information resource system, and then provide scientific and accurate data reference for civil aviation aircraft maintenance. During the establishment of the system, advanced data processing technology and information technology should be used to collect, transmit, aggregate, analyze, filter, synthesize, and synthesize various information to form a digital, intelligent, and informatized aircraft maintenance database. The system ensures the efficient, reasonable and orderly operation of maintenance work.

3) Use scientific and technological means to improve the level of maintenance technology

Traditional aircraft failures are mainly simple mechanical failures, while modern aircraft failures involve more high-tech factors, such as digital technology failures, information technology failures, electronic failures, electromechanical failures, and so on. Nowadays, the maintenance technologies that are widely used in the field of civil aviation aircraft include microelectronics technology, software measurement technology, computer technology and digital technology. Under this circumstance, in addition to mastering the above-mentioned series of high-tech maintenance technologies, maintenance personnel must also be familiar with and understand the performance of some new equipment, new materials, and new processes for aircraft maintenance, and use more and more extensive maintenance experience to discover aircraft manufacturing. And the deficiencies and deficiencies in the aircraft maintenance process. For example, many civil aviation aircraft are equipped with corresponding electronic diagnosis and electronic monitoring technology and functions, which can help maintenance personnel to quickly and accurately judge and check the failure of civil aviation aircraft, help prevent maintenance work, and also Effectively reduce maintenance costs.

3.2. Man-made violations in aircraft maintenance

Based on the errors caused by human factors in various aircraft maintenance companies in recent years, after analysis, we found that the errors are induced by the following two main reasons. The first is because of the maintenance workers themselves, operating in violation of regulations and acting blindly and brutally. The maintenance manuals for various types of aircraft provide the operating procedures, operating methods and safety precautions to be followed for various maintenance tasks, which are not only the basis for ensuring the quality of aircraft maintenance, but also the guidelines for carrying out safe production work. However, some maintenance personnel did not follow the provisions of the maintenance manual during the maintenance work such as fault isolation, accessory disassembly and assembly, and system debugging. In this way, loopholes and mistakes will inevitably occur in the work. Flight crews with unstable thinking and maintenance are the two pillars to ensure flight safety, and their status should be affirmed. However, the status of maintenance personnel has gradually declined in recent years, and compared with other civil aviation units, there are gaps in remuneration and housing. The more important thing is that there is a wrong idea, always thinking that the maintenance department cannot generate revenue, it is pure consumption. Therefore, the maintenance cost investment, the construction and renovation of plant equipment, the distribution and distribution of labor insurance supplies and other external links directly caused the failure of the maintenance team. stability. From the internal perspective of locomotive maintenance, some locomotive personnel feel that doing locomotion is a disadvantage, not rushing, bitter and tired. They would rather abandon the locomotive expertise they have learned, and find ways to transfer out of locomotive positions, resulting in the loss of locomotive maintenance personnel, and indirectly. Here comes the instability of the crew. However, due to the unstable thinking of the personnel, there are hidden safety hazards in the maintenance work casually and casually. Therefore, the quality of aircraft maintenance cannot be guaranteed. Maintenance personnel participate in few trainings and their professional quality has deteriorated. In the past ten years, my country's civil aviation industry has been growing at a rate of more than 20% per year during the rapid development of total transportation turnover. However, such continuous high-speed development has also brought many problems and contradictions to civil aviation, especially the problem that the professional quality of civil aviation maintenance personnel has not kept up with the rapid development of the industry as a whole is more prominent, which has also caused the low quality of aircraft maintenance today. Another major factor of

The second is the reason for the aircraft system. 1. The error prevention design is not perfect. Error prevention design is the fundamental design concept and preventive measures taken to prevent human errors and loopholes during flight driving and maintenance operations. Many years ago, the installation of the wire and plug of the autopilot mechanism of the TY-154 aircraft caused a major flight accident. The cockpit instrument of a certain type of aircraft was installed reversely; the poor waterproof performance of the magneto of a certain type of engine caused two engines, 4 Three of the magneto's water penetrated and caused a major flight accident. Wait for these errors to happen. In addition to the fact that the operator does not understand the characteristics of the aircraft, and is responsible for maintenance without conducting an in-situ power-on inspection, the aircraft's error prevention settings

The imperfect calculation is also an important reason.

2. There are omissions in the implementation of the inspection system. Adhering to the inspection system is the key to maintaining the quality of maintenance. In this regard, the airworthiness management department has formulated relevant regulations and procedures for a long time, and many maintenance departments also have a sound quality management system and quality control system. Omissions in the implementation of the inspection system mainly exist in the incomplete inspection system of some maintenance units, and some inspectors are not very responsible or have non-full-time inspectors with insufficient experience in the quality inspection department. Due to the existence of these problems, some human errors that could have been avoided have passed the test. 3. The maintenance environment and guarantee conditions do not meet the maintenance requirements

Repair requirements. Failure to meet the maintenance environment and support conditions means that the manpower, site, facilities, tools, equipment, environmental conditions and other maintenance hardware used cannot meet the requirements for maintenance work, which leads to system errors. For example, an airport apron is too small and the aircraft is parked at a small distance. The crosswind causes the aircraft to spin and a collision. , Resulting in noise interference and harsh environment during the maintenance operation. The aviation materials warehouse is small. The aviation materials of different models are stored in the same inventory, which is prone to mistakes and misuse of aviation materials. The maintenance human resources are tight, and high-intensity overtime work will also cause human errors. happened.

4. Inadequate maintenance management. Due to imperfect rules and regulations, working procedures, technical standards, operating specifications, poor operability, or poor execution, it may lead to illegal operations and may cause human errors. For example, the aircraft's weighing wheel does not block the wheel block, causing the aircraft to slip forward, loading and unloading goods not in accordance with the load balance manual, the aircraft's center of gravity is out of balance, the tail is damaged, the towing aircraft is turning at a large angle and speed, and the tow bar safety pin is broken. . Another example is that when a foreign company completed an aircraft overhaul for a company in my country, it left the flashlight in the aircraft operating system and caused jams and was punished by the suspension of the maintenance license. A certain company has known that the tires of the two front wheels of the aircraft have seriously exceeded the standard. There was a fluke in the blind blindness, and the flight was canceled because the front wheel of the plane burst during taxiing without replacing it. The occurrence of this kind of human error is a violation of the rules by the worker.

The fundamental reason for the low maintenance and work standards is the ineffective maintenance management.

3.3. Suggestions

Facing the complicated human factors in aircraft maintenance, we have to grasp well: 1. Firmly establish safety awareness.It is a prerequisite to ensure safety. The establishment of safety awareness firstly comes from the education of safety thoughts. Organizations and cadres at all levels of maintenance should earnestly publicize and understand the meaning of ensuring safety, educate all employees in a targeted and persuasive manner to establish the concept of "safety first", correctly handle the relationship between safety and production, safety and efficiency, and ensure On the premise of safety, provide maximum capacity for air transportation. Safety education should be extensive, in-depth, diverse in forms, pragmatic, and work hard. Not only pay attention to the pre-job education of new comrades, but also pay attention to the regular periodic education of old comrades to make them vigilant, not only pay attention to vigorous and vigorous, but also pay more attention to reality, and find the right foothold and cut in

The point, that is to say, the important meaning, but also the responsibilities of each post, so that safety education can be deeply rooted in the hearts of the people, leaving no dead ends. Secondly, the party, government, and working groups have reached a consensus to achieve joint management, consolidate the achievements of education, and work together to ensure safety. The formation of security awareness is not achieved by a certain leader or department, but the result of cooperation and concerted efforts of various organizations and units. In the event of a safety accident, the efforts of hundreds or even thousands of people were destroyed, and the entire unit could not escape the investigation. Therefore, safety work must penetrate into all links, encourage all employees to take safety at heart, thoroughly overcome the idea of "safety has nothing to do with oneself", create a good atmosphere of "I contribute to safety", and establish a comprehensive safety responsibility system , To form a network for group security.

2. Strict implementation of industry standards and regulations is the basis for ensuring safety. Industry standards and rules and regulations are the code of conduct and technical operation of locomotive work. They are the summaries of experience, even the lessons of blood, and are highly pertinent and maneuverable. As a maintenance person, you must never do anything that is prohibited. Any warning and reminder should be strictly followed and consciously implemented. However, the main problem at present is that a considerable part of the staff does not pay enough attention to the ideology, the concept of the rules and regulations is not strong, and even self-righteous and do whatever they want. There are many problems in the implementation.

Some rules are unsound and unruly, and some have rules that are not followed. For example, the pre-flight and post-flight checklist system is in place in advance and cannot be left at will. They cannot be consistently adhered to. In some workshops and groups, the leaders set by example Being strict in self-discipline and setting an example of subordinates, and even taking the lead in violating rules and disciplines, has a very bad impact. Some cadres have low standards and lax requirements for subordinates. After discovering problems, major issues have been reduced to minor issues, and they have not been seriously investigated and dealt with.

If it is not taken seriously, human errors and human liability accidents will inevitably increase. Therefore, the maintenance department must faithfully maintain the seriousness and statutory nature of the rules and regulations, and cannot take rectification measures only after problems or accident signs occur. To change from passive to active, we must always look for shortcomings and hidden dangers in daily work, pay close attention to the links that are prone to errors, pay attention to discipline, work style, management at all levels, and implement safety work every time and every place. . There is another point that should not be ignored. It is necessary to strengthen the construction of a work environment with strict discipline, strict requirements, and serious attitude. Such a gradual, interlocking, and strengthen the legal concept of all employees, so that laws must be followed and orders must be followed.

3. Strict organization and management and strict aircraft quality are the basis for ensuring safety. The locomotive itself is a complex system. The first is technical complexity. The aircraft integrates contemporary advanced scientific and technological achievements and involves multiple subsystems such as mechatronics, followed by many institutions. Aircraft maintenance engineering and production activities are related to many departments such as technology, quality control, production, aviation materials, and field maintenance. To make effective use of existing manpower and material resources, do a good job in maintenance, and timely provide airworthy and safe aircraft into flight operations, we must rely on strict organization and scientific management. From a vertical perspective, organizational management is not just a matter for the leaders of the aviation maintenance department, such as factory directors, managers, and workshop directors. Even team leaders and section leaders must learn and strengthen organizational management because their work directly affects them. Maintenance quality and safety. From a horizontal perspective, for their own interests, various functional departments and various types of work restrain each other, fight internal conflicts, and shirk responsibilities,

which will inevitably affect the orderly progress of work. If there is a slight negligence and negligence, it will directly affect safety issues. Therefore, in addition to improving the safety management system, the necessary rectification of management personnel in production planning, technology, quality, etc., to make them clear responsibilities, correct attitudes, establish ideas for flight and production services, and proactively provide technology for front-line units Support and airworthiness release requirements. Through organization and management means, implement the organization and coordination of the grassroots units that ensure safety, so that

It becomes an organic whole, unity and cooperation can give full play to the role and advanced experience of various functional departments to ensure safety, cooperate with each other, exchange information, improve airworthiness awareness, and strictly control quality. In this way, everyone has their responsibilities, the work is standardized, the work has standards, and the inspection has a system. Eventually improve the level of machine maintenance to ensure safety.

4. Strengthening on-the-job education and training is a guarantee for safety. In recent years, with the introduction of a large number of new aircraft, the shortage of aviation capacity has been alleviated, and a large amount of new knowledge and technology have been brought in. As a result, the overall quality and business adaptability of the maintenance team have declined. Therefore, strengthening the on-the-job education and training of employees must keep up with the development of the times and advances in technology. The maintenance department has realized the importance and necessity of on-the-job training, and has spared no effort to promote it. However, in terms of specific operations, there is insufficient understanding of complexity and difficulty, and pre-job training of new employees is emphasized. However, due to the negligence of job training in normal production tasks, or seldom pays attention to operation skills training, ignoring professional ethics and psychological factors and other qualities The training mainly focuses on short-term education and training in the aspects of modification, difference, and the profession. There is a lack of systematic and uninterrupted training services and long-term goal planning. In this way, it is difficult to achieve the desired effect if it is exhausted to cope. The system reliability of modern civil transportation flights has reached a fairly

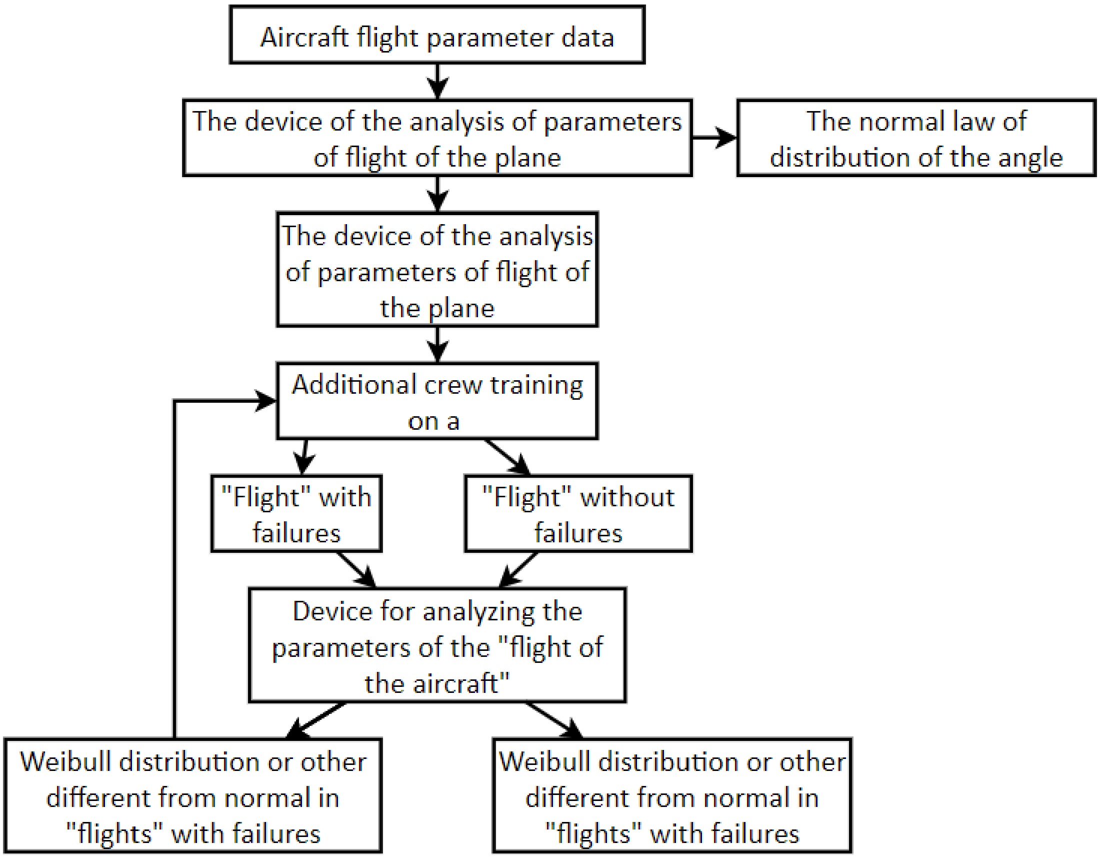
good level. Under normal circumstances, the probability of failure is low, and the on-board auxiliary failure detection system can display failure information, thereby reducing the load of maintenance work. However, it also makes it difficult for people to check and eliminate faults, conduct comprehensive analysis, and make judgments. It also puts forward higher requirements for the depth and breadth of knowledge understanding. Moreover, aviation technology is constantly being updated and developed. A qualified crew must also have good qualities and professional ethics, and these cannot be changed and achieved in a short period of time. Therefore, establish the concept system of "training is safety", establish a special training organization, formulate detailed long-term plans and long-term goals, be responsible for safety, be responsible for employees, conduct systematic safety and professional business knowledge training, and have a purpose Train a group of modern maintenance personnel with both ability and political integrity. On the other hand, create an academic learning atmosphere that respects knowledge and talents, creates a relaxed research and exploration environment for professional and technical personnel, and encourages people to devote themselves to science and aviation maintenance to ensure safety rigorously and scientifically. In summary, aircraft maintenance has an impact on aircraft safety all the time and everywhere. Only with the establishment of a good maintenance system can safe flight be achieved.

CHAPTER 4
Piloting technique quality assessment system

4.1. Description of the piloting technique quality assessment system

The main work goal of the pilot technology quality assessment system is the flight parameters and data of the pilots during the flight or training phase. It is mainly an intelligent data integration analysis system. The main purpose is to collect the pilot's flight parameters and main flight data, and then compare the data with the best flight model created by the system. The pilot’s current flight is evaluated and scored, and the evaluation results are finally presented in the hands of the pilots and instructors. In this way, the most reliable and direct description of the flight situation can be provided to the pilot. Allow pilots to have the clearest understanding of their own flight conditions. Provide the main direction of flight training and provide effective help to ensure the safety of air flight.

The main work flow chart of the system is shown in Figure 3.1;



The research goal of the system is the flight parameter data of the aircraft. The aircraft flight parameter data is collected and sent to the aircraft flight parameter analysis device for parameter analysis through the equipment on the aircraft. During the flight, in terms of flight conditions, the flight skills The conceptual model focused on flight training will be regarded as a standard driving model.

Various methods can be used to identify the approximate best model of the current flight status, and the most effective method is the variable averaging method.

The best graph of the averaging method is shown in Figure 3.2

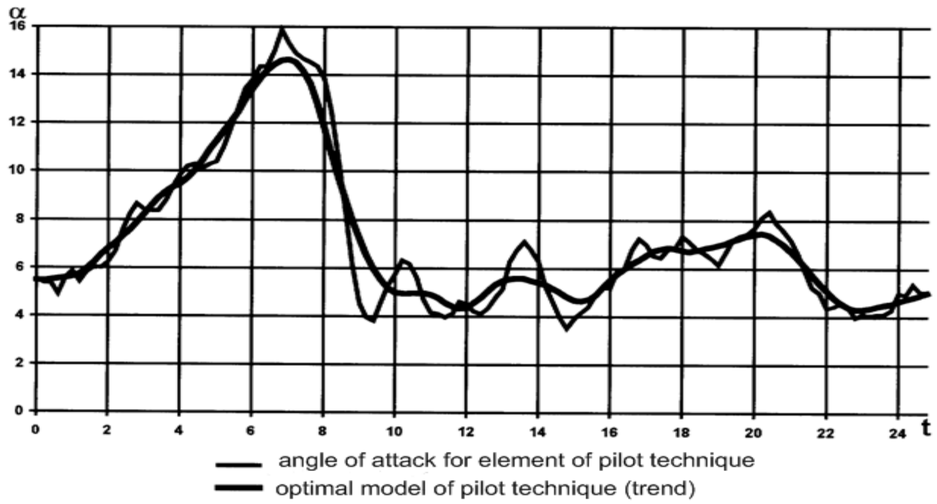


Fig 3,2 The best graph of the averaging method

$$\bar{\bar{X}}(t) = \bar{\bar{X}}_t = \frac{1}{2n+1}\left(\sum_{i=t-n}^{t-1} X_i + X_t + \sum_{j=t+n}^{t+1} X_j\right)$$

Where X_t is the discrete measurement value of the defined parameter x at a given time.

The execution formula of the pilot frequency technology:

$$\overline{X_t} = X_t - \bar{\bar{X}}(t)$$

Suppose that the query period of parameter x is T, and the smoothing filter period is

$$\Delta t = T(2n+1)$$

Based on the existing flight data, it is known that the most suitable smoothing time t for selecting the best flight mode is between 2.2 and 2.7 seconds. A pilot with intensive motivation is the true value of the logistic function

$$Cl = (|\Upsilon| > 10o) + (|\Psi| > 10o) + (ny > 1{,}5) + (ny < 0{,}5)$$

$\sigma = \sqrt{\frac{1}{k}\sum_{i=1}^{k} \bar{x}_i^{\,2}}$ Is the standard deviation of the function

The maximum allowable deviation is 1.

Type 2 parameters include that the parameter deviation should be as close as possible to the best model. When the maximum deviation of the execution model exceeds the maximum allowable value, the flight status is not up to standard. Therefore, for Type 2 flight modes, the ration reserve between the limit and the maximum deviation of the best model should be checked.

$$m = \left|\frac{A}{\delta_m}\right|$$

The estimated value m may vary from 0 to 1. This element has a dangerous tendency at m1. The important parameters are the angle of attack and gain. On airplanes, it is recommended to install indicators for safety assessment parameters l, m, and m on the channel and m, as well as the fault and comment channel.

The essence of the proposed method of evaluating quality is to estimate the dispersion of the control effect of manual control (execution model) with respect to the calculated useful signal (trend). The selection of current value and execution model is carried out in accordance with the above method. The dispersion estimate of the optimal model is determined by the variance (bias power).

$$\bar{\bar{X}}(t) = \frac{1}{2n+1}\left(\sum_{i=t-n}^{t-1} X_i + X_t + \sum_{j=t+n}^{t+1} X_j\right)$$

The data of the aircraft's parameter roll angle and pitch angle analyze the law of normal distribution, and evaluate the flight error of this flight. If the first failure of the system follows the webull distribution, the failure rate is

$\gamma(t) = \lambda\beta t^{\beta-1}$

With minimal maintenance, the system failure intensity function is: $u(t) = \lambda\beta t^{\beta-1}$

Where β is the shape parameter, λ is the scale parameter; t is the working time of the system. This is a power law model, an extension of the weibull distribution, used to analyze the reliability of complex repairable systems.

After the data analysis is over, the crew will be guided and trained, enter the simulator for additional training, and re-analyze the data obtained. Observe the difference between the Weibull distribution rule and the normal distribution rule of roll and pitch angles in the failed flight and the difference in the distribution rule of the flight failure in the air. After analyzing and summarizing, re-enter the simulator training, and finally reach the standard flight quality.

4.2. Experimental studies of the quality of piloting technique

Safety issues are one of the main issues of the air transportation system. The most common situation is that if special circumstances occur in flight, the quality of driving skills will decline. Usually, such accidents are of an impossible nature. In most cases, the crew is flying in the command and control mode of the aircraft. Due to equipment failures and malfunctions, human operators aggravate the negative situation due to stress conditions. Therefore, it is necessary to prepare for the flight under special circumstances. We recommend evaluating the quality of driving skills through the autocorrelation function and its spectrum. We recommend evaluating the quality of driving skills through the autocorrelation function and its spectrum.

Through the autocorrelation function and the law of roll angle distribution, a method for evaluating the quality of crew driving skills is obtained. The normal distribution law and small value of the coefficients of the autocorrelation function indicate a good quality test technique.

The flight quality of an aircraft is determined by a lot of flight data. It is not only determined by the standardization of the aircraft's actions, but the accuracy of the position is also important in some flight phases of the aircraft.

The overall flight process of an airplane is taxiing, taking off, climbing, cruising, descending, and landing. This chapter mainly talks about the flight technical quality of the aircraft when the aircraft approaches before and after entering the glideslope before landing. When the aircraft enters the boundary of the slideway entrance and enters the gliding phase, not only the accuracy of the movement must be considered, but also the airspeed of the aircraft. In some cases, the crew not only failed to maintain a stable airspeed, but incorrectly adjusted the depression angle of the aircraft, causing the aircraft to collide with the ground when it landed.

The flight operation of the aircraft when entering the glideslope is a landing attitude after aligning to the runway during landing. After continuous trimming, the aircraft aimed at the runway and prepared for landing. In this process, the crew must control the aircraft's glide state according to the parameters of the airport and the performance of the aircraft.

The glide path is a landing profile of the aircraft. The situation will not be able to pull up the plane and cause an accident. This is an unsafe sign and is strictly forbidden.

During the landing process of the aircraft, without the influence of environmental factors, the roll angle of the aircraft only needs to remain stable until landing. During this process, the aircraft does not need to roll. However, because of environmental impacts, such as a sudden gust of wind from the flank of the aircraft, the roll angle of the aircraft has deviated. At this time, it is necessary to adjust the aircraft attitude in time to prevent excessive deflection and make it impossible to land safely. The calculation results show that the statistical distribution of the pitch angle is not inconsistent with the normal distribution. As we all know, the normal law of parameter distribution indicates a high-quality test technique. By analyzing the autocorrelation function of the pitch angle and its frequency spectrum, the evaluation of the quality of the pilot technology is consistent with the estimation method based on the distribution law. Established a good technique for driving Boeing737 pilots under normal driving skills.

Analyze the flying mass of the boeing737 during the actual flight 200s before landing. We constructed a histogram of the roll angle distribution when approaching the pilot 200s before landing.

$$\gamma := \begin{pmatrix} 1 & -1 & 1 & -1 & 0 & -2 & 2 & -3 & 1 & -1 & 2 & -2 & 0 & -1 & 1 & 0 & 2 \\ 0 & 1 & 0 & 2 & 0 & 1 & 0 & 1 & -1 & 0 & -1 & 0 & 2 & -2 & 0 & 1 & 0 \end{pmatrix}$$

$$n := hist(6,\gamma) = \begin{pmatrix} 1 \\ 3 \\ 6 \\ 11 \\ 8 \\ 5 \end{pmatrix} \qquad fg := histogram(6,\gamma) = \begin{pmatrix} -2.583 & 1 \\ -1.75 & 3 \\ -0.917 & 6 \\ -0.083 & 11 \\ 0.75 & 8 \\ 1.583 & 5 \end{pmatrix}$$

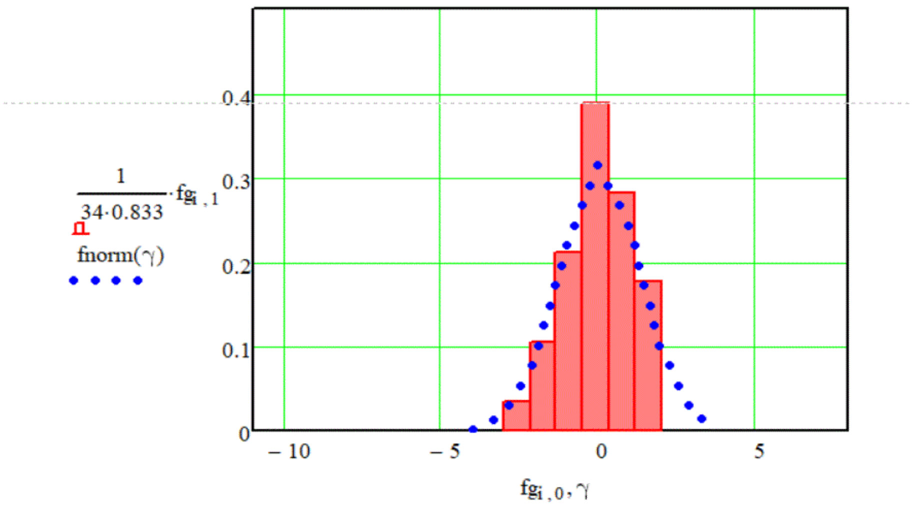
$K := 6 \qquad \Delta\gamma := 0.833 \qquad N := 34 \qquad k := 0..5 \qquad q := \min(\gamma) = -3$

$mean(\gamma) = 0.088 \qquad var(\gamma) = 1.61 \qquad \sigma := \sqrt{var(\gamma)} = 1.269 \qquad d := var(\gamma) = 1.61$

$\mu := 0.088 \qquad c := \dfrac{1}{mean(\gamma)} = 11.333 \qquad \gamma := -4..4 \qquad \nu := \dfrac{\sigma}{\mu} = 14.418$

$int_k := -3 + \Delta\gamma \cdot k$

$$int = \begin{pmatrix} -3 \\ -2.167 \\ -1.334 \\ -0.501 \\ 0.332 \\ 1.165 \end{pmatrix} \qquad k = \begin{array}{|c|} \hline 0 \\ \hline 1 \\ \hline 2 \\ \hline 3 \\ \hline 4 \\ \hline 5 \\ \hline \end{array} \qquad fnorm(\gamma) := \frac{1}{\sigma\sqrt{2\cdot\pi}}\cdot \exp\left[-\frac{(\mu-\gamma)^2}{2\cdot\sigma^2}\right]$$



$$fnorm(\gamma) := \frac{1}{\sigma\sqrt{2\cdot\pi}}\cdot \exp\left[-\frac{(\mu-\gamma)^2}{2\cdot\sigma^2}\right]$$

Fig 3.4 The histogram of the roll angle distribution is similar to the law of normal distribution.

Analysis of consent Norm-model

The theoretical probability of failure in the k-th interval Δt

$N := 34 \qquad a := 0..5 \qquad K := 6 \qquad k := K - 1$

$r := K - 3 = 3 \qquad \Sigma n := 34$

$$Qnorm_a := \int_{int_a}^{int_a + \Delta\gamma} fnorm(\gamma)\, d\gamma$$

$$Qnorm_5 := 1 - \sum_{a=0}^{4} Qnorm_a$$

$Qnorm_a =$

0.03
0.093
0.19
0.255
0.226
0.205

$$n = \begin{pmatrix} 1 \\ 3 \\ 6 \\ 11 \\ 8 \\ 5 \end{pmatrix}$$

$$\chi2norm := \sum_{a=0}^{K-1} \left[\frac{\left[(n_a) - N \cdot Qnorm_a \right]^2}{N \cdot Qnorm_a} \right] = 1.248 \qquad P \approx 0,7$$

Fig3.5 .Verification of the conformity between the theoretical normal distribution and the statistical distribution

Let us verify the corresponding relationship between the theoretical normal distribution and the statistical distribution according to the Pearson agreement criterion. The calculation results show that the statistical distribution γ does not contradict the normal distribution, and its probability is about 0.7. Analysis of the autocorrelation function and its roll angle spectrum We use the analysis of the autocorrelation function to evaluate the flight quality from the end of the second round to the fourth round to after landing (excluding turns). We only consider the amplitude parameter.

We also selected the corresponding theoretical distribution.

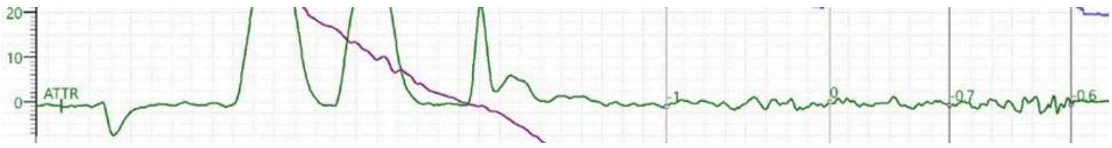


Fig 3.6 Waveform of the actual roll angle of the Hyundai series B-737 before landing

The flight quality can be improved by controlling the flight attitude of the aircraft, and the flight quality of the pilots can also be evaluated by evaluating the flight attitude of the aircraft. The flight attitude control of the pilots can be trained through a flight simulator to improve the reliability and safety of air flight.

By analyzing the autocorrelation function of the pitch angle and its frequency spectrum, the evaluation of the quality of the pilot technology is consistent with the estimation method based on the distribution law. Established a good technique for flying Boeing737 pilots under normal flight conditions. Proposed a fault early warning system for the indicator speed indicator light or the angle of attack indicator light. And made recommendations on the pilot's actions in this situation. The design scheme of the fault alarm system of the indicator speed indicator light or the angle of attack indicator light is put forward. And made recommendations on the pilot's actions in this situation. When the tension (pressure) of the crew increases, they will behave incorrectly. The proposed method for evaluating the quality of driving skills should be applied to a comprehensive aircraft simulator. According to our recommendations, if the system indicates the angle of attack or the instrument speed fails, it is also recommended to deal with the action of the simulator.

4.3. Methodical recommendations

Flight accidents are distressing, but accidents can become valuable wealth. Through the study of global flight test accidents, the lessons to be learned are at least the following:

(1) Treat flight test accidents with a mature attitude:

The development of aviation science and technology has never been smooth sailing. Flight test itself is a highly exploratory and risky industry. To develop new technologies, flight test accidents are inevitable, and a positive attitude towards accidents should be pragmatic.

The investigation and analysis of accidents should be independent, and we should get rid of all unfavorable disturbances. The conclusion of the accident should be as transparent as possible in the industry, so that experience and lessons can be truly learned and similar incidents should be avoided from recurring.

(2) Good flight quality is the basis of flight safety. Aircraft design defects found through the analysis of flight accidents should be improved by designers as much as possible. Some accidents seem to be caused by pilots, but are actually caused by aircraft design defects. The designer should examine whether it is possible to avoid such accidents through design. During an F18 roll maneuver at sea, the pilot produced a roll attitude "illusion" based on the HUD flight and crashed into the sea. Afterwards, analysis showed that the HUD "pitch ladder" did not roll with the roll angle at that time, resulting in the pilot's attitude. illusion". Based on this, the designer changed the HUD format,

This is the origin of the currently widely used "swimming" elevation ladder.

In 2004, an American F-22 aircraft crashed during a test flight. The causal chain of the accident investigation was: the flight manual was not clearly written, the test pilot did not do BIT when the standby power was switched to the main power supply, the power supply was interrupted instantaneously, the rate gyro and the flight control The system worked incorrectly one after another, and the plane crashed. This conclusion should enlighten researchers.

"Some problems are very difficult to solve, with long cycles and high costs, and even affect the current combat effectiveness. It is impossible to realize them immediately in engineering. In this case, the designer should first explain the technical defects to the user department and give treatment measures. And to be trained. Like the MiG-19 accelerated rotation problem of the year, it is not that a model must be rejected as soon as an accident occurs.

Experience has shown that in order for the new aircraft to have satisfactory flight quality, designers must not only pay attention to the aerodynamic layout, but also the system (flight control and human-machine interface); not only the vertical flight quality, but also the horizontal flight quality; Not only should we pay attention to the control law design, but also the human-sensing system design.

(3) Test pilot training is extremely important

In an emergency, the pilot controls the aircraft based on his senses and experience, and sometimes even relies on conditioned reflex to deal with emergencies. To enable them to make correct judgments, respond quickly, and deal with them properly at critical moments, the only way is to fly more, practice more, and train more. First of all, they must be familiar with the target in theory, so that they have the ability to predict the flight characteristics of the task they are performing. Only the judgment and handling based on understanding can be confident, timely and correct. Blind flight is extremely dangerous. Inexplicably.

Test pilots must participate in the tests, especially the "iron bird" platform and flight simulation test in the ring. Before the first flight of the new aircraft, test pilots must have tens to hundreds of hours of ground simulation tests, and during the test flight, they must continue to carry out repeated iterative simulation training from the air to the ground. In addition to ground simulation, new aircraft test pilots should also undergo air flight simulation tests and training.

An excellent test pilot must have abundant flight practice, fly as many as possible, including old and advanced aircraft, and fly more foreign aircraft when possible. Flying is not only a technology but also an art, and cooperation and exchanges are of great significance for expanding horizons and increasing talents.

(4) Flight test engineers have important responsibilities for flight safety. Flight test engineers must be familiar with design, and must be familiar with aircraft aerodynamics, structure, engines, flight controls and systems. Only flight test plans and programs formulated on this basis are reasonable and beneficial. For flight safety, the predicted characteristics of the flight mission and the established emergency response procedures can be credible and feasible. Only the data processing and analysis can be targeted and the conclusions can be accurate. Flight test engineers who do not understand the subjects under test do not have the flight test qualifications for modern complex aircraft. The competent department and design department have the responsibility to support and help them to obtain such qualifications. There is no small matter in the test flight, and the following three links must be grasped:

1. Flight simulation before flight test: For each flight of the new aircraft test flight, it is necessary to do as much as possible an immediate pre-flight drill.

At least key items, risk subjects, and envelope extensions must be simulated on the ground with people in the ring. The flight test department has the responsibility to check the correctness of the simulation model through the flight test and feed back the results of this check to the design department and the user department.

2. Telemetry monitoring during flight test: From the time the aircraft is powered on at the take-off line to when the aircraft returns to the field and landed, the monitoring and command personnel of the telemetry monitoring station should work with the pilot on the aircraft throughout the process to monitor changes in the status of the aircraft and the control actions of the pilot at all times. Remind whether the technical status is good and what the driver should do. In fact, the driver in an emergency may forget things that seem extremely simple under normal conditions, such as ignoring altitude and forgetting communication. It should be known that in an emergency situation, for ten seconds, or even a few seconds, correct prompting and command may save the aircraft and even avoid casualties.

During a low-altitude afterburner flight of a new aircraft, due to a fuel system failure, the total fuel level was displayed a lot, but the fuel supply tank was low. Due to the prompt and command of the ground monitoring personnel, the test pilot closed the throttle in time and saved the aircraft. After more than ten seconds, the fuel ran out and the car stopped, and disaster was inevitable.

3. Summary after flight test: A meeting should be held after each flight test. Flight test engineers and designers must clearly understand the test flight, data and results in time, and solve problems immediately without delay. The test pilots have detailed comments every time, but the technicians can’t arrange the next flight test plan based on the test pilot’s comments to reduce hidden and potential problems. The indivisible whole.

(5) Flight quality analysis in the accident

There are many reasons for airplane flight accidents, and flight quality is one that must be faced when performing a fault tree analysis, especially after other unlikely causes have been repaired, more careful analysis is required. The following questions should generally be considered:

① Whether there are deficiencies in flight quality, and whether the pilot is aware of hypoxia traps and dietary measures;

②Whether the flight status at the time of the accident exceeds the scope of the flight envelope, including speed, altitude, overload envelope and various usage restrictions;

③Whether the aircraft systems, especially important systems such as flight control and hydraulics, are working, and whether there is a state of degraded flight quality normally;

No Qualified pilot’s manual. The correct provisions of the manual are correct, reasonable and clear;

④ Analyze the wrong behaviors of the pilots, and prevent the mistakes of the pilots that are not easily considered to be the mistakes of the pilots, which lead to the mistakes of the pilots. Harmony and thinking require continuous state behavior under high pressure.

CHAPTER 5 Labor protection

5.1. Introduction

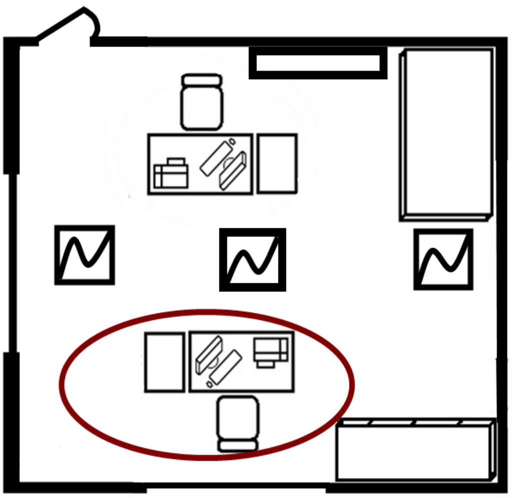
In the design process of the thesis, we analyzed the existing pilot technology quality evaluation device and developed an evaluation device. The entity we designed for design and real-time design is a research engineer who will perform some technical tasks in the operation process. . Because the design of the equipment is related to electromagnetic radiation, and the analysis component of the data processing is a personal computer. Therefore, you may suffer psychological and physical harm from the outside world during work. Long-term exposure to this environment may cause serious injury.

The labor protection measures designated by the researchers to avoid the source of harm from the working environment to the subject are formulated, and ensuring the safety of the staff and the harmless working environment is the core content of this chapter. The subject's workplace is the research laboratory of the design office.

5.2. The task description and working conditions of the research engineer

The research work of system development is carried out in the laboratory, which is one of the workplaces. The researchers spend most of their daily lives in this location. Most of the work needs to be done in this laboratory.

The laboratory is configured for two researchers. The room is located on the fourth floor of the laboratory building, which is an independent laboratory building. There are no high-rise buildings nearby, and the geometric dimensions of the room are 5m in length, 4m in width, and 3.5m in height. The lighting method used in the workplace is a mixed lighting method of artificial lighting and natural lighting. Workplace, equipment and furniture are placed as shown in the figure



The total area of the working laboratory is

$A = a \bullet b$ [m^2]

$A = 4m \times 5m = 20[m^2]$

a is the width of the laboratory, b is the length of the laboratory.

The working area of each person is

$A1 = 20m^2 \div 2 = 10m^2$

The total volume of the working laboratory is

$V = A \cdot h[m^3]$

$V=20m^2 \times 3.5m=70[m^3]$

h is the height of the laboratory

The perimeter of the laboratory is

$P=2a \cdot 2b[m]$

$P=2 \times 4m+2 \times 5m=18m$

The size of all research rooms meets NPAOP 0.00-1.28-10 "Regulations on Labor Protection in the Operation of Electronic Computers"

The working posture during work is mainly sitting. The researcher's workplace is equipped with the following equipment:

Personal computer, printer, computer desk, chair, smart humidifier.

The design and development of the system are carried out in the laboratory of the research institute. In the development process of the system, the engineer controls and masters the development process. The windows of the laboratory face to the southeast, and there are no high-rise buildings around, and there are no obstacles that can block the passage of light. Can guarantee the supply of natural light during the day. The side two-way lighting system is used with the help of window openings, with a size of 2 x 1.1 m, which meets the standard of DBN B.2.5-28-2006, and provides the necessary light supply for daily work.

Working hours are eight hours a day and 40 hours a week.

The room can maintain normal working conditions through natural ventilation and intelligent ventilation of the ventilation system.

The source of humidity in the laboratory is

-Atmospheric air

-The human body breathes naturally

-Intelligent humidification system

Under normal circumstances, doors and windows are closed tightly to prevent airflow in the room. Therefore, the air movement speed is in line with the normal working environment. A specific staff member will clean the room every week.

5.3. List of harmful production factors at work area

1. Insufficient natural lighting and artificial lighting

2. Excessive psychological pressure, excessive mental stress leads to excessive physical and psychological load

3. The air temperature in the room changes suddenly with the change of natural weather

4. Too high voltage causes a short circuit to endanger personal safety

5.4. Analysis and resolution of harmful risk factors

5.4.1. Insufficient natural lighting and artificial lighting

The standardized illuminance index of the researcher's workplace under combined lighting should be 300-500 lux [2.5-28-2006 "Natural and artificial lighting" [78] The lighting must be at least 300-500 lux], and the actual illuminance value is 200-250 lux. This is due to the obsolescence or failure of the natural lighting system, the location of the research laboratory, and the need to replace the artificial lighting system. The lighting system is used in the laboratory. In the case of insufficient window position and size, the collection and supply of natural light may be problematic, which will easily affect your health in the long term.

5.4.2. Over-voltage short-circuit problem

The maximum voltage of the power supply equipment in the laboratory can reach 1000v. The laboratory is powered by a 220v, 50Hz AC power supply, and the voltage is provided by a public switch. Use insulated cables to power electrical equipment. The insulation parameters meet the requirements of GOST 12.1.030-81 SSBT. Protect grounding and return to zero. To prevent the network from short-circuiting, a fuse is installed near the main switch. From the current value of the standard fuse in the nominal range, select the nearest fuse with a current of 125 A.

5.5. Formulate labor protection measures

The improvement of the lighting system is accomplished by replacing lighting equipment with stronger lighting or regular maintenance and inspection of existing lighting equipment. Use the current more advanced lighting equipment, increase the power or increase the number. Or use smart lighting equipment, which can automatically adjust the illuminance according to the current brightness, which can most effectively keep the illuminance within the standard range. Using diodes as tubes is safer, longer life, and higher power. By improving in this way, the light collection will be improved.

The use of insulated equipment supports to control the voltage in the circuit, and the PC terminal grounding can protect the human body from the danger of the circuit, and can also improve the safety of the circuit.

By making ergonomic and aesthetic changes in the workplace and formulating clear work responsibilities fulfillment algorithms, the impact of neuropsychological states related to mental stress and emotional overload can be reduced.

The use of a central heating system can maintain the temperature in the laboratory at the best temperature throughout the four seasons.

5.6. Laboratory fire safety

Fire safety is very important. The general causes of fire in the laboratory may be as follows:

1. A fire caused by a fire caused by a malfunction of an electronic device

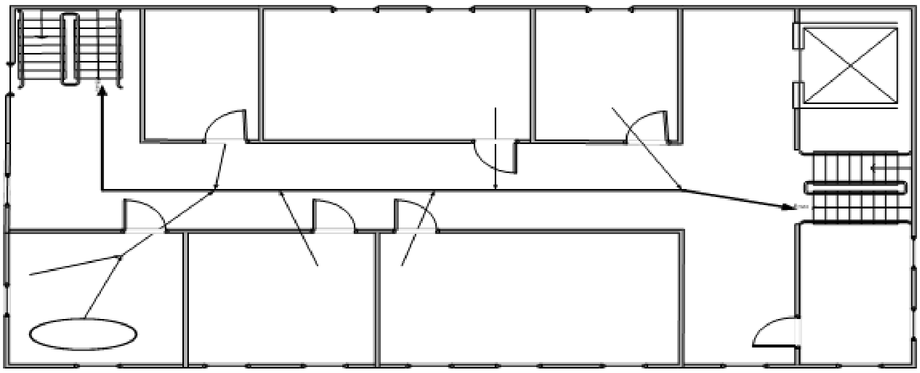
2. Excessive use of electronic equipment causes excessive power to catch fire and cause fire

3. Fire caused by incorrect use of open flame devices in the laboratory for human reasons

4. Fire caused by failure to comply with fire safety regulations

Installing a smoke alarm device in the room can make people aware of the occurrence of a fire in time to fight the fire or escape. Escape plans and directions are clearly marked in the laboratory.

The fire safety category of the laboratory is "G". The laboratory should be equipped with a "PPKP Alai" fire alarm system, a smoke alarm SPD-3.4 (one room is sufficient) and a portable dry powder fire extinguisher VP-5. The evacuation method of the fire safety passage is shown in the figure



5.7. Calculation of artificial lighting in laboratory rooms

Calculate the illuminance of the experimental artificial lighting before the implementation of labor protection measures. According to the previous mention, the area of the laboratory is about 20m², and the lighting equipment used in the laboratory is 6 sets of 6×36w incandescent lamps for laboratory lighting. The calculation formula of indoor average illuminance is:

$$E_{av}=N\varphi UK/A$$

Where E_{av} is the average illuminance on the working surface, the unit is lx; φ is the luminous flux of the light source, the unit is lm; N is the number of light sources; U is the light utilization factor, and the light utilization factor in the laboratory is 0.4; A is the work The area of the surface; K is the maintenance factor of the lamp, which is 0.8. So we can calculate the old indoor illuminance as:

Eav=6×6×360lm×0.4×0.8÷20lux=207lmx

The standard artificial illuminance is 300-500; therefore, the old artificial lighting equipment does not reach the standard artificial illuminance, so we need to replace the lighting equipment with six sets of 6×10w LED lamps as the laboratory lighting equipment. At this time, the artificial illumination in the laboratory is:

Eav=6×6×600lm×0.4×0.8÷20lux=346lmx

At this time, the illuminance of the light reached the standard between 300-500.

in conclusion

In the analysis of the laboratory, harmful risk factors were identified. Through calculation and improvement, it is determined to replace the unqualified artificial light intensity with the qualified artificial light intensity equipment.

CHAPTER 6 Environmental protection

6.1. Introduction

With the development of the aviation industry, the impact of aircraft on the environment is also increasing. Since the airplane is flying at high altitude, the pollutants emitted by it have a more obvious impact on the atmosphere than those emitted by the ground, and are more likely to cause the greenhouse effect and global climate change. As people's awareness of environmental protection increases, people are paying more and more attention to aircraft noise and pollution emissions. Some relevant administrative departments are formulating stricter technical standards in order to reduce aircraft noise and pollution emissions. This brings new challenges to the development of aviation technology. At present, people have used technologies such as aerodynamics, structure, and engines to significantly reduce the noise of jet aircraft, improve flight efficiency, and reduce pollutant emissions.

6.2. The impact of aircraft on the environment

The impact of aircraft on the environment is mainly manifested in exhaust pollution and noise pollution. Since the airplane is flying at high altitude, the pollutants emitted by it have a more obvious impact on the atmosphere than those emitted by the ground, and it is more likely to cause the greenhouse effect and the change of the golden globe climate. According to estimates, the total greenhouse effect caused by humans is about 1.5 times larger than the greenhouse effect caused by carbon dioxide produced by humans, and the total greenhouse effect caused by airplanes is about two to four times larger than the greenhouse effect caused by the equivalent amount of carbon dioxide on the ground. The main reason for this difference is that the greenhouse effect of aircraft emissions such as hydrocarbons, nitrogen oxides, and water vapor at high altitudes is more pronounced than on the ground. According to different affected objects, aircraft noise can be divided into internal noise and external noise. The noise inside the aircraft will not only affect the comfort and health of the passengers and crew in the aircraft, but also produce a strong sound load on the aircraft structure. When the sound pressure level of the sound load exceeds 130dB, it may cause the structure to produce Fatigue damage. Moreover, the higher the sound pressure level and the longer the sound pressure acting on the aircraft structure, the more serious the damage. The noise outside the aircraft mainly affects the lives of residents near airports or aircraft routes.

6.3. Safety analysis of research equipment

The main way of environmental protection is the legislative actions and man-made measures to reduce the influence of harmful substances and industrial factors on the following substances.

-soil

-water

-atmosphere

-Animals and plants

In recent years, environmental protection has become one of the most serious problems in the current society, and environmental pollution has reached the time to have to face it. At this time, everyone on the earth should contribute to the protection of the environment and make their own efforts to protect the world's environment.

Activities related to the creation and use of air transport (AT), rockets, and space technology (RTC) under modern conditions are the most important areas for the application of human intelligence and technological capabilities in national defense, economics, and scientific issues, and the most important of scientific and technological progress One of the components. However, the negative consequences of the modern technological revolution are the direct and indirect effects on the environment (NPS), the reduction of raw materials and energy resources, the negative effects on human health, and so on. With the increase of traffic intensity and RCT operation, people realized that this kind of equipment will significantly affect NPS not only in the operation field of airports and spaceports, but also on a larger time and space scale. In aviation, the installation of neutral working conductors and neutral protective conductors is not uncommon in practice, and the insulation damage of neutral working conductors is not uncommon. Therefore, it is necessary to carry out installation inspection according to the plan and carry out special control. The existence of leakage current in electrical devices will not only lead to the above environmental problems, but also other problems-the electromagnetic compatibility guarantee of technical means, the magnetic field in the surrounding space is generated by the current in the conductor. Therefore, the reason why MP IF appears near power transformers, motors, etc. obviously. The situation of the cable line system is more complicated. The total current along the single-phase and three-phase load power supply lines is equal to zero in any load split-phase distribution, and the magnetic field generated by the current flowing in these cable lines in the conductors laid next to each other is also a little negligent. Among the economic sectors whose activities have an adverse effect on the environment is civil aviation. The technical operation of the aircraft is accompanied by environmental pollution. From the perspective of eco-economic analysis, materials, semi-finished products, and products are used to make booths, thus causing damage to the environment.

6.4. Impact of the device on the environment

The operation of the developed equipment is related to the use of electricity. The use of electricity will affect the environment, because the electricity generated by the aircraft power generation system is related to fuel combustion or radioactive decay reactions, the emission of harmful substances, and radioactivity and electromagnetic radiation. The operation of electrical appliances is likely to pollute water sources (lakes, rivers, oceans and oceans). The lithosphere is related to the uncontrolled exploitation of natural resources, because the biosphere is related to the destruction of the flora and fauna on the earth

6.5. Environmental protection measures

As environmental pollution is about to reach its limit, the problem of environmental pollution has become a problem that must be solved. It has become very urgent to protect the environment and prevent the environment from being polluted by the earth's various energy sources and gas emissions.

The problem of filtration and purification of gas emitted by thermal power plants, nuclear power plants, and automobile (including aircraft) engines is prominent. The decisive solution to this problem is the transition from TPP to gas fuel, the transition from NPP to hydrogen power plants, and the transition to electricity that does not produce fuel materials in vehicles. Or clean energy can be used to fundamentally solve the problem of gas emissions.

This solution requires a lot of research costs and human resources. However, in order to maintain the sustainable development of the world and provide a good living environment for the earth's organisms, these efforts are very necessary. In the future, new energy will be the main material to provide energy for the world.

In order to change the exchange characteristics of the environmental impact caused by the use of generators, it is also a very effective method to fundamentally improve the efficiency of fuel use. One way is to increase the utilization rate of electricity and reduce the energy produced by the combustion of fuel, so as to centralize the energy provided by users, and generally move forward like clean flying energy. Completely eradicate gas environmental pollution.

6.6. Environmental protection methods during the implementation of the device

Learn about a set of science and technology, industry x, and organizational measures designed to reduce or eliminate man-made pollution in the biosphere based on the NPS protection method. There is usually no universal method, so it is impossible to completely solve the problem of NPS pollution in the real industrial period of human development (try to remember the level of resource utilization and waste, and the scale of impact on NPS). Therefore, only by combining some reasonable collection and scientifically-proven measures in each case can there be a chance to produce the expected effects and results for the protection of NPS.

In order to protect the NPS from pollution (in our case, from the activities of the aircraft power generation system providing power to the user), please use the following methods:

1) Organization and technology-reduce the concentration and degree of pollution from production to the spread of the biosphere, that is, the use of industrial protection measures and organizational planning measures.

2) Science and technology-is a direct impact on the process of science and technology, as a source of debris, generating new technical processes (disposal, storage, cleaning, etc.).

The first type of methods seem to be more beneficial, but they have limited types of impact and cannot suppress the cause of pollution.

The second type of method is more effective in solving problems, but it is quite time-consuming and more costly: rebuilding the system, stopping using the old system and designing a new system using alternative technologies, specialized research and experimental work, some socio-economic issues, such as rebuilding workers, Automation and computerization of production.

The direct method can reduce the quality, volume, concentration and degree of pollution directly from the pollution source in the process. For example: reducing the sulfur content in the fuel; the manufacture of plasma engines, etc.

The auxiliary method cannot guarantee to directly reduce the pollution degree from the source, but try to reduce or eliminate the formation of pollutants in the following technical actions. Example: the application of modern casting technology; change from gas welding to electric welding, then to laser, etc.

The highest form of production technology improvement-forming a closed process flow, circulating water supply system and waste-free technology, can only be directly coordinated with the secondary. Waste-free technology is understood as a closed technological process, in which the waste of the previous process is used as the raw material for the next process. An example of this technology is the material and energy cycle in nature. NPS protects the future of technological methods as progress and the environment. The implementation of waste-free technology at all stages of production will make it possible to completely eliminate the problem of man-made pollution in the biosphere. The use of organizational and industrial methods has nothing to do with the direct impact on pollution sources and is used to protect NPS by:

-The dispersion of pollution sources; it does not directly protect NPS from pollution, but it can reduce the local load of harmful substances in the biosphere to a possible concentration and level. So far, nature has been able to neutralize it;

-Location of pollution sources due to isolation, shielding and waste treatment can limit the spread of pollutants in the biosphere;

-Use professional technical devices and devices that use physical, chemical, physicochemical, and biochemical methods to purify and disinfect pollutants to purify (completely or reach an allowable concentration) emissions that enter the biosphere.

At this level of technological development, the use of organizational and technical methods is the main way to combat NPS pollutants.

The joint use of all the above methods can ensure that the earth may gradually restore the purity of NPS and create harmonious conditions for the coexistence of mankind and all residents of NPS.

6.7. Environmental protection measures during design and implementation

This set of environmental protection measures includes activities aimed at the protection and rational use of natural resources, taking the project unit (power user) as an example. Organizational measures guarantee the use of territories, forms of ownership, legal protection of territories, the formation of territorial administrative and economic management organizations, and special environmental services and protections at the legislative level. Economic measures ensure the introduction of resource-saving technologies, penalties for non-compliance with environmental laws and regulations, establishment of payments and taxes for the use of territories, and provision of subsidized loans for ecological cleaning products. Urban planning measures ensure the protection of the natural environment through reasonable territorial functional zoning, the formation of sanitary protection zones, and the establishment of natural reserves territories to ensure the ecological balance of natural landscapes and urban areas. The main principles of environmental protection are as follows:

-Support and rational use of important natural resources;

-Comply with the maximum allowable environmental load level standard of construction site environmental and sanitary standards;

-Allocate nature reserves, landscapes, resorts and leisure, historical and cultural areas, and have an appropriate protection system;

-Approval of sanitary protection zones to protect reservoirs, water supply sources and mineral water, healing mud, beaches, etc.

Legislation and legal framework for environmental protection in the implementation of design devices.

Ukrainian law defines the legislative foundation and functions of environmental security \"environmental protection\", the main direction of national policy in the field of environmental protection, natural resource utilization and environmental security, "Ukrainian national security concept".

According to Ukrainian law \"Environmental Protection\" {25.06.1991 № 1264-XII Law (revised on October 26, 2014)}, (Articles 1-3, Article 8, etc.). Ecological security is the environmental state that guarantees to prevent the ecological state from deteriorating and endangering human health.

And the implementation of environmental protection in the design device is based on the following regulations (laws):

-"Law of the Land Code of Ukraine" {Law No. 2768-III of October 25, 2001 (as amended on September 6, 2014)} (Articles 1, 19, 65-67, 72, and Article 76, etc. e.);

-"Ukraine Water Code" {Code of 06.06.1995 № 213/95-VR (26.04.2014 edition)}, (Articles 1-2, Article 7, Article 12, etc.);

-"Ukraine Subsoil Code" {(27.07.1994 № 132/94-VR) (as of April 26, 2014)}, (Articles 1-3, Articles 5-6, Articles 13-15, etc. e .);

-Ukraine "Atmospheric Protection Law" {(16.10.1992 № 2707-XII Law (April 26, 2014 version))}, (Article 1-17).

Conclusion

1. The introduction of new avionics technology and new concepts is aimed at giving the quality of aviation flight safety and quantitative indicators of existing pilot operations. Generate a set of evaluation criteria from existing and newly generated flight data. In this way, the probability of flight accidents can be reduced and the guarantee of safe flight can be improved.

2. The quantitative feature of the degree of objectivity displayed by the control result of the object state is the reliability of the control. In many different works, the influence of the accuracy and reliability of the control method on the reliability has been studied in detail. In the study of pilot operations, the most typical errors of the operator contained in the overall circuit of the control system include errors in performing basic operations due to deviations in sensory and motor behavior, errors in non-execution or delay in execution, such as using certain actions Replaces serious errors such as errors in certain actions.

3． The development of the system is mainly to achieve the goal through pilot quality training. During the training process, the pilots' awareness of their own flight conditions are improved, and through continuous training, the pilots can ensure that the flight arrangements are made during the standard flight. Because at certain times, the pilot may decline due to certain factors, making it impossible to guarantee safe flight in the air, which is a safety hazard. The development of this system can eliminate the hidden dangers caused by this situation. The structural elements of the pilot quality will be evaluated in a set of functional integration parameters, and then it will create conditions for a more reliable, reliable and objective way to evaluate the implementation methods, the flight process and the overall area of the flight. Blocks for inputting parameters, highlighting trends and performance models, introducing constraints, and calculating estimates are also introduced, which in turn will provide opportunities for evaluation. Driving techniques with central indicators: driving accuracy evaluation, control quality evaluation, and execution elements Or the risk assessment of the flight segment, the degree of conformity between the driving technical parameters and the typical training parameters, and the nature of the square technical quality assessment party.

A strong will is an important guarantee for a pilot to complete a flight mission well. Flight activity is a process of willful action that continuously overcomes difficulties, overcomes difficulties, and achieves expected goals. Pilots must respect themselves first, and believe in themselves second. To respect yourself is to accept your shortcomings and achievements frankly and form a good inner relationship with yourself. At the same time, to believe in yourself, you must control the bad tendencies in your personality, maintain tolerance in your heart, and be bold and confident in your actions. Pilots should have the spirit of not fearing hardship and sacrifice, persevering when encountering difficulties, never giving up, and overcoming difficulties.

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