**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ**
**НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ**

**Кафедра авіоніки**

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач кафедри
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# ДИПЛОМНА РОБОТА
## (ПОЯСНЮВАЛЬНА ЗАПИСКА)
## ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ
## “МАГІСТР”

**Тема: «Підготовка та обслуговування літаків на довготривалому зберіганні»**

**Виконавець: ________________________________** Андрій Євтушин

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Київ 2022

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**
**NATIONAL AVIATION UNIVERSITY**
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"____"______________ 2022р.

# GRADUATE WORK

## (EXPLANATORY NOTE)

## GRADUATE OF EDUCATIONAL AND QUALIFICATION LEVEL "MASTER"

**Theme: «** Preparation and maintenance of aircraft in long-term storage **»**

**Done by: ____________________________________________** Andriy Yevtushyn

**Supervisor: __________________________________________** Olena Kozhokhina

**Consultants from individual sections of the explanatory note:**

**Labour protection: __________________________________** Kateryna KAZHAN

**Environment protection:_____________________________** Lesya PAVLYUKH

**Standard controller: _________________________________** Vasyl LEVKIVSKY

Kyiv 2022

NATIONAL AVIATION UNIVERSITY
Faculty of Aeronautics, Electronics and Telecommunications.
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«____» _________________ 2022.

**TASK**
Andriy Yevtushyn

**1. Topic of the thesis:** «Preparation and maintenance of aircraft in long-term storage», approved by the rector's order from «13» September 2021 №1413/ст.

**2. The term of the work:** from 05.09. 2022 to 30.11.2022.

**3. Initial data for work:** Statistical calculations of number of aircrafts that have been parked for short-term, mid-term, long-term conservation.

**4. Contents of the explanatory note (list of issues to be developed):**
Maintenance of aircrafts before, after and during long-term storage. Opportunities for the development of the conditions of conservation in the air transportation market.

**5. A list of mandatory graphic material (**with a precise definition of mandatory drawings, diagrams, tables, etc**.).** Table of equipment characteristics, workplace diagrams, workplace ergonomics, equipment location and its example, footage from the online class.

6 . Calendar plan-schedule

| №<br>п/п | Task | Deadline | Performance note |
|---|---|---|---|
| 1 | Validate the rationale of graduate  work theme | | |
| 2. | The main aspects of conservation of the airline fleet in crisis period | | |
| 3 | Aircraft parking and storage procedures | | |
| 4. | Aircraft return to service | | |
| 5. | Experiment | | |
| 6. | Conducting a practice lesson with airline personnel | | |
| 7. | Labour protection | | |
| 8. | Environmental protection | | |
| 9. | Preparation of graphic material | | |
| 10. | Issuance of an explanatory note | | |
| 10. | Presentation to the department. Elimination of deficiencies, preparation of an explanatory note | | |

| | | | |
|---|---|---|---|
| 11. | Preparation for review | | |

7. Consultants from individual departments

| Section | Consultant (post, Name) | Date, signature | |
|---|---|---|---|
| | | Issued the task | I accepted the task |
| Labour protection | Kateryna Ivanovna | | |
| Environmental protection | Pavlyukh Lesya | | |

8. Issue date of the assignment: «____» ____________ 2022.

Supervisor of the thesis ___________ Olena Kozhokhina

The task took to perform ___________ Andriy Yevtushyn

**PAPER**

An explanatory note to the graduate work «Preparation and maintenance of aircraft in long-term storage» contains: 86 pages, 4 figures, 5 table, 11 references.

Airlines, analysis, profitability, competitiveness, air carriers, parking and storage of aircrafts.

The object of the work is the formation of air carrier management and analysis of air transportation management.

The subject of the work is analysis of behaviours of different airlines during economic crisis

Research methods - analytical, systemic, dialectical-materialistic and general in the field of air traffic analysis.

The paper considers the essence of conservation in an aviation enterprise, the study of the management of the airlines and its future possibilities.

The obtained results and diploma materials can be useful in scientific activity or educational process. Conclusions for the preparation and maintenance of fleet are made on the basis of current supply and demand, as well as further trends in Ukraine and world development.

## CONTENT

# INTRODUCTION

**Relevance of the topic:** The development of the modern world is impossible without air transport, because the speed of passenger and freight traffic plays an important role. Long-distance freight transportation also makes a great contribution to the development of the aviation industry, as it is not only fast, but also more profitable. More than two years ago, Ukraine received permission from the EU for a visa-free regime. This has caused a significant increase in passenger traffic, in particular by air, as the visa-free regime allows Ukrainians to cross the border without the consent of the embassies of the European Union. The development of air transportation was mostly reflected in the creation of new low-cost companies, which reduced prices significantly due to the abandonment of traditional passenger services. That is why the aviation industry and the development of air transport is especially relevant today.

The proliferation of air travel is not something special at the moment, it has been constantly growing all over the world for several decades. The constant development of information technologies, globalization processes, and liberalization tendencies of the world have an important impact on the aviation industry. All this causes constant changes in the functioning of airlines, and therefore the problems associated with it, so successful adaptation and competition are the key to the creation of modern airlines and the relationship between market participants in the national and global arena.

To develop fully, countries need to keep up with the times. This contributes to strengthening relations between countries, and favorable economic growth. At present, air transport is efficient and expedient. As already mentioned, significant advantages among other modes of transport are the speed and very long distance of transportation, as well as convenience and independence from many conditions, such as combined (road, sea, rail) transportation. Urgency often influences the choice of the customer of services. In recent decades, developed countries have significantly mastered the airspace, and in terms of economic benefits, the efficiency of air transportation is constantly increasing.Developed air communication bases and established relations with many countries. Air transport meets the needs of freight, travel, mail, and so on. All these services are regulated by regulations and legal acts, which contribute to increased security and better organization of many processes.

Ukraine has great opportunities in the aviation industry, but our state does not expand it. We have large territories and a large population, which should contribute to the development of capacity, but even those that are currently not used effectively or in full. Large Ukrainian cities have airports, but their infrastructure is not very developed compared to European countries. One of the problems, in turn, is the organization of air transportation. However, there are currently many studies and suggestions for improving them, but for the most part theoretical studies require practical experience, which is not currently being implemented.

Despite the fact that aviation is basic and strategically necessary for the economy of Ukraine, today this industry is declining under the influence of the systemic crisis. This applies to the economy and management of enterprises-components of the aviation industry, as well as transportation. The analysis of the transportation market of Ukraine will give a clearer picture of development and trends, which will allow to create a plan for future actions for further development.

**Goal of the work:** analysis of the work of Ukrainian airlines: study of air transportation, possible changes and further development processes, trends and factors that have an impact. According to the goal, we do the following tasks:

- Reveal the essence of management, its significance and function;

- Define the management of the competitiveness of airlines;

- Analyze the aviation industry as well as the creation of the Ukrainian aviation company UIA;
- consider UIA, its activities and competitiveness;
- Consider the air transport of UIA, as well as other airlines of Ukraine;

**Object of work:** formation of air carriers' management and analysis of air transportation management by Ukrainian airlines.

**Subject of work:** proposals for good governance and consideration of opportunities to improve transportation among Ukrainian airlines.

In performing the task of this work, I used many research methods. An important among them is the dialectical-materialist approach. Although this ideology was distorted during the Soviet era, the skilful application of this approach today can provide a much deeper understanding of the legal system than the method of legal positivism that is widely used in science today. In this paper, this research method shows the problems in the analysis of the air transportation market in Ukraine. The formal-logical method was used to explain the legal norms. It has a set of methods by which the content of the object under study is reflected in the form of a rational design. This method in any study occupies one of the leading places. They studied the model of public relations regarding the air transportation market by Ukrainian airlines. There were also other methods in the work, such as comparative, systemic, historical, etc. One of the methods of analysis was the general scientific method, it divides the whole into constituent parts and considers them.

**The theoretical and methodological basis** is a systematic and analytical approaches to understanding and studying the object of study. Theoretical and empirical methods were used to obtain the goal and solve the problem. In scientific practice it is comparative analysis, logical, statistical methods, as well as methods of induction and deduction, aggregation and abstraction.

**In practical terms**, the results obtained, as well as research, conclusions, and practical recommendations can be useful and used:

- In the legal field: creation of a process according to the current norms of the legislation of Ukraine in the field of air transportation;
- In rule-making: on improving the relevant processes in the legislation of Ukraine;

- In scientific and research activities: in the study and creation of a more efficient or improved existing mechanism for managing airlines and transportation in Ukraine.

The structure of the work is reflected in the purpose, which forms the sequence and logic of the study. The work consists of an introduction, three chapters, a conclusion and a list of references. The total amount of text is XX pages, and the list of used sources has 12 items.

## CHAPTER 1

## CONSERVATION OF FLEET IN CRISIS PERIOD

### 1.1 How crisis has affected the aviation industry

The aviation industry is one of the many segments that have been significantly affected by the COVID-19 pandemic. Travel limitations and bans have reduced aircraft operations. Airlines have no choice but to curtail their services by grounding their fleets: as of May 2021, nearly 15,100 of the 23,000 passenger aircraft worldwide were grounded. Airport operators are struggling to accommodate most of the landed aircraft using their main operating place. such as platforms, taxiways and runways. Restricted area at airports often means that aircraft need to be parked in unusual locations, which can impact the airport's everyday operations. When planning aircraft parking, safety is the main priority. The result of long-term loading was not taken into account during the design of the road surface and could lead to increased requirements for road surface maintenance. Airport operators have to take into consideration that airplane maintenance necessities in terms of electronics, hydraulics, flight decks and etc.

The sudden epidemic crisis has created an emergency and critical situation with airplane parking requirements. In addition to planning and design requirements, there are operative problems that deviate from the normal operations of an airport and airline.

The non-conventional airplane parking at the airport is becoming an important problem for the airport and airlines during the crisis period. Also, many airports had to close their critical reception facilities to maintain airplane operations because of decreased services. The COVID-19 pandemic has resulted in an abrupt and unprecedented collapse in air travel, bringing down a large portion of the world's airline fleet. According to the Airports Council International (ACI), more than 80% of airports worldwide already have plans for overcrowded car parks. This means that airports will become active aircraft storage, and such active airport storage will need to be organized, regulated and verified between brokers to provide airplane safety and facilitate easy retrieval.

This essay provides the result of extensive research into non-conventional airplane parking, examines the effect on airport operation, and compares the best proposals and guidances for non-conventional airplane parking with overflow during the crisis period.

This study focused on the issue of the impact of the Covid-19 pandemic on civil aviation, in particular on the aircraft parking area and the need for their parking, storage and maintenance. The scale of the problem and especially the speed of its occurrence is incomparable to any other crisis in civil aviation. When landing the Boeing 777 , it was necessary to ensure the parking of less than 900 aircraft (as of May 2020, 405 were delivered to customers and as of December 2020, about 389 were produced and stored) in case of aircraft parking during the Covid-19 pandemic, they had to be parked.

The conducted research is a type of explanatory research. Addressing it explains and confirms the behavior or dependence in the system and tries to explain the regularities of the system's behavior, its processes and structure; explanation is an attempt to understand the causes of phenomena, the factors and mechanisms that cause them. This study used an inductive explanation strategy.

They tried to explain the behavior of the system using some known principles, establishing general rules and recommendations based on specific cases. The problem with induction can be that the mind often draws conclusions about limited experience that seem correct but are actually far from reliable. When using induction, there is often a problem of checking the results. In this case, the results were tested and confirmed by  comparing solutions and results from different cases. Although the history of Covid-19 is relatively short, our study predominantly used a historical method. The historical method allows you to study individual events or processes that took place in short periods of time. This study examined a wide range of available materials, re ports, manuals, standards and recommended practices published by international organizations, government agencies, airlines and airports. The historical method includes the methods and principles by which primary sources and other evidence are used for research. Historical research can also mean collecting data from situations that have already occurred and performing statistical analysis on that data in the same way as a traditional experiment. Also, we have used the monographic methodology, focused in our study on one particular case, the overcrowded aircraft parking problem. This method understands the problem under study as a whole, in contrast to the typological method, which singles out only one aspect.

## 1.2 **Airport park requirements and risk evaluation**

Since airports have become storage areas for aircraft during this pandemic, parking spaces are now very limited and additional parking spaces are a critical need. With maximum capacity on the apron, the airport must resort to less preferred options such as parking on non-pavement areas and using a space designated for temporary parking.

In terms of airport operation and traffic requirements, it may be recommended to use all space at exits and aprons first before considering taxiways and runways as parking options. For long-term parking, concrete pavements should be preferred over flexible asphalt pavements.

Options include contact and remote gates, remote night parking and aircraft defrost areas, and active taxiways that can be closed to traffic. The parking situation, which lasts for several months, should be regularly reviewed. The existing gate must be used first. When all the stands at the goal are occupied, other options can be considered, for example. compaction of parking lots on ramps and aprons, and then taxiways. On taxiways selected for storage of aircraft, different sections can be defined that will be closed in sequence. Taxiway lighting must be turned off in closed areas and sections of taxiways leading to these areas (for example, ramps from an active taxiway). Parking areas should be covered with red light barricades, as in the airfield construction area. If the taxiway is closed to aircraft parking, the US Department of Transportation has also noted that deactivating taxiway lighting circuits is a good practice to follow. If deactivation is not possible because other taxiways on the same circuit must remain open, it is recommended that the light bulb not be removed from energized fixtures, as an excess of open-ended isolation transformers may damage the DC regulators and/or increase the flow current above its normal value. In this case, the solution may be to cover the lighting fixture so that light leakage can be avoided. It is necessary to secure, identify and place any above-ground temporary wiring in the pipeline to prevent electric shock and sources of ignition.

To use any taxiway for aircraft parking, it must be temporarily closed. The US Department of Transportation has issued an advisory circular to airport operators on the use of specific ground markings to ensure safe operation, such as:

• Set boundaries outside the safe transition zone taxiways;

• To place a mark, such as an X mark, at the entrance closed taxiway so that it can be seen from the runway (STD);

• In case the airport operator has a closure plan on a taxiway for an extended period, it is good practice to remove the center line markings, including those leading to the closed area. Later, in a situation where the taxiway reopens, the airport operator must repaint the centerline markings.

It was mentioned above, the airport operator must use all ramp stands and the entire apron to the extent possible with regard to flight safety. If the apron is fully occupied, it should not obstruct the movement of aircraft between the operating parking lots and the terminal area. However, the airport operator can make maximum use of the intermediate taxiways for potential parking.

As far as practicable, the use of runways as a temporary stand should be avoided due to the potential increased safety risk of an inadvertent landing on a closed runway. According to FAA guidance, runway closures should be the last option for airport operators due to the potentially high risk. The FAA has taken a clear position on this issue in Cert AlertPart 141 on Temporary Parking of Aircraft. This is supported by data records of aircraft making final approaches over temporarily closed runways, some of which have massive obstacles or equipment on the runway that should have alerted pilots, or even taxiways occupied by aircraft. However, permanently closed and decommissioned runways can be considered.

Aircraft stand planning and design is an important part of supporting the operation of a new aircraft stand. It can be tested and optimized by performing a full inspection of the runway area before implementing the plan. It is also important to consider not only the number and size of the stands, but also the flow of traffic around the parking lot. In order to minimize the waiting time for taxiing and reduce interference, it is necessary to consider different scenarios of aircraft routes.

Given the current situation, ACI World recommended that the airport operator develop and update a comprehensive plan for temporary aircraft parking.


The purpose of the Temporary Aircraft Parking Plan is to identify parking options and priorities and clearly define where to park different types of aircraft. The plan should be constantly monitored and updated as necessary and define as a minimum:

• Places for long-term, medium-term and short-term parking aircraft;

• effect of parking options on limiting safety barriers surfaces and operations;

• Distance between planes;

• Non-conventional parking spaces that can be used safe overflow parking of airplane;

• Notification procedures and security measures at non-conventional parking spaces are used (for instance , runways and taxiways).

Some airports reported using geographic information systems and digital tools to complement the plan and monitor the implementation of changes. Insertion of pictures and diagrams is highly recommended. For instance, airport expects to have up to 90 aircraft parked ranging from an A320 to B737. The airport has therefore created additional ten dedicated parking zones to accommodate the increased demand. The new additional parking areas include runway, taxiway, logistic apron and various other aprons. To design or plan the additional parking positions, airport operators should take into account the following considerations:

• The additional position should be created in a way that it can be returned to their original purpose when needed;

• Parking positions of aircraft should allow their regular maintenance;

• The maintenance staff should have an easy and unrestricted access to aircraft in order to perform their duties.

Due to the Covid 19 pandemic, most airports in the world are experiencing overcrowded parking spaces. The FAA has issued a national Part 141 Cert Alert as a solution for the airport to deal with the parking situation. Le Bris argues that it is good practice to establish a parking plan and procedure for temporary parking of incoming aircraft. It should be prepared jointly by a working group or committee composed of representatives of stakeholders potentially involved in such situations and should include the airport dispatcher, rescue and fire service (RFF), air traffic control (ATC), aircraft operators, ground service providers. maintenance, fixed base operators, maintenance, etc. The plan must be scalable, i.e. adapt to different numbers and types of aircraft, to pave the way for a timely and adequate response the next time the airport is faced with overcrowding. These efforts should consider and balance brokers needs, explore short and long term parking options, and document the rationale for the choice.

The plan and procedure should be regularly updated based on lessons learned and evolving conditions at the airport.

Ideally, the plan should be drawn up using CAD applications. This will facilitate discussions with stakeholders, improve identification of potential geometric and safety issues, and provide field teams with an accurate description of the parking plan. This plan should provide for positioning support for each aircraft. This can be the location of the nose and main landing gear. This assistance must be in accordance with the means available on the ground. For example, if GPS receivers or other surveying tools are not available to crews, it is recommended to use visual aids (such as the number or identification number of a concrete pave) in addition to georeferencing. Temporary marking is also possible. The following are recommended considerations FAA, which should apply when overflow of temporary aircraft parking at an airport occurs due to excess capacity during the Covid-19 emergency. This list should be considered a minimal list of considerations, not an exhaustive list. The safety of the public and of aircraft flights must remain the highest priority:

• Establish an aircraft parking planning committee (airport operators are encouraged to work together as a committee with airline members and other brokers);

• Document aircraft parking plan considerations;

• Approval of the plan (approval of the plan for the temporary parking of surplus aircraft at the airport with all airport users as needed).

The airport operator is responsible for the rules and procedures that ensure the safety of aircraft on the stands or apron, as well as for the dissemination of information to airline operators. According to the ACI Airfield Safety Book, airport operators are responsible for conducting a risk assessment for the risk associated with a particular activity. A risk assessment should be carried out for each task that personnel must perform and can be performed at the highest level of operations, such as prioritizing a non-standard parking space. Finally, the results of the risk assessment may give the airport operator the opportunity to activate non-standard parking positions.

It is important to evaluate the safety impact of overcrowded aircraft parking on infrastructure, obstacle limitation surfaces and operations and take appropriate action to mitigate risks, including collision risks. ACI World also recommends in its bulletin that airport operators adapt to the specific conditions of their airports by creating a security risk assessment template. The template can show a specific score such as hazards, consequences, risk control score, mitigation actions, and new controls for specific risk events.

Understandably, most airport operators face the same challenge of finding a new aircraft seat to meet airline demand due to the Covid-19 pandemic. According to the ACI in its bulletin, this situation could lead to airport infrastructure and security risks, including:

• Damage from using the pavement in a way that first appointed;

• Damage to the aircraft, especially the risk of collision during parking maneuvers with minimal clearances;

• departures from the runway or taxiway;

• Issues related to access and availability of aircraft.

Most importantly, the parking plan and procedure must put safety first. The security risk needs to be assessed. The airport must be able to continue operating safely. Closing part of the airport to aircraft storage means creating a new taxiway layout. This new temporary layout should be able to accommodate capacity and address common safety issues including, but not limited to, runway incursions, NAVAIDS integrity, and pilot deviation.In addition, the line of sight from the tower to the active parts of the movement should not be obstructed. Pilots must be aware of runways and taxiways closed to aircraft parking. To increase situational awareness, special messages to pilots are issued. In turn, pilots must report any problems, such as deviations or inaccuracies of instrument-landing system signals or displays of lights that could cause confusion.

Appropriate markings and indicators shall be provided as necessary. Even if the aircraft is parked on work zone pavements designated for regular aircraft use, positioning the aircraft for long-term parking may pose a safety hazard. For example, the tail of an aircraft parked diagonally on the taxiway may touch the protective surface of the runway or interfere with the ILS signal, while they are fine when the aircraft is aligned on the center line. The various safety zones and surfaces that prevent safety problems and protect flight operations must be checked before the aircraft is parked. For this reason, the FAA requests an FAA form 85670 if there is any potential exposure to these surfaces to confirm the potential hazard. If temporary engine start locations are provided, the jet should also be carefully considered.

Within that time, airports have a limited number of parking spaces and allow for other areas among them, as well as flexible sidewalks to accommodate aircraft. Statica loads from an aircraft over an extended period can lead to deterioration of the road surface, in particular in the case of flexible asphalt pavements. Today, airline operators and airports face the challenges of short- and continued-term airplane conservation. Because aprons and parking lots are not designed to withstand long-term static loads, medium-term storage of an aircraft on these sites can increase the risk of permanent deformation. To preserve the coating during continued-term storage of the aircraft, it is recommended to give preference to areas with a hard coating. A flexible type of pavement (asphalt) is not the best solution for parking stands with a high load. They are more sensitive than asphalt pavement to static loads and more sensitive to high temperatures due to the rheological properties of the bitumen, or more specifically, static loads from aircraft over a long period, especially on flexible pavements, can lead to deterioration of the pavement. In addition, while planes are parked, airlines must perform aircraft maintenance, so any fuel or oil spills can lead to deterioration of the concrete pavement.

Paving analysis should be implemented if the storage space is not intended for long-term storage of aircraft, taking into account the overload on the pavement. Parking lots and aprons, where aircraft operate at low or very low speed, are usually made from cement concrete pavements. The bearing strength of taxiways (medium speed section) is greater than runways (except in some cases of runway thresholds), but lower than stands/apons specially designed to accommodate aircraft static loads with traffic. The lower the speed, the lower the elastic modulus and the higher the shear deformation in the lower part of the bituminous layer. Bituminous materials have a viscoelastic behavior and their modulus of elasticity depends on temperature and loading speed (rheological properties of bituminous material). Based on the above, it is understood that taxiways subjected to static aircraft loads are more susceptible to constant deformation than taxiways subjected to moderate or high velocity loads.

To support airlines and airports in the long-term storage of aircraft, Airbus has produced the ACI-supported Pavement and Asset Preservation document. In addition, the document defines advanced methods of storing aircraft on taxiways and runways. A key consideration for airlines and airports when planning long-term aircraft storage can be found in Airbus Consulting Services - Recommendations for Coating (Storage) Preservation. As stated by ACI in its advisory bulletin on reducing the risk posed by overcrowded aircraft parking, it is important to evaluate the strength of the pavement to withstand the load and check the compatibility of the aircraft classification number and the pavement classification number. Technical analysis should be performed before overloading the coating by more than 25% of the declared strength of the coating.

Besides that, in the event that the airport operator cannot avoid congestion for any reason (aircraft movement/aircraft parking), according to an advisory circular published by the FAA, the airport authority has three options for choosing a pavement strength rating:

1. Let CPN remain derived from technical estimation method, but estimate loading/transshipment to the pavement, taking into account local features, such as planned repairs or reconstruction. Experience in operating a particular type of aircraft in a particular mix of operations may also influence decisions to operate with ACNs in excess of the published CPN, or underweight to stay within the CPN.

2. Provide an increase in CPN by adding a pad or refurbishment to accommodate aircraft with higher ACNs. Increase the CPN to the plane with the highest CAN, but recognize the need to wait for possible major maintenance. This will result in a previously planned refurbishment or closure due to reduced pavement life.

3. The load on the pavement also depends on the tire pressure, which affects the size of the contact area between the tire and the pavement. When planning to store an aircraft for an extended period, the aircraft should be kept as light as possible, unloading everything that can be properly and safely removed without sacrificing wind resistance. Loading can be distributed over a larger contact area by downloading tires, but no less than recommended by the manufacturer.

Also, one of aircraft tire manufacturer in their published document, it is important to control the tire pressure at the set values when the aircraft is parked. Tire pressure should always be checked when the tires are cool at ambient temperature. A tire/wheel can lose up to five percent pressure within 24 hours and is still considered normal. This means that tire pressure changes every day.

For example, the MAU maintenance team included tire maintenance in their maintenance schedule during a major decommissioning plan. The maintenance team ensures the aircraft's wheels come back by being towed on the pavement or lifted into the air to be rolled out to ensure tire maintenance is done.

## CHAPTER 2

## AIRCRAFT PARKING AND STORAGE PROCEDURES

### 2.1 General operations and efficient considerations

A significant drop in airline operations has resulted in approximately two-thirds of global airline fleets being shut down (at peak impact reached in April 2021) and a projected (as viewed so far) annual RPK decline of around two-thirds in 2021 (together with domestic and international). Ensuring the airworthiness of aircraft is an important element of the safety of airline operations, and the challenges of maintaining the continuity of aircraft airworthiness in the face of massive and long-term idleness of the global fleet are numerous.The aviation industry infrastructure is not optimized for the simultaneous termination of most fleets and airlines that have completed numerous temporary or long-term aircraft parking operations outside of their usual hubs, stations in the served network or their maintenance facilities.While there are always technical issues that need to be addressed in maintaining the airworthiness of an “inactive aircraft”, even if its long arrival on the ground is carefully planned, this is further complicated in cases of long-term parking with limited capabilities / maintaining the availability of the aircraft, the availability of consumables - parts - GSE and specialized workforce, adverse meteorological events (such as typhoon season) or aggressive corrosive environments (such as high salinity and atmospheric humidity).

The uncertainty of the crisis in airlines and the situation of "influx" negatively affect the timeliness of decision-making on the types and sizes of the aircraft fleet for:

• active ready-to-fly parking or parking duration,

• storage or early return to lease and decommissioning with the possibility of partial disposal.

The aircraft parking and storage facilities provided by the OEM for the type in question are part of Chapter 10 of the AMM Parking and Berths. The parking area should, as far as possible, provide a suitable "aircraft facing the wind" position and, if necessary, consideration should be given to the need to moor the aircraft (see Chapter 10 MAM). The wide variety of scenarios that operators face when dealing with these reduced flight reductions has left OEMs with little work to do to optimize and increase the flexibility of maintenance requirements focused on aircraft parking and storage. Although some of these changes will be reflected in the AMM revisions of the relevant section, many of them are considered "one-time" relaxations and will not be reflected in any revisions (even in the TO) of Chapter 10. Thus, for a comprehensive awareness and accurate assessment of the latest changes, flexibilities and eases provided by OEMs in the field of aircraft parking and storage, it is necessary to ensure timely tracking of relevant AEM documents.

It is the airline's responsibility to ensure the safety and efficiency of its connection with its specific carrier for the management of parking procedures and aircraft savings. It is evident from technical discussion, connected with the middle periods of parking, not part of the MP, kind of a complete equipment. Even if it is subject to technical maintenance and is included in the charge, stink shards are not recognized, so the OMP document and the 2nd body, which is confirmed / accepted, are filed for review as a planned maintenance package that will end with the service vessel's life extension, how not to blame the non-visible furnishings of the utility vessel's tribal parking lot. It has different terminology, as it is chosen by OEMs to refer to the parked casting mill, and, as a rule, the maintenance is similar, so it is not identical, the terminology is not binding and narrow in the galleys. The operator can go beyond the established terms, such as: parking, immobilization, parking delay, parking delay, active saving, short-line saving, three-line and long-line saving, deep saving long. Although different OEMs may have different "names" that determine the type of sprue seating, if the light does not end with a flight, the foot between different filling methods is.

So to be on the ground, between canvases or technical operations and for a long period, which may sound from many years or nights to many days. So, you can be in the camp of negain readiness to the floor, which can be used to fix the most important jobs with service (for example, refueling), and there are no special jobs from technical maintenance, which are associated with the status of “parked truck” seeing the studs without pitch and the cover-stub cover, which has been restored).

Parking active (short string) while on the ground, not working, and not undergoing any scheduled maintenance as part of an OMP or modification/SB/ADaction/campaign. The tri-currency of parking is transferred to revise the number of days (then, as a rule, more days) and expand to the number of days. Locking pins, covers and plugs are installed in the prescribed manner, and for the period of waiting, the parking is completed by the exchange / minimal work of the robot with conservation. Like undergoes periodic maintenance (by counting and number of times), I turn on the APU robot and the engine. Turning the litak to the canvas, if you don’t want to meet, can be done in a short time (then, as a rule, during the day).

Long-term storage parking the ship was found to be on the ground, not working and not undergoing the expected scheduled maintenance as part of the WMD or modification / SB / AD / campaign. Counting to the triviality of the parking of the deck of the zabbizni stilettos, the crushing of the plugs of the litaka get up, and the elaboration of the robot is the patch of the park not overthrow є minimalnoye (set, can be turned on with the vitality of the vigor, the shepherd's pale Vessels are regularly serviced (excessive maintenance is to be carried out at regular intervals or less). Actuators of the LRU of the aircraft (like from the engine and the battery of the APU) can be repaired from the aircraft between the scheduled maintenance intervals, and in another period the configuration of the aircraft is lost without external parts/components. It is impossible to bring down a litak into political power in a short period of time.

It was checked the ship is docked and not operated in the middle or three times (be aware that the wine has been moved for 3-6 months) and in rich weather knows to walk in the area with a possible room, then / or an important affordable carpet. A lot of light systems are located in a saved camp, which does not allow them to be twisted, otherwise the main parts are of the form and a ballast of the light is installed (for example, a type of battery lazy, sour balloons, balloons and navit APU and/or moving thinly). RTS aircraft vimagatime is full of hourly behavior. The operator has several elements that must rotate, and be powered, along some life path, but at the same time must not optimize their decision related to the park in this minimal context with a significant component that does not matter:

• As part of the vantage-hopefulness of the park will immovably be demanded by the coming three months, the beer, the whole rock and beyond?

- Is the actual configuration of the aircraft in line with the fleet's expected operations, or are aircraft configuration adjustments needed? (for example, preparing the cabin of a passenger aircraft for certain cargo operations)

- Does the airline have the material, organizational, technical, logistical and commercial structure necessary to support the fleet, taking into account the complications/consequences of the decision? (e.g. station locations, accessibility, capability with GSE - specific ground services - consumables - parts - supply chain/logistics, etc.)

- While a "ready-to-fly" parking has minimal initial maintenance costs, the frequency and amount of maintenance work required during parking is significant, as are the costs. This will make such a solution economically suboptimal if the envisaged parking horizon exceeds 4 months; the opposite is true for long term parking or storage where the initial cost is high, but the minimum maintenance work required during the parking period would make this a cost effective solution if the envisaged parking horizon is greater than 3 months (Note: The "economics" of the 4 month adoption time (AMMs make significant efforts to provide a technical/feasibility study to support the 8-month decision point, however the use of these technical mitigations must be assessed on a case-by-case basis for the "cost-optimal" solution)

- The cost-benefit analysis of using a parking or storage approach is highly dependent on the individual circumstances of the operator and the final conclusion may differ accordingly; one operator reported 4 similar cumulative man-hours for park or store options before the end of the year, if scheduled maintenance required

• EOMs, at the request of operators, are considering how to facilitate a smoother transition from one type of parking to another (i.e. providing credit for previously completed tasks, easing time limits for completing transition tasks)

• The FAA adopted an Interim Short Term Escalation Authorization (STE) provision under which, subject to certain requirements and restrictions, an operator could benefit from a 25% increase in the proper task performance benchmark instead of a 12% cap. – see INFORMATION 30055 on flexibility in managing scheduled maintenance requirements due to the COVID-19 public health emergency.

Consideration should always be given to the potential maintenance, logistical and economic burdens that operators may experience if parking and storage requirements are only partially met (or not met at all). During the RTS phase, many operators are interested in adapting the stand/storage maintenance program to address specific aircraft maintenance tasks through maintenance activities that go beyond standard requirements. There are two main categories/types of aircraft maintenance activities that operators must undertake:

a) maintenance related to the initiation and maintenance of aircraft parking/storage and associated decommissioning to return aircraft to service;

b) maintenance related to the AMP under which the aircraft is released to service;

The maintenance tasks in “a” above can be considered to be 'capability based' and which rely on the applicable content of section 10 of the MAM. The maintenance tasks in point “b” above are included in the scheduled maintenance program applied by the operator. to the aircraft concerned and rely on the MDP and MBRR documents. The operator will have to take into account the SD, SC or other applicable documents from the regulatory authorities or EOMs when carrying out their maintenance planning and execution duties in both mentioned categories. While an aircraft landing always means a loss of the operator's carrying capacity and associated revenue, it is a very good opportunity for aircraft maintenance to "make up for lost time" with previously delayed cabin modifications and repairs, or to include various applicable (but optional) SB. . The business decision to carry out such maintenance must consider whether the relevant work is feasible in terms of technical capabilities under the relevant constraints imposed by the crisis. During the development of the ZCU, a certain rate of use of aircraft (FHDand FI) was assumed. While changing/moving to a maintenance program for "low utilization" aircraft will not reduce the "maintenance burden" corresponding to operational FD or FI (and in fact the reverse would be expected), utilization assumptions should be considered when analysis of the effectiveness of maintenance tasks of any ZMU optimization, which is carried out under crisis conditions. Although the reduction or complete cessation of aircraft operations has postponed the need for maintenance tasks controlled by aircraft actual use parameters (FD or FI), tasks controlled by calendar time (KT) can still be performed during this period of inactivity. There are some limited life extension options that MAMs have already made available for most aircraft types (see Appendix B). Such extensions can sometimes be called from a practical point of view "stopping the on-board clock". This additional flexibility for the AA holder's CIA allows operators to consider not only the constraints currently imposed on maintenance activities ( due to aircraft parking, airspace closures), but also to avoid the potential bottleneck of potential overflow of maintenance needs. maintenance during resumption of work.

However, operators considering the use of such flexible task escalation should be aware that the potential maintenance outcomes and work involved in restoring an aircraft part or system to the required airworthiness standard (removing aircraft corrosion in situ to level will take place. Cost. In addition, for an aircraft still under warranty, any repair claims related to tasks that have been outsourced under the above flexibility may be challenged by the organization offering the warranty (the manufacturers original equipment).The provisions for the “a” maintenance tasks created above were recently revised by the EOMs (see Appendix B) to include additional flexibility/options regarding the threshold, interval, consumables, and instructions for performing such tasks.

| Event | Hazard | Consequence (worst case scenario) | Existing Controls | Risk: Probability | Risk: Severity | Risk: Rating | Mitigation Action | Ownership | New Controls | Risk: Probability | Risk: Severity | Risk: Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Organization's Capability and Resources (e.g. certifications, personnel, GSE, consumables and parts, accessibility etc.) | | | | | | | | | | | | |
| Expiration of validity of operator's AOC | The operator losses its regulatory established quality/roles/responsibilities towards management of the continuing airworthiness of its fleet of aircraft and, consequently, the recognition of the operator's actions for aircraft continuing airworthiness could be lost. | Invalidation of Operator's performed aircraft airworthiness related actions/work<br>Grounded fleet | | | | Intolerable | Ensure the continued validity of the AOC by requesting to the CAA of the State of the Operator an extension of the AOC validity (based on exemption or alleviation mechanism) until emergence from pandemic restrictions. | | | | | Tolerable (with mitigation actions) |
| Expiration of validity of CAMO certification of an organization executing continuing airworthiness work for the operator's fleet. | The said CAMO loses the regulatory recognition to perform the continuing airworthiness services within the scope of its approval. | The Operator cannot receive continuing airworthiness services from said CAMO organization<br>Grounded fleet | | | | Intolerable | The Operator subcontracts the respective continuing airworthiness work/services to another CAMO with valid certification or develops the required in-house capability | | | | | Tolerable (with mitigation actions) |

| Event | Hazard | Consequence (worst case scenario) | Existing Controls | Risk: Probability | Risk: Severity | Risk: Rating | Mitigation Action | Ownership | New Controls | Risk: Probability | Risk: Severity | Risk: Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prolonged parking with inadequate record keeping | Missing or incomplete records documenting the aircraft maintenance work executed during the prolonged parking period | Asset financial degradation<br>Financial cost of unnecessary rework | | | | Tolerable (with existing controls) | Institute temporary dual-path tracking of executed maintenance tasks in view of reconciling that for timely entrance in the MIS<br>Re-constitute records for completeness | | | | | Tolerable (with mitigation actions) |
| Operation of aircraft engines (idle or above) including T/R operation as required by maintenance tasks. | Aircraft parked in area generally not used for aircraft presence with engines in operation | Personnel fatality | | | | Intolerable | Ensure visibility of "aircraft with running engine" status, instruct personnel, communicate, signal and secure aircraft proximity dangerous areas during engine in operation | | | | | Tolerable (with mitigation actions) |
| FOD ingested during operation of aircraft engines (idle or above) including T/R operation as required by maintenance tasks. | Aircraft parked in area generally not used for aircraft presence with engines in operation | Significant aircraft damage | | | | Tolerable (with existing controls) | Execute additional inspection for and removal of FOD in the proximity of the aircraft before engine operation | | | | | Tolerable (with mitigation actions) |

## 2.2 **Aircraft systems specifications**

Although this section will identify some of the specific elements of aircraft systems and equipment that must be addressed, the discussion is at a general level within a specific TAA direction. maintenance actions, but to illustrate the complexity of the elements that need to be considered in the maintenance of parked/storage aircraft with specific examples. Operators are strongly encouraged to keep up-to-date with the relevant aircraft type information provided by the relevant aircraft EOM. Timely technical information available to operators through normal communication channels with their EOMs (see Appendix C - Operators Contacting Aircraft EOMs) is essential for determining specific maintenance actions and performance details. Operators should be aware of the number of task interdependencies and that using some of the flexible task escalation options provided by EOMs in this crisis context may result in additional requirements when returning aircraft to service.

Aircraft long-term parking or storage procedures related to electrical/electronic equipment and components shall take into account:

• Aircraft grounding (electrical) if necessary;

• Selecting the control switches to the "OFF" position. and deactivation of switches to the "open" position;

• Check the batteries for full charge before de-energizing the drone and physically disconnect the drone batteries between drone power cycles for maintenance; Note that at least one EOM. It is emphasized that repeated physical disconnection and periodic reconnection of nickel-cadmium batteries required for parking can lead to a gradual and permanent decrease in the capacity of these batteries, and this is caused by the vision of some applicable EOM requirements;

• Based on the type and condition of the batteries, the ambient temperature of the aircraft stand, and the frequency of maintenance, consider whether the batteries should be left on the wing or removed for storage/service in the workshop;

• Verify that maintaining the avionics ARU in an inactive state on board between maintenance power cycles is compatible with parking/storage environmental conditions;

• Close all disconnected electrical connectors;

• Maintenance requirements and frequency of operation of VHD and VGH.

Preservation and maintenance of the system during parking includes in general (but not limited to):

• Keep all surfaces clean and free of corrosion and all structural drains unblocked;

• If necessary, lubrication and temporary protective coating;

• Location of controls and flight control surfaces in neutral/stowed condition. Note: If an aircraft type is required, make sure "Gust Locks" are installed/engaged;

• Periodic activation of the required systems ( electrical and hydraulic) to verify the operation of all flight control surfaces throughout the full range of flight. Note: include all primary and secondary flight control surfaces with their control and actuation channels/subsystems (mechanical - electrical/electronic - hydraulic).

In general, the engine and APUs comply with the park/preservation program and applicable maintenance tasks established by the aircraft EOM. Some airlines may be interested in following an EOM engine conservation maintenance program to provide the additional flexibility offered by the engine EOM. While this "uncoupling" of conservation programs between the aircraft and its engines may be of interest, especially when performing engine dismantling (ie ending with an "automotive engine"), airlines should pay attention to properly tracking "asset" conservation task criteria.

• Inlet and outlet plugs/caps must be installed. Note: If a standard kit is not available, EOM approved alternatives may be used;

• Periodically rotate the motor shaft as necessary (Note: This should apply to LP, IP and HP motor spools);

• Periodically start and operate the engine according to the engine operating profile suggested by the EOM (including T/R mode if required);

• If necessary, preserve the engine's fuel system;

• Special care may be required to prevent corrosion of the motor leading edge skin;

• periodic launch and operation of the ZSU;

• Conservation of the fuel system of the Armed Forces, if applicable;

• Considered deactivation/removal of engine and anti-aircraft fire extinguishers.

Maintenance activities specific to the aircraft fuel system and fuel tanks shall include, as a minimum:

• Provide at least 15% of fuel in each tank for the entire period of parking.

• If it is necessary to drain fuel due to future maintenance work, the airline is obliged to ensure that the drained fuel is used as soon as possible for refueling the same aircraft or another aircraft belonging to the same airline.

• Periodically drain all fuel tanks (i.e. fuel drain)

• Perform initial and periodic analysis of fuel samples for microbiological contamination of each fuel tank (even if the aircraft has been subjected to preventive biocide treatment during an extended period of parking).

• Provide biocidal treatment of fuel tanks based on monitoring of microbiological contamination (ie medical treatment).

The operational condition of the aircraft's hydraulic systems is necessary to perform some technical tasks required while the aircraft is parked (eg, depending on the aircraft type: movement of flight control surfaces, steering, gear doors, braking system, etc.). Before activating the aircraft's hydraulic system (including checking the fluid level in the hydraulic reservoirs), proper maintenance must be performed. An alternative to using aircraft hydraulic pumps is to use a ground hydraulic truck (GST) to give pressure to the system (if necessary) to avoid pollution of the aircraft's hydraulic circle). Standard emergiences should be followed when performing any technical work on the high pressure hydraulic circle.

Periodic maintenance tastss of a parked aircraft must be included:

• Checking the hydraulic system for leaks;

• Cleaning and lubrication of the rods of hydraulic drives that are exposed to the external environment.

It is very important to protect aircraft probes and sensors with appropriate covers and plugs. This will prevent or limit corrosion to them while parked, and will also prevent any contamination of ports or lines. Such infestation by hatching and nesting insects is common in landed aircraft.

System conservation activities should contribute to a RTS, which includes:

• Removal of all covers and plugs (special attention should be paid to complete removal in case of using special and non-standard protections for probes and sensors);

• Perform a detailed inspection of all equipment, including checking that their drain holes are free and clean;

• Checking and decontaminating all static pitot lines, probes and sensors (including purging the lines with low pressure nitrogen if necessary).

The fleet's unprecedented move to park and store aircraft has revealed some challenges that have forced airline technical teams and their OEM counterparts on a steep learning curve. This section has been included in the guidance document to reflect some of the specific lessons shared by participants in teleconferences and webinars organized by IATA on aircraft technical issues. Addressing the problem of high ambient humidity may result in the operator deciding to run the aircraft's air conditioners once every three days to control cabin humidity levels. Draining the water from the fuel tanks on a three-day cycle has proven effective in a wet parking environment. Preventing corrosion of the ADF by starting the ADF every three days was effective in high humidity conditions, and also allowed the use of air conditioning units to limit the humidity level in the cabin. Storing batteries on the plane and not disconnecting the batteries became possible with a three-day battery charging cycle (coordinated with the mileage of the Armed Forces). The absence of circuit breaker clamps can be remedied by temporarily using electrical ties, taking appropriate precautions to avoid abnormal mechanical stress on the circuit breaker during installation/removal of the tie.

Aircraft cavities and ports/openings must be carefully and securely protected/sealed with covers, plugs or other suitable protection to prevent the entry and nesting of small animals, birds and insects (such as mud wasps); the presence of such covers should always be easily noticed by technical personnel due to their bright colors and safety flags. Application of temporary protective coatings (i.e., corrosion inhibitor compounds—CIC) to all bare metal surfaces may be required in severe parking conditions prior to OEM required time limits.

Implementation of a seven-day cycle of cleaning the engine leading edge with approved solvents followed by dry wiping has proven effective in preventing engine leading edge skin corrosion. The frequency of engine operation during parking must be optimized by the operator; a seven-day cycle may sometimes be chosen based on operational considerations for aircraft systems and corrosion prevention actions, although engine runs may have been scheduled according to a much more lenient OEM requirement (eg 14 or even 28 days); in addition, the full operation of the air intake system components (with HPV engine, PRSOV and LP check valve) may be better, although it requires higher engine power during ground travel, as opposed to engine operation only at idle.

Some maintenance tasks may exceed the capabilities available at the aircraft stand location and may require one-off flights to another location with appropriate authorization/dispatch and flight restrictions (e.g. landing gear down and base bound flights where lift capabilities exist aircraft and landing gear lift).

The following are the safety considerations for aircraft parking as they are intrinsically related to the continued airworthiness of aircraft during the parking period:

• The aircraft is stored in a physically controlled facility or appropriate mechanisms are in place to ensure that the aircraft is not damaged during parking;

• ensure access to the aircraft only to personnel and equipment with the appropriate identification, qualifications and status, verified and known to the aircraft operator/owner

• ensure that any activities/events associated with the aircraft are accurately recorded/documented in the appropriate technical and safety logs.

# CHAPTER 3

# AIRCRAFT RETURN TO SERVICE

## 3.1 **Phases of returning fleet to normal service**

After a return to service has been approved, airlines cannot take the aircraft back into service. A lot of documentation and checks need to be done again. The main purpose of aviation is safety and ensuring continued airworthiness. It also creates a problem for regulation, as the regulatory body simply does not have the staff to monitor such a large number of aircraft. How the recovery will be organized remains the subject of much controversy in aviation circles.

The suggestion of one of the airplane manufacturer's technicians is that the operational condition of an aircraft in service is very different from the condition of an aircraft after returning from maintenance or parking for more than one day. If an operational check is needed after the aircraft has been on the ground for an extended period of time, maintenance activities must be carried out. Also, the recommends of each person involved in returning an aircraft to service are critical to airlines in ensuring the safety of the aircraft.

Airline operators ought to consider recertifying runway surfaces and taxiways used for aircraft parking during the Covid-19 pandemic before resuming operations. If some pavement damage is not found when returning to normal site maintenance, the risk will be passed on to aircraft and in such cases the necessary repairs will affect operations. Not only airport operators, many aviation authorities and regulators are unable to perform standard administration of various licenses as their operations have also been affected by the outbreak of the Covid pandemic.

To deal with this, the ICAO, in a press release, created a system called Pandemic Disputes (CCRD) so that all states can record any differences related to their standard policies. Through this action, ICAO will be able to properly ensure the safe continuity of flights between countries and document this when operations return to normal.

The RTS phase must be carefully coordinated taking into account all possible risks/hazards/mitigation measures that the airline has included in its SAR. Reviewing and scrutinizing all maintenance work on the aircraft and its components/parts is essential. Particular attention should be paid to the actual modification of the aircraft, its comparison with the acceptable configuration and the processes to eliminate any existing gaps. This should cover both aircraft hardware and software components/parts. Additional consideration should be given to the proper handling of any aircraft components/parts removed for maintenance or storage outside the aircraft during the stand-down period, as well as any "aircraft eating" activities that may have taken place during this period.

The availability of aircraft records with a complete and accurate display of the state of the aircraft (including all its systems - equipment - components), as well as the relevant maintenance work that took place after the last flight before entering the parking/storage procedure, is necessary for:

• ensuring the return of the aircraft to the condition of airworthiness, necessary for permission to operate

• preservation of the value of assets for what the airline decides for a specific aircraft (for example, RTS, or return from lease, or disposal for partial withdrawal and capitalization)

The format of such records (including, but not limited to, logbooks, engine logs, maintenance work packages, AC and SC status, LPL report) must ensure that the information is readable by any legitimate interested party (e.g., operator, owner, regulator). In today's electronic records context, attention must be paid to software compatibility issues associated with MSI files. The end of airplane mothballing is determined as the end of the aircraft parking/conservation period and the comeback of the asset to service following a maintenance response completed with the appropriate aircraft service-release (SRC) certification. The scenario where an aircraft returns to flight for a single position change during a flight clearance (FC) flight with appropriate fly conditions (FC) is not an illustration of the upper declaration.

## 3.2 Basic aircraft safety measures for secure release

These aircraft safety analisations are listed down here as they are intrinsically related to the airworthiness of an aircraft when reactivated after a long period of parking or storage. They are an important step in the process of returning the aircraft to normal service and related to the certification of the aircraft's release to service.

Conduct a risk evaluation of critical data and communication technology systems related to aircraft development and connectivity based on the new cybersecurity structure (arising out of the pandemic context), including cybersecurity to support airworthiness. Agree with the aircraft OEM a list of essential systems and provide that logs are integrated, new baselines are ready for anomaly detection, and updates are confirmed with integral checks.

Engage appropriate airworthiness oversight bodies to review and disseminate possible information, manuals or disclosures of software fixes and updates etc.

Keep in touch with organizations/subcontractors involved in the supply chain to implement changes and adjustments to systems and processes, and to ensure log integration and new baselines are ready to identify anomalies and verify updates with integrity checks. Check the expiration dates of certificates used for authentication with the identity management solution in use, as well as the KPI or cryptographic system to ensure data integrity and compliance.

Log review, authentication and archiving of all software related to mission-critical systems to maintain no illegal software has been installed or connected to the aircraft, illegal access to onboard systems or modification during parking and storage. If illegal activity is considered, appropriate actions should be implemented to verify the integrity of the connected systems and, if necessary, restore them accordingly to the set instructions of the appropriate person.

Perform method alike to that referenced above for all service devices such as data loaders, media, all software and credentials. Compare the MOP with the latest risk evaluation, as new teams implementing sustentation or remote operations might have changed the ground attack landscape of certain equipment, particular attention should be paid if such remote access could affect aspects of continued airworthiness. Provide general cyber security training, checklists and best practices to all groups performing or providing airplane maintenance activities.

The dispatcher must be aware of any EOM or ACA requirements for an aircraft upon completion of a non-revenue flight after an extended lay-up or storage period and prior to TRS for a profitable flight. If such a flight is demanded, the planned flight profile must be clearly arranged to fit the requirements. Whensoever the checks required in flight can be minimized by appropriate replacement steps on the ground, the operator should look for this alternative if appropriate ground support possibilities are accessible (a formal ground pressure test can satisfy a long flight).

Occasionally, an aircraft may have endured serious maintenance work (e.g. planned intensive basic checks, fixes or reparations) due to a parking period, or completion of a handover to dispatcher/owner, delivery and return to lease at the end of this period. Commercial obligations and practices selected by the operator may result in an inspection flight, although this is not required by the regulatory body and is not needed by the EOM. That's important to take into consideration that if a maintenance check (MC) flight is to be operated, accordingly to the details of the flight account and the multiplicity of the elements of the check during flight, definite regulatory demands for flight qualified crew and experience must be considered as part of the particular CMF operations and clearances that the operator must have to perform the following flights.

Maintaining the airworthiness and reliability of the aircraft required for operation is largely dependent on the MOP. During the period of storage/parking, elements may appear that must be precisely taken into account during the further implementation of the SS. In particular, the use of EOMs with "limited" extensions for some task thresholds/frequency should be considered. The "cascading effect" of like these additions will result in extra and untimely maintenance duties that will need to be planned, monitored and maintained for a long period after the airplane is returned to service. The expenses of doing so may even prompt dispatchers to take into consideration "interim maintenance" acts to get back the airplane to "non-extended mission limitations".

The TRS might also occur simultaneously with some airplane transfigurations (such as cabin changes) which may result in adjustments, deletions or addings to some MOP sustentation tasks.

According to crisis caused by the pandemic, much attention is being paid to changing the methods of clearing and fumigation of aircraft to meet the biosecurity demands and expectancies placed on commercial air transport. Such additional details may affect the SS and should be examined by the SS in the following areas:

• Biological hazards during maintenance: water and wastewater system maintenance tasks are noted in the AMM with caveats to use appropriate PPE (e.g. protective clothing, gloves, eye protection, face mask, etc.), compliance with all local safety and health measures and regulations, including the appropriate disposal of hazardous or biohazardous wastes and substances; this should also be emphasized when dealing with certain components of the air conditioning system - for example, removal/replacement/disposal of HEPA filters performed earlier than 72 hours after the last passenger flight was performed by the aircraft in question should be considered as the generation of potentially biohazardous waste , and extracted filter banks should be handled accordingly;

• Prevention of intrusion into avionics and electrical units: the condition of protective and sealing elements of control panels, environmental sensors, electronic displays and avionics, or electrical equipment that can be exposed to the penetration of vapors and liquids (eg cleaning and disinfecting agents5). partially checked / restored; such regular maintenance activities should be carried out especially for the flight deck, but also include the passenger cabin, kitchens, lavatories and crew rest areas;

• Cabin maintenance: The consequences of an intensive sanitization program implemented during the operation of aircraft during the pandemic may result in additional maintenance measures due to the frequent use of cleaners and disinfectants; actions will be aimed at maintaining performance features and characteristics (in particular, mechanical, flammability, surface condition and aesthetics). ) seats, monuments, IFE equipment, cockpit windows, etc.; chemicals used and methods of application must be in accordance with the documentation approved by the OEM and the operator; any relevant finds must be reported and must initiate appropriate recovery and monitoring actions;

• Corrosion control: Structural components such as seat tracks may be exposed to corrosive cab cleaning/disinfection fluids in particular if they are not applied according to the planned procedure or are unintentionally spilled in large quantities; the geometry of the component may present areas/crevices/narrow spaces prone to trapping/accumulation of liquid, which will increase the effect of corrosion; the appropriate tasks of inspection, repair or replacement must be implemented.

The unprecedented change in fleet size when exiting active flights and returning has highlighted specific challenges that have forced airline technical teams and their OEM counterparts to embark on a steep learning curve. This section has been included in the guidance document to incorporate some of the RTS lessons learned and shared by participants in IATA's aircraft maintenance teleconferences and webinars. elements of increased visibility (for example, colors, safety flags) to remove them before the flight; failure to do so may result in system contamination, system malfunction or inoperability, and damage to the PPE, which may result in serious safety consequences. All pneumatic valves must be inspected, and their operation must be checked according to the relevant AMM task. Before the first RTS flight, provision should be made for a high power engine run-in to perform a full operational check of the engine air intake system valves (including HPV, PRSOV, LP check valve) and the operation of the aircraft air conditioning units (using engine source, ZSU, cross-purge). , low and high settings, etc.). Ensure all drain ports/holes are clear and clean. Special attention to a detailed inspection of areas prone to the penetration of wild animals, birds and nesting insects. Particular attention should be paid to possible contamination of the pitot static system and air parameter sensors, including any associated measurement lines. Operational tests of thermal anti-icing systems and corresponding anti-icing valves. Allowing sufficient time (to avoid dispatch delays) for the aircraft to thermally stabilize (in some cases the aircraft may need to be cooled) followed by power-up, PBIT completion and systems reset and troubleshooting as necessary.

Consider major operational checks of Avionics/Electrical/Backup/Alternate systems after the stand-down period. Carry out a detailed inspection and operational checks of the galley equipment - boilers, stoves, faucets and plumbing equipment. Full operational checks of flight controls in all normal and alternate modes of operation. That’s very important that operators understand the specifics of each individual aircraft in their fleet:

• The actual configuration and location of the aircraft (with detailed information about the availability of the aircraft and SGE availability, restrictions on APU and engine operation, fuel on board and last refueling, etc.)

• Records about the state of maintenance and use (with information about the last flight, the maintenance program the aircraft is undergoing, and the maintenance tasks performed, including any storage work performed, etc.)

• Acceptance and use of any expanded or excluded or rejected maintenance tasks (agreed by EOMs and provided by the Regulatory Authority).

As a general rule, operators must perform a detailed safety risk assessment to identify hazards, assess and mitigate relevant risks. Some examples of possible risks include, but are not limited to:

• Restrictions related to the availability and/or location of the aircraft

• The required and planned work package for the aircraft and its compliance with the latest documents and information from the aircraft manufacturer and the relevant competent authority (AC)

• Qualification of available personnel;

### 3.3 Warehouses of material and technical supply of airports

To ensure the reliability of air transport due to the preservation of aviation equipment, the following conditions must be met.

All premises must be equipped with modern engineering networks, video surveillance, fire alarm and fire extinguishing systems.

Management of warehouse processes should be carried out by information systems and allow automatic monitoring of the terms of carrying out technical regulations with stored property.

Storage conditions in aviation equipment warehouses must meet the regulatory requirements for the storage of aviation and technical property.

The specifics of these processes were described in the "Manual for airport design in civil aviation, part 4. Warehouses of material and technical supply of airports" in order No. 1101/29231 dated August 8, 2016 "On the approval of the Rules of engineering and aviation support (IAZ) of state aviation of Ukraine", also No. 130/28260 dated January 25, 2016. "On the approval of the Rules of Aerodrome Technical Support (ATZ) for flights of aircraft of the state aviation of Ukraine".

The following technological processes at warehouses of material and technical supply (MTP) at civil aviation airports are decisive.

1. The main groups of technological process operations at logistics warehouses at civil aviation airports are:

• receipt of aviation and technical property (ATM) and material and technical property (MTM) of general industrial purpose;

• acceptance of goods to the warehouse;

• storage of ATMs and MTMs in the warehouse and their assembly for issuing to consumers;

• issuance of ATMs and ATMs to consumers.

2. ATMs and MTMs are delivered to logistics warehouses by rail, road, water and air transport in containers, bags and unpackaged form. The cargo receipt operation includes unloading from vehicles, initial acceptance of cargo by the number of seats, moving cargo to the expedition or storage section.

3. Acceptance of goods into the warehouse involves determining the number of ATMs and MTMs according to the nomenclature, checking with accompanying documents, transferring the received goods into warehouse containers (on pallets, in boxes, boxes, etc.) and moving them to the storage area, drawing up accounting documentation about what came to me

4. Storage of ATMs and MTMs in the warehouse involves ensuring the necessary conditions for the preservation of property in accordance with the technological requirements for their storage, re-conservation of units and products after the established terms, completeness of ATMs and MTMs for issuing to consumers.

5. Issuance of ATMs and MTMs to consumers involves the movement of warehouse containers (pallets, boxes, boxes, etc.) to obtain the necessary amount of the requested property, its assembly, packaging, loading on vehicles and registration of accounting documentation on the movement of the issued property.

. Determination of storage areas at warehouses for material and technical supply of aviation transport

The warehouse area is determined depending on the accepted capacity of the warehouse, taking into account the technical parameters that characterize the processing processes at warehouses for the material and technical supply of aviation transport.

The total storage area of the Fzag MTP warehouse is equal to:

$$F_{заг} = F_1 + F_2 + F_3 + F_4$$

where $F_1$ - storage space for closed storage;

$F_2$ - storage space for storage of chemical and paint materials;

$F_3$ - area of sheds for semi-closed storage;

$F_4$ - the area of open storage areas.

The total area for closed storage of ATMs and MTMs is defined as the sum of the areas of all floors: above-ground (including technical), basement and basement (measured within the inner surfaces of external walls or axes of extreme columns, where there are no external walls), galleries, tunnels, all tiers of shelves , platforms, mezzanines, ramps to transitions to other buildings. Areas for maintenance of crane tracks and cranes are not included in the total area. The warehouse area for closed storage of ATMs and ATMs, auxiliary and auxiliary areas are determined by the sum of the corresponding areas of the premises.

The warehouse area for semi-closed storage is defined as the sum of the areas measured within the inner surfaces of the outer walls and within the axes of the building columns (in the absence of outer walls). The warehouse area for open storage is defined as the sum of the areas of open areas within hard or other coverings intended for the production of lifting and transport operations.

The total warehouse area for closed storage F consists of the area of premises for closed storage of ATMs and ATMs and the area of expedition:

$$F_1 = F_{закр} + F_{експ}$$

where, $F_{закр}$ - the area of the closed storage area; $F_{експ}$ - the area of the expedition.

The main method of storing ATMs and MTMs in buildings for closed storage at MTP warehouses of aviation transport is the racking method. The number of rack cells required to ensure the specified capacity of the rack storage zone n is determined by the formula

$$n = \frac{E_{cm}}{P_{ком}}$$

where, $E_{cm}$ - rack storage capacity, t; $P_{ком}$ - load on one cell, i.e.

The number of racks in the span $N_{cm}$ is determined based on the following dependence

$$N_{cm} = \frac{2 \cdot (B - 2a)}{B_1}$$

where, B - the span of the warehouse building in the ATM and MTM rack storage area, m; a- distance from the center line of the grid of columns to the rack, m; $B_1$ - the width of one complex (two racks and a passage between them), m.

The number of cells depending on the height of the rack is determined by the formula

$$n_в = \frac{H_1}{h_{ком}} + 1$$

where, - $H_1$ lifting height (distance from the possible lower position of the load to its upper position) of the load-grabbing body of the mechanism, m; $h_{ком}$ - vertical step of the cell, m.

The length of the rack is determined by the formula

$$l = \frac{n \cdot l_{ком}}{n_в \cdot N_{ст}}$$

Where $l_{ком}$ is the step of the cell of the rack horizontally, m.

The length of the rack storage area L is determined taking into account the distance necessary to accommodate the mechanism that came out of the inter-rack aisle for taking (issuing) goods or moving to another inter-rack aisle

$$L = l + l_o$$

where $l_o$ is the necessary distance for exiting the racks of the mechanism when picking up (giving out) cargo, m.

The area of the closed storage area of ATMs and MTMs is calculated according to the formula

$$F_{закр} = (B - 2b) \cdot L$$

where b is the distance from the center line of the grid of columns to the inner surface of the wall, m.

The coefficient of use of the space in the rack storage area is determined by the formula

$$K_н = \frac{n \cdot F_{ком}}{n \cdot F_1}$$

where $F_{ком}$ is the area of the rack cell (taking into account the thickness of the structural elements of the rack per cell), m2.

The determination of the area of the expedition $F_{експ}$ is carried out according to the average daily receipt of ATM and MTM, taking into account the unevenness of the receipt of goods

$$F_{експ} = \frac{Q \cdot K_{нер} \cdot T_1}{T \cdot q \cdot h_y \cdot K_e}$$

where Q is the annual volume of ATM and MTM receipts, tons; $K_{нер}$ - coefficient of unevenness of cargo arrival (1.2-1.5); T - number of working days in a year; $T_1$ - the number of days the goods stay at the expedition site (up to two days); q - load per 1 m2 of storage area at a stacking height of 1 m, t / m2; $h_y$ - the coefficient that takes into account the height of the cargo stacking (a dimensionless value, equal to the height of the cargo stacking in meters); $K_e$ - the utilization factor of the expedition area (0.3 - 0.4).

The area of the storage area of chemical and paint materials $F_2$ is determined taking into account the storage method based on the use of dependency

$$F_2 = \frac{E \cdot \alpha_1}{q \cdot h_y \cdot K_{вик2}}$$

where E is the capacity of the MTP composition, t; $\alpha_1$ - the share of the storage capacity of chemical and paint materials in the total capacity of the MTP warehouse (5-7%); $K_{вик}$ - coefficient of use of the storage area of chemical and paint materials (0.21 - 0.24).

The storage area of the semi-closed storage area $F_3$ is determined based on the use of dependency

$$F_3 = \frac{E \cdot \alpha_2}{q \cdot h_y \cdot K_{вик3}}$$

where $\alpha_2$ - the share of the capacity of the semi-closed storage area in the total capacity of the MTP warehouse (10 - 15%); $K_{вик3}$ - coefficient of use of the area of the semi-closed storage area (0.30 - 0.35).

The storage area of the open storage area $F_4$ is determined by the formula

$$F_4 = \frac{E \cdot \alpha_3}{q \cdot h_y \cdot K_{вик4}}$$

where $\alpha_3$ - the share of the capacity of the open storage area in the total capacity of the MTP warehouse (10 - 15%); $K_{вик4}$ - coefficient of use of the area of the open storage area (0.45 - 0.55).

## CHAPTER 4
## LABOUR PROTECTION

### 4.1 List of hazardous and harmful production factors

Labour protection is necessary during maintenance of aviation equipment. Everyone who involved in this process, from the employer to the newest worker, has different but essential duties to keep the workplace safe. Because employers have the most authority in the workplace, they have the most significant responsibility. However, it is crucial for maintenance staff to own safety that you understand everyone's health and safety duties, including they own.

Knowledge of all hazardous and harmful production factors are obligated to preventing injuries and illnesses at work.

In Ukraine, companies that maintenance aviation equipment, for example, 'MAU technique', minimum safety and health requirements for staff during using personal protective equipment at the workplace followed by. Moreover, regulated by Order No. 1804 of 11/29/2018 is valid from 01/15/2019 published by the Ministry of Social Policy of Ukraine 'On approval of the Minimum Safety and Health Requirements when employees use personal protective equipment at the workplace'. In addition, Law of 10/14/1992 No. 2694-XII 'About labour protection' from the Verkhovna Rada of Ukraine.

An understanding of the importance of labour protection of aircraft maintenance engineering is essential to anyone considering a career as a licensed aircraft engineer. Labour protection impinges on everything an engineer does in the course of their job in one way or another. Knowledge of this subject has a significant impact on the safety standards expected of the aircraft maintenance engineer.

Various factors impinge upon the engineer's physical working environment it include:

- workplace layout and the cleanliness and general tidiness of the workplace (e.g. storage facilities for tools, manuals and information, a means of checking that all tools have been retrieved from the aircraft and other);
- the proper provision and use of safety equipment and signage (such as non-slip surfaces, safety harnesses and other);
- the storage and use of toxic chemical and fluids (as distinct from fumes) (e.g. avoiding confusion between similar looking canisters and containers by clear labelling or storage in different locations, and other).

To some extent, some or all of the factors associated with the engineer's workplace may affect his ability to work safely and efficiently. JAR 145.25(c) - Facility Requirements states:

- 'The working environment must be appropriate for the task carried out and in particular special requirements observed. Unless otherwise dictated by the particular task environment, the working environment must be such that the effectiveness of personnel is not impaired.'

The **working environment** comprises the physical environment components of the working environment interact (Fig. 5.1.), for example:

- engineers are trained to perform various tasks;
- successful task execution requires a suitable physical environment;
- an unsuitable or unpleasant physical environment is likely to be de-motivating.

The specific design of buildings and structures of the aircraft maintenance facility (AMF) may be adjusted in accordance with the adopted scheme for organizing the maintenance of the aircraft, which should be reflected in the design task.

The plot of AMF should be of a size that ensures the placement of all buildings and structures for maintenance of the aircraft, taking into account the sanitary and fire requirements set forth in Construction Regulation Standards Building Code "General plans of industrial enterprises. Design standards". In determining the size of the plots, the future development of the AMF complex should be taken into account. For this purpose, certain areas are reserved, adjacent to the buildings and facilities planned for expansion.

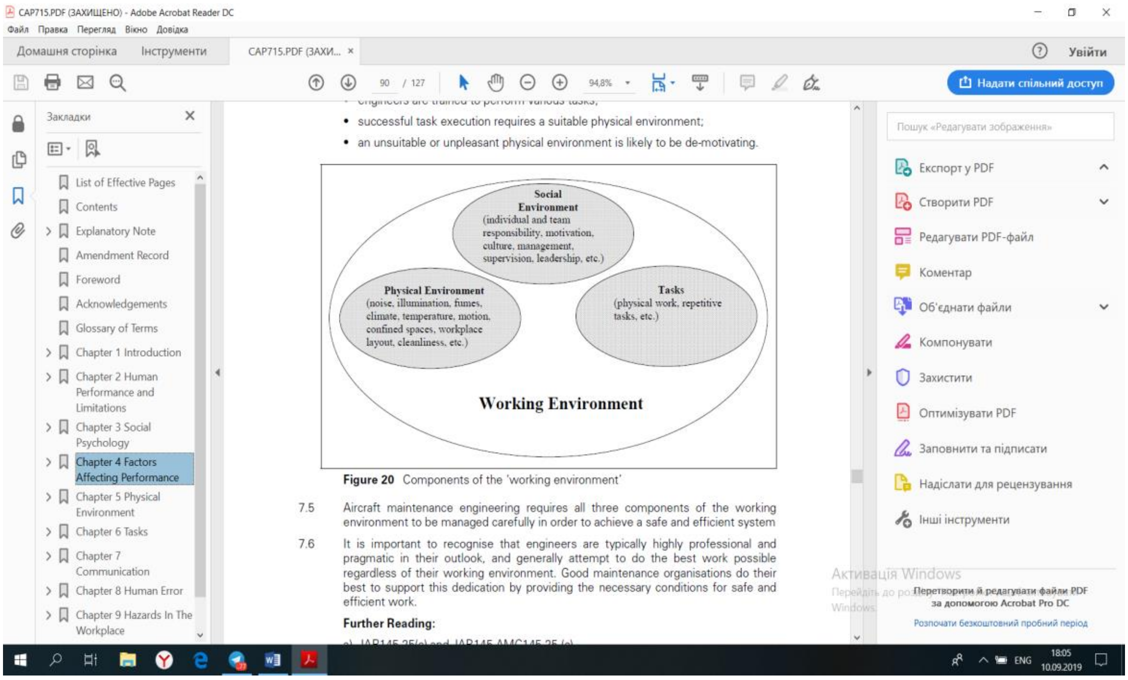


**Fig. 5.1.** Components of the ‘Working environment’

Modern hangar construction is characterized by a large variety of planning and design schemes, while some are used for one type of aircraft; others suggest the content of different types of aircraft and helicopters. Nowadays, almost all commercial and military hangars have dozens of engineers and technicians who carry out repair and service around the clock. To protect the life and safety of the airplanes as well as buildings, it is necessary to install high-performance fire detection and fire extinguishing systems.

Aircraft hangar is an area of the fire hazard difficult detection due to a large area, the presence of fuel, solvents, accumulation of vapours, radar and electrical interference.

Although the crew is trying to spend as much fuel (jet fuel or aviation gasoline) as possible before the aircraft enters the hangar, but many hangars take just tucked aircraft as well.

Explosive materials may be also stored on the maintenance plot. In addition, staining occurs accumulation of vapours, which may cause fire.

Some flame detectors can be activated (triggered by an alarm) due to interference caused by radar, bundle, and X-rays. An effective practice is to use detection devices with Electromagnetic interference (EMI) / Radio Frequency Interference (RFI) protection. EMI and RFI protection are the subjects of study in my thesis work.

### 4.2. Technical and organizational measures that intensify or minimize the impact of hazardous and harmful factors on maintenance stuff

The noise environment in which the aircraft maintenance engineer works can vary considerably. For instance, the airport ramp or apron area is clearly noisy, due to running aircraft engines or auxiliary power units (APUs), moving vehicles and so on. It is not unusual for this to exceed 85 dB - 90 dB that can cause hearing damage if the time of exposure is prolonged. The hangar area can also be noisy, usually due to the use of various tools during aircraft maintenance. Short periods of intense noise are not uncommon here and can cause temporary hearing loss. Engineers may move to and from these noisy areas into the relative quiet of rest rooms, aircraft cabins, stores and offices.

For work with hazardous and hazardous working conditions, such as high noise levels, workers are given free of charge special elements according to the established standards, which are an obligatory minimum for the employer to issue personal protective equipment free of charge, defining the protective properties of the personal protective equipment and the terms of their use. This was approved by the Order of the State Committee of Ukraine for Industrial Safety, Labour Protection and Mining Supervision No. 62 of April 16, 2009, registered with the Ministry of Justice of Ukraine on May 12, 2009 under No. 424/16440 [10].

It is very important that aircraft maintenance engineers remain aware of the extent of the noise around them. It is likely that some form of hearing protection should be carried with them at all times and, as a rule of thumb, used when remaining in an area where normal speech cannot be heard clearly at 2 meters.

Old jet and turbo-jet engines can produce noise levels that exceed 115 dB. Auxiliary power units, ground power units, condensed air equipment, tugs, fuel trucks and loading and unloading equipment also increase the level of background noise. Levels of noise in the runway and in aircraft parking areas are rarely lowered to 80 decibels. Protective equipment should provide effective noise reduction, be convenient in terms of ergonomics and does not hinder communications between the staff. Dual systems (headphones and earplugs) provide better protection and allow adjustment at different noise levels.

In order for the flights to be conducted strictly according to the schedule and satisfy all the requirements of the passenger, ground equipment is moving at high speeds, aircraft parking, runways and runways but is often poorly lit.

Workers are at risk of being tightened up in turbines of jet engines or can be hit by a propeller or by a jet exhaust.

Limited visibility at night and unfavourable weather increases the risk of attacking ground stuff by moving equipment and operating mechanisms.

The strict control over the procedure of stuff in dangerous proximity to fuel storage facilities should be included in the general program of labour protection.

Compliance with the rules and cleanliness is important to sequence the order on the airfield. It is necessary to carefully remove spilled and spent liquids. The fulfilment of these requirements is also important in carrying out the basic repair.

When setting standards for noise limitation, as a rule, they are not from the optimal (comfortable), but from the permissible conditions under which the harmful effects of noise on a person are not detected, or insignificant.

Noting that Regulation (EC) No 216/2008 provides for the involvement of European countries not Members of the European Union with the objective of ensuring a proper pan-European dimension, in order to facilitate the improvement of civil aviation safety throughout Europe. Considering that Ukraine and the European Union and its Member States have initialed a Common Aviation Area Agreement (CAA Agreement) [12] which provides for Ukraine's participation in the relevant parts of the EASA system. So permissible limits for aircraft noise are defined in 'Certification Specifications for Aircraft Noise CS-36', 3 April 2007 by EASA.

Industrial noise permissible limits defined in DSN 3.3.6.037-99 'Sanitary standards of industrial noise, ultrasound and infrasound'. Rated (normalized) parameters of permanent or intermittent production (transport) noise are the levels of sound pressure in the octave frequency bands (the boundary spectra measured in dB, the designation of the spectrum corresponds to the sound level in the 1 kHz band), and the sound levels corrected on the scale 'A' of the standard noise meter (dBA).

Permanent noise is considered, the levels of which over time vary by no more than 5 dB. Non-constant noise is considered, the level of which over time varies by more than 5 dB. Intermittent noise is interrupted by pauses lasting for several hours, minutes or seconds.

$$Itkb \quad (a) = 10 \lg lg \left( \frac{1}{100} \sum_{i=1}^{n} t_1 * 10^{0.11} \right)$$

Where: L - average class i, dB; t - time of the impact of noise class i from the total control time, %.

Calculated values of Lkb (A) are compared to rated (normalized) sound levels (dBA).

For discrete and pulsed noise, the permissible levels are reduced by 5 dB.

The normalization of noise in facilities and on the territory of residential buildings. In made adjustments to the nature of the noise (for tonal or pulse -5 dB), the time of day (for day time - +10 dB), the location of the object (for the resort area -5 dB) and the total time of exposure to noise.

The normalized values have the following meanings: at a geometric frequency of 1/3 octane band 12.5 kHz - 75 dB, at 16 kHz - 85 dB and at frequencies above 20 kHz - 110 dB.

Exposure levels and duration - professional noise exposure must be monitored in such a way that the exposed person does not suffer from excessive exposure, which is determined by the level and duration of the sound per person. The values of the acceptable combination of level L and duration T are given in Table 5.1, or they are calculated by the formula, min.

The corresponding values of the dose exposure of noise are given in the table. 1.2., where TWA is the eight-hour time-weighted average sound level:

TWA = 10 lg (£>/100) + 85, and D - dose of noise.

The choice of the exposure limit depends on the definitions of two parameters: 1) the maximum acceptable threshold level of hearing (TLH), above which there is a deterioration of the hearing and below which it is believed that the hearing is normal; 2) the proportion of exposed population noise, which is protected from hearing impairment.

There are no restrictions on infrasound level yet. It is recommended to use as an indicative maximum permissible level of infrasound of 95 dB, if the time of exposure to ultrasound is more than four hours.

Table 5.1.

The dependence of the permissible sound level on the duration of its action

| I, dBL | t | | |
|---|---|---|---|
| | Hour | Min | Sec. |
| 80 | 25 | 24 | |
| 90 | 2 | 31 | |
| 100 | | 15 | |
| 110 | | 1 | 29 |

| | | | |
|---|---|---|---|
| 120 | | | 9 |

Table 5.2

Dependence of the average level of sound from the dose of noise

| D % | TWA |
|---|---|
| 50 | 82.0 |
| 100 | 85.0 |
| 1000 | 95.0 |
| 10000 | 105.0 |
| 100000 | 115.0 |
| 1000000 | 125.0 |

The fires in the paint areas usually begin with the explosion of the steam-air mixture, which is accompanied by the destruction of the protective element, and are characterized by high average volume temperature, dense smoke of the air, the danger of the transition of fire into other hangar rooms, the structural elements of the building are destroyed in the absence or non-development skidding designs. Parameters of the system of surround fire extinguishing with the distribution network and the weight of the fire extinguisher in a tank of 150 kg and more. Minimum mass of fire extinguisher, kg, required to protect this space, calculated by the formula:

$M_{min} = M1+M2+M3$

where: M1 – main mass of the fire extinguisher, proportional to the amount of protected space, kg;

M2 - additional weight of the fire extinguisher to compensate for the attribution of the powder part through openings, the each area of which $S_{p1}$ is less than 5% of the total area of the building envelope structures – $S_{1G}$, with the total area of such openings greater than 1% but less than 15% of $S_{0G}$, kg;

M3 - is an additional weight of the fire extinguisher to compensate for the transfer of powder through the openings, the area of each of which $S_{r2}$ is more than 5% of 8, and the total area of such openings does not exceed 15% of $S_{0G}$, kg. The total area of openings that are not closed during the submission of the fire extinguisher from the system $S_{p1}$ and $S_{r2}$, should not exceed 15% of $8_{0G}$.

The M1 and M2 weights should be evenly distributed in the protected volume during feeding. The weight of M3 shall be fed along the corresponding slot in proportion to its area $S_{p2}$.

$$M1 = q_{v0} \cdot V_3$$

$$M2 = 2{,}5\Sigma S_{n1}$$

$$M3 = 5{,}0\Sigma S_{n2}$$

- where $q_{v0}$ - the rate of supply fire extinguisher for bulk extinction, $kg*m^3$; $V_3$ - the volume of protected space, $m^3$; $S_{n1}$ - the area of openings, which is less or equal than 5% of the total area of the enclosing structures, $m^2$; $S_{n2}$ - area of openings, the area of which is more than 5% of the total area of the enclosing structures, $m^2$; 2.5 - the rate of supply of additional mass of the fire extinguisher to compensate for its assignment through the slots in the area of $8_{n1}$, $kg * m^2$; 5,0 - the rate of supply of additional mass of the fire extinguisher to compensate for its assignment through the slots area $8_{nl}$, $kg*m^2$.

The rate of supply of extinguishing powder from the system is accepted like: $q_{v0} = 0{,}6\ kg*m^3$.

The minimum expense of the fire extinguisher, kg*s, which must be provided by the system, is determined by the formula:

$$G_{min} = \frac{M\,min}{30}$$

In this case, the intensity of the supply of the fire extinguisher should be:

$I_{vo} \geq 0{,}02\ kg*s*m^3$

The minimum duration of the outflow fire extinguisher, $t_{min}$ in a volumetric manner with a distribution network is determined by the formula:

$$t_{min} = 0{,}67 q_{v0} * I_{v0}^{1}$$

However, it should not be less than 5 seconds.

For other combustible materials and grades, the specified delivery rules may be clarified because of fire test results.

### 4.3. Providing fire and explosive safety in hangars

When designing a fire-extinguishing unit for aircraft hangars, the following moments should be taken into account: the rapid development of the fire due to the large amount of solid combustible materials, aviation fuel and other combustible liquids, a low degree of fire resistance of the partitions.

Typically, aircraft are housed in aircraft hangars without aviation fuel in tanks, but there is still some fuel in the fuel system. Moreover, many technical fluids in an aircraft are also combustible. These substances affect the nervous system, the organs of sight and breathing of the person (immediately there is a deterioration of vision, tearing, choking, vomiting, and convulsions).

The main aluminium alloys of the wing and airplane shells have a low critical temperature (about 250 ° C) and a low melting point (≥ 520 ° C for the D16 alloy), due to which, if there is a burning of fluid and rubber, there may be a loss or drop in mechanical the strength of these alloys and their rapid destruction.

Given the high reaction temperature (~ 3000 ° C), the combustion zone of magnesium alloys stands out in a brightly lit spot against the background of "low temperature" flames of other substances and materials. This will bring new sources of fire. The combustion area is increased until covers the entire surface of the structure. Requirements for automatic foam fire extinguishing systems are contained in the following normative documents: НАПБ А.01.001-2014 ‘On approval of the Fire Safety Rules in Ukraine’, ДСТУ EN 60079-0:2017 (EN 60079-0:2012, IDT) ’Explosive environments. Part 0. Equipment. General requirements’.

When choosing a method of extinguishing a fire in a hangar and the type of foam generator, the following facts should be taken into account:

- a fire may occur both inside and outside of the aircraft;
- in aircraft there is a mixed fire load, which includes polymer materials, fuel, rubber goods;

- the rate of development of a fire in the hangar is high due to the probable opening of all hatches and doors;
- before the placement of aircraft in aircraft hangars, fuel is usually drained, but part of it still remains in the fuel system. In American fire safety standards, the aircraft is charged if it contains more than 0.5% of the fuel (A1.3.1.1.1 ETL 02-15).

American standards (including ETL 02-15) provide a volumetric method of extinguishing a fire, but in its formulations, there are a number of differences from the ones adopted in the annex to.

The requirements for a surface fire extinguishing method in an air hangar are given in the NPA 2018-15 ‘Rescue and firefighting services at aerodromes’ by EASA. The main provisions in this document are:

- the calculated area of the fire section is determined by the ratio of the hangar area to the maximum number of aircraft in it;
- the estimated fire duration is 10 minutes;
- fire extinguishing unit should ensure the simultaneous and uniform supply of air-mechanical foam on top of the plane and to not cover them the floor area of the fire department, as well as the bottom of the lower surfaces of the aircraft;
- from above it is recommended to submit foam of average multiplicity, below – of low multiplicity;
- moment of inertia detector response to the flow cell foam - no more than 30 seconds.

### 4.4. Fire and explosion safety instructions

According to, at a meeting of gas turbine engine aircraft or helicopter, a person who encounters should be in sight of the commander of the aircraft at a distance of at least 25 m from it; and for aircraft with piston engines - at a distance of at least 10 m.

The movement of aviation personnel, special transport, self-propelled machinery and other mechanisms before a controlling aircraft is prohibited.

After installing the aircraft to the parking lot, shutting down the motors and stopping the airspeed, the aircraft must be immediately grounded with a special device and the thrust pads must be fitted under the wheels of the main supports.

Responsible for the issue of aircraft, must make sure that there are no obstacles and the security is provided. He should be standing left to the aircraft to be in visual communication with the commander of the aircraft.

Control of the aircraft at night or with limited visibility, should be carried out with the inclusion of aeronautical lights and headlights.

The brigade of not less than three people carries out Works in the middle of fuel cistern-tanks. The direct executor works in the middle of the caisson tank, is provided with the necessary overalls, special footwear, rescue belts and hose gas masks.

When checking the aircraft fuselage for leakproofness - the area around it should be fenced off at a distance of 13 m, install a sign with the inscription "Caution! Possible spreading of the glider parts". Before starting the test, check the operation of the device for emergency reduction of air pressure in the fuselage. Persons who are not participating in the test are taken out of the danger zone beyond the boundaries of the aircraft. The noise level at the parking lot, during the leakproofness test, shall not exceed 50 dB.

Treatment of aircraft with anti-fluid liquids should be carried out at special places of parking in accordance with technological instructions for the performance of work on aviation engineering.

### 4.5 Conclusion

Careful handling of labour protection in the maintenance environment should serve to minimize risks. However, should health and safety problems occur, all personnel should know as far as reasonably practical how to deal with emergencies, which may include:

- An injury to oneself or to a colleague;

A situation that is inherently dangerous, which has the potential to cause injury (such as the escape of a noxious substance, or a fire).

The organization should also provide procedures and facilities for dealing with emergencies and these must be adequately communicated to all personnel. Maintenance organizations should appoint and train one or more first aiders.

Compliance with the requirements of regulatory documents is necessary to ensure a safe and high-performance working process in the production and operation of technical systems. In aviation hangars, it is recommended to pay particular attention to noise and fire safety issues. After all, in the first place, the violation of these requirements leads to the most serious consequences for both technical personnel and the property of the enterprise.

## CHAPTER 5

## ENVIRONMENTAL PROTECTION

### 5.1. Description of Electromagnetic interference

The last two decades have seen enormous changes in how human health affected by electromagnetic interference (EMI), especially during maintenance of any aviation system. It is so essential that studying the effect of EMI is necessary for all aviation engineers following the requirements EASA PART 66 and is described in Module 5 topic 5.1 Electromagnetic Environment.

In Ukraine companies that maintenance aviation equipment such as ‘MAU technique’ minimum safety and health requirements for staff during using personal protective equipment at the workplace followed by. Moreover, regulated by Order No. 1804 of 11/29/2018 is valid from 01/15/2019 published by Ministry of Social Policy of Ukraine. On approval of the Minimum Safety and Health Requirements when employees use personal protective equipment at the workplace.

EMI is the disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction (Fig. 5.1).

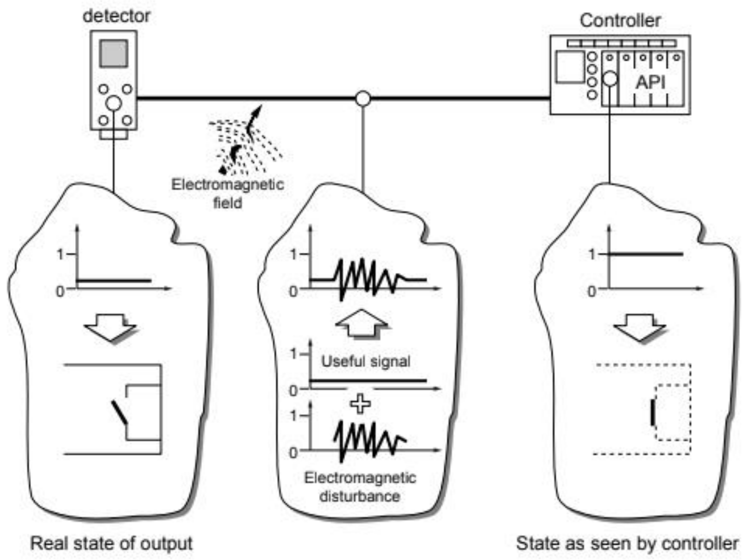


**Fig.5.1.** Example of EMI

Electromagnetic fields harm the health of maintenance staff. Low frequency, radio frequency and microwave frequency may cause a flow of current through the human body. This flow of current generates heat and produce thermal injury. Natural low frequency fields are static electric fields between the ionosphere and Earth, and static electromagnetic pulses due to lightning. These fields have been keeping living beings in an invisible cage of EM wave and pulses. The health effects that might originate from EM radiations are almost certainly the most complicated and difficult to understand of all the effects of EM radiations.

This graduated work is concerned with of influence human factors on operation and maintenance of remotely piloted aircraft systems. In addition, should be pointed out that EMI problem is tightly connected with one of the most popular models of human factors, which is the SHEL model.

E. Edwards first introduced the SHEL model (Fig 4.2.), and then in 1975 supplemented by the Hawkins diagram illustrating it, and adopted by ICAO as a conceptual model for explaining the role of the human factor in aviation [1].

The constituent blocks of the SHEL model (this abbreviation is formed from the initial letters of the names of the model blocks: Software - software, Hardware - object, Environment - environment, Liveware - subject) clearly emphasize the need for their mutual correspondence.

This chapter is devoted to the issues related to the influence of electromagnetic radiation on the environment and humans. Using modern technology, some measures to reduce harmful emissions can significantly reduce the negative impact on maintenance staff and the environment.

## 5.2. Electromagnetic interference during maintenance

It should be noted that the increased concern of EMI (Fig. 4.3.) during maintenance in recent years because it occurs due to the following and regulated by 3.3.6.096-2002 'On Approval of State Sanitary Rules and Regulations when working with Electromagnetic Field Sources' [15]:

1. Greater dependence on electrical and electronic systems for continued safe flight.
2. Reduced electromagnetic shielding due to greater use of composite materials.
3. Increased susceptibility of electrical and electronic systems to HIRF due to increased data bus and processor operating speeds, higher-density integrated circuits and cards, and greater sensitivities of electronic equipment;
4. Expanded frequency usage, especially above 1 gigahertz (GHz);
5. Increased severity of the HIRF environment because of an increase in the number and radiated power of radio frequency (RF) transmitters; and
6. Adverse effects experienced by some aircraft when exposed to HIRF.

There are the following sources of external interferences in aircraft (Fig. 4.4.):

- Two forms of interference
- Conducted interference

Radiated interference

Sources of interferences

- External Electrical Systems
- Engines system – ignition system

- Inadequate bonding
- Faulty static discharger/wicks.

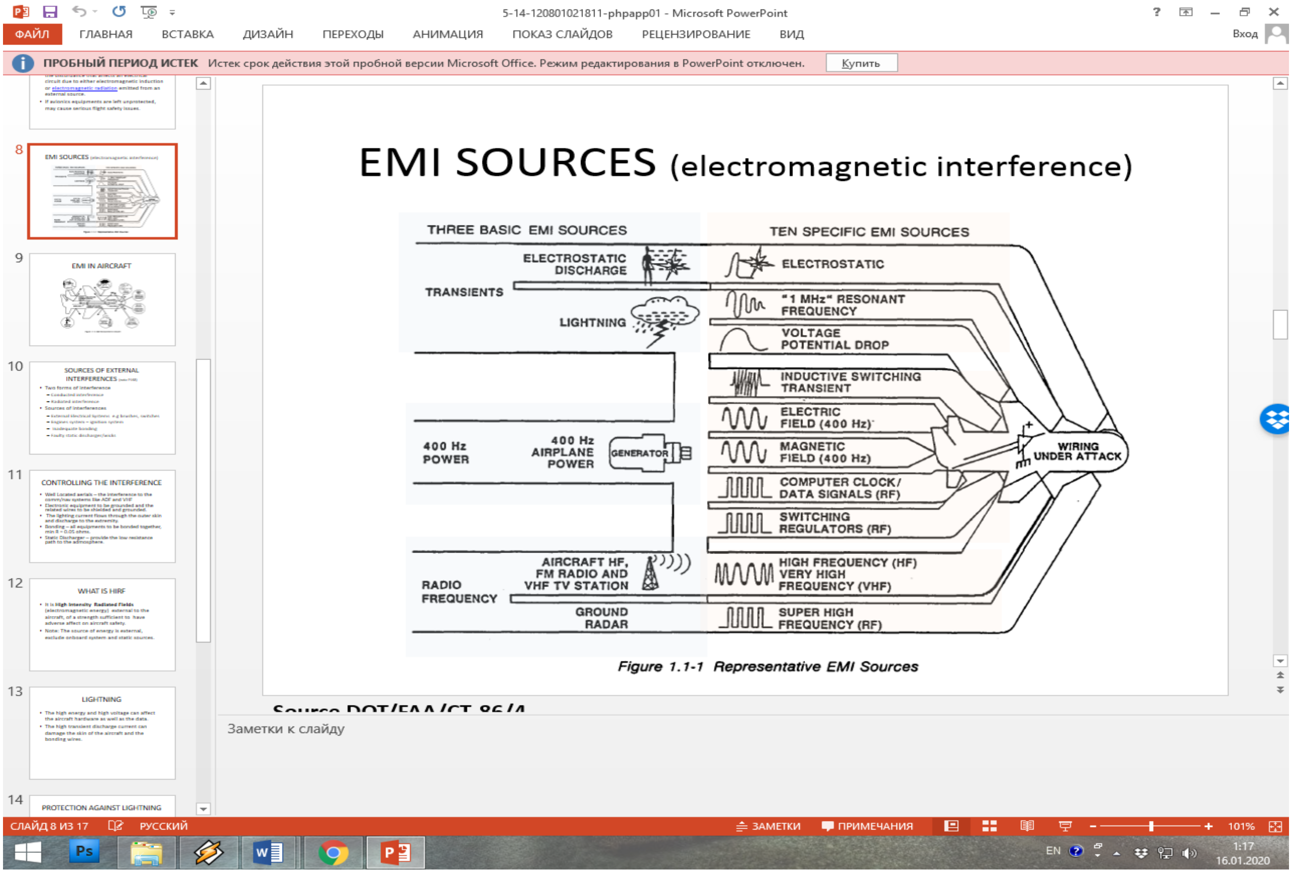


**Fig. 4.3.** Representative EMI sources

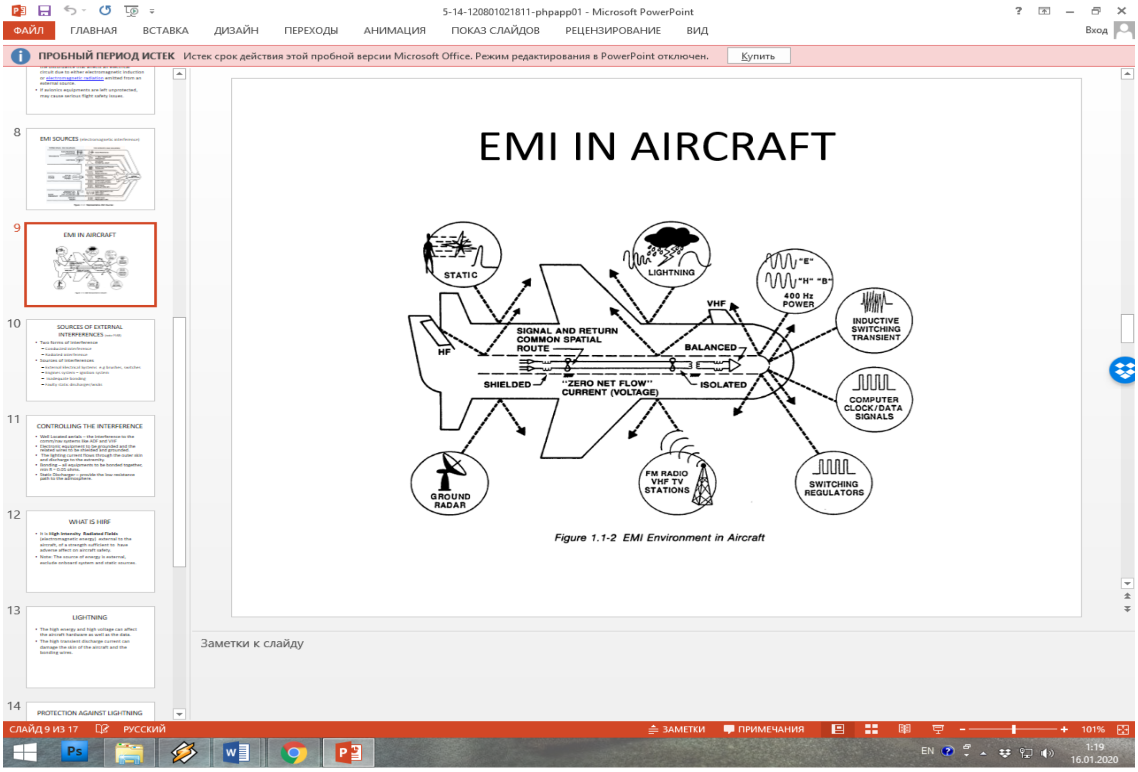


**Fig. 4.4.** EMI Environment in aircraft

The following can control EMI on aircraft:

- Well Located aerials – the interference to the comm/nav systems like ADF and VHF (Very high frequency).
- Electronic equipment to be grounded and the related wires to be shielded and grounded.
- The lighting current flows through the outer skin and discharge to the extremity.
- Bonding – all equipment to be bonded together, min R = 0.05 ohms.
- Static Discharger – provide the resistance path to the atmosphere.

There are also worries about suspected electromagnetic interference with aircraft systems. It was reported many aviation incidents connected, for example:

- June 07, 1997. B737-300: *Verify position* was indicated on the CDU. Both the IRS and radio position was correct. The flight management system (FMC) position was not. The difference rapidly increased to 8 nautical miles. After switching a GSM in the cabin from STBY to OFF, the FMC updated normally. FMC was correct for the remainder of the flight and on the return flight.

- April 30, 1997. B737-400: During the level cruise, the AP pitched up and down with ROC/ROD of 400 fpm indicated. Another AP has selected no change. The cabin was checked for PC's and other electronic devices: nothing was found. Requested passengers to verify that their mobile phone (GSM) was switched OFF. Soon after this request, all pitch oscillations stopped.

Therefore, it can be easily seen that EMI affect not only maintenance staff but also all aviation systems and can lead to aviation incidents and accidents.

### 5.3. The impact of EMI from avionics the environment

Today, the new age avionic system is equipped with tons of micro and microcomputers, electro- and radio devices. Without them, it is no longer possible to imagine the modern aircraft, moreover the cockpit.

One of the most harmful computer hardware for the human body is the displays and generators of clock frequencies of processors and co-processors.

Displays, designed based on cathode ray tubes, are the sources of electrostatic field, soft X-ray, ultraviolet, and infrared and visible frequency spectrum and form high-frequency electromagnetic radiation (EMR) due to the high charged-particle accelerators.

The influence of the EMR complex or its species on the occurrence of various diseases began to be studied from the moment of their use. At the end of the 1950s, the first norms limiting radio frequency influence were introduced in the USSR. In the late 60s, Soviet scientists found the influence of electromagnetic fields, even feeble, on the human nervous system. In the 70s, this problem became the subject of broad discussions and studies, which are relevant by these days.

The sources of EMC are power supply (frequency 50 Hz), linear scan system (2-400 kHz), and cursor beam modulation unit (5-10 MHz).

It was found that low frequency radiation, in the first place, negatively affects the central nervous system, causing headaches, dizziness, nausea, depression, insomnia, lack of appetite, the emergence of stress syndrome, and the nervous system responds even to short duration effects relative to the weak

Frequency fields: changes in the hormonal state of the body, broken biocrasses of the brain. All this is reflected in the learning and memorizing processes.

The low-frequency electromagnetic field can cause skin diseases (acne, eczema, pink lichen, and other), diseases of the cardiovascular system and the intestinal-gastrointestinal tract; it affects the white blood cells, which leads to the appearance of tumours, including malignant [3].

Noting that a flight crewmember may have exceeded that limit before confirmation of pregnancy, operators should have effective provisions in place to ensure that the flight crewmember does not exceed a dose of radiation after declaration of pregnancy.

The standards for video display terminals in the cockpit are as follows:

— to ensure protection and achieve normalized levels of computer radiation, it is necessary to use preshrink filters and other protective equipment that has been tested in accredited laboratories and have an annual hygienic certificate;

— the screen should be located at an optimum distance from the pilot's eyes, taking into account the size of the letters and digits and symbols - 600 – 700 mm.- place the keyboard on the table surface at a distance of 100 - 300 mm from the edge closer to the user;

- when performing the main work, the noise level in the cockpit should not exceed 50 dB [4].

The basis of such considerations lies in the fact that laptops use screens based on liquid crystals that do not generate harmful radio frequencies, typical of ordinary monitors with an electron-beam tube.

However, the results of research conducted in research centres showed that the electromagnetic radiation of notebook computers far exceeds the environmental standards due to the peculiarities of the formation of an electrostatic field for the organization of the required level for the polarization of liquid crystals. The frequency of clock generators reaches tens and hundreds of MHz, which also generates a hazardous EMR.

### 5.4. Methods of protection against electromagnetic radiation

If the characteristics of the EMR exceed the requirements of normative acts, different means and methods of flight crewmembers protection are used.

The following methods of protection against EMR were the most widespread:

1. Reducing radiation power in the source. Reducing the radiation parameters directly in the source itself is achieved by the rational choice of the generator, the use of coordinated loads and special devices – absorbents of power (equivalent to the antenna and load). The latter is used as generator loads instead of open emitters. Power absorbents are coaxial and wave guidelines, partly filled with absorbent materials.

2. Distance protection system unit and monitor should be as far away as possible from the user. If it is impossible to reduce the intensity of irradiation by these methods, use protection distance and its increase. Distance protection is provided by the mechanization and automation of production processes, the use of remote control and special manipulators, and the rational placement of equipment in the workplace.

3. Screening of radiation sources and workplaces. Screening is one of the most effective and most frequently used protective devices from the EMR.

4. Use of a liquid crystal monitor, since its optical radiation, is much smaller than other types of monitors. This option is also widely used on-board of modern aircraft.

5. To protect against radiation and health, it takes much time to spend in the fresh air and to protect from a sedentary seat behind the computer you need to interrupt the work for physical exercises and rest for the eyes.

6. It is also necessary to take care of the eyes, for example, to use glasses with appropriate light filters [3].

### 5.5. Conclusion

Electromagnetic pollution of the environment is one of the most pressing problems of humanity in our time.

Widespread use of a variety of electrical appliances, including personal computers, aircraft systems, leads to an unceasing increase in electromagnetic background. It has already been proved that the action of electromagnetic waves on a human body has a disastrous nature.

EMI can cause avionic equipment performance to degrade or even malfunction. EMI can affect cockpit radios and radar signals, interfering with communication between pilot and control tower. Airborne devices that can cause interference include laptop computers, electronic games, cell phones, and electronic toys, and all have been suspected of causing events such as autopilot disconnection, erratic flight deck indications, and airplanes turning off course.

EMI effects from lightning, solar flares, electrostatic discharge, and HIRF from radar and various kinds of transmitters or communications equipment – have all resulted in numerous aviation incidents throughout the years. As a result, EMI effects are now considered in all aspects of avionics design and certification.

Generators of electromagnetic interference to an aircraft can come from several sources, for example:

- Transmitters of radio frequencies that may be installed on the aircraft itself, such as high-frequency (HF) or VHF communication links, or high-energy sources located on the ground such as our everyday frequency modulated (FM) radio or HF-VHF-UHF broadcast HIRF;
- The aircraft power line 400-Hz electric and magnetic fields;
- The computer and avionics microprocessor timing and control clock signal circuits that generate radio frequencies of one MHz or higher;
- The aircraft power switching regulators which are used to convert from one level of power to another;
- Electrical switching transients sparked by the turn on and off of aircraft lights, fans, and engines or by the operation of control surfaces, ailerons slats, and flaps ;
- Electrostatic discharges including lightning.

The conductive paths of electrical wiring provide an avenue to usher electromagnetic interference directly to airplane avionics and signal inputs. Eliminate wiring, and electromagnetic interference almost vanishes. Wiring is the most important factor in electromagnetic interference and electromagnetic compatibility.

In order to prevent or reduce the negative impact of EMI, workers must comply with the norms of electromagnetic radiation and the peculiarities of working with it. It is also worth to make sure of compliance with sanitary standards for electronics and high-tech optical technology.

Since electromagnetic radiation on the aircraft at least meets international norms and standards, but has a negative impact on human health, it therefore needs to take recommended measures to protect against EMF in the radio frequency range and optical range.

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# CONCLUSIONS

The negative impact of pandemic crisis on the entire aviation industry has forced airlines and airports to significantly curtail their operations due to depleted travel demand and restrictions imposed by governments. This situation became difficult for airport operators when airlines were forced to maintain their fleet for long periods of time. To meet airline storage requirements, airport operators have had to prepare plans in collaboration with key stakeholders to ensure that all major issues are addressed while maintaining flight safety.

To respond to the situation, airline and airport operators, as well as aircraft manufacturers, have taken various measures, from placing landed aircraft in designated parking areas to scheduling intensive maintenance to ensure the safety and airworthiness of aircraft through compliance with standards and requirements. In addition, appropriate precautions must be taken to ensure

Used Books operability as aircraft and associated equipment are static for long periods. continued-term storage of aircraft can become a serious problem for airlines if they are not able to manage and maintain it properly.

In addition to the above, the maintenance group of the airline plays a key role in the maintenance of aircraft on the ground. They must have a precise schedule, including preparations for when the aircraft will need to fly again. The engine, interior and exterior of the cabin, on-board radio-electronic equipment, wheels are critical assets that airlines should pay more attention to. For this, as a best practice, airlines can always refer to the Aircraft Maintenance Manual provided by the manufacturer.

Similarly, the airport operator needs to pay more attention to ensuring the safe condition of the road surface, the suitability of aircraft for operation, and the deployment of airline line maintenance crews to carry out the necessary scheduled maintenance of aircraft on the ground. In addition, the airport operator must provide access to and maintain existing and new stands to avoid any delays that may affect the performance of aircraft.

Ultimately, airports and airlines are encouraged to always ensure safety as a top priority in accordance with the recommendations of ICAO,EASA and aircraft manufacturers. All key brokers must ensure and understand the current operating environment as vital to the long-term sustainability of the aviation industry.

The problem of continued-term airplane conservation is related to other issues, such as, for example, long-term static loads of airfield surfaces, which can be the subject of further research.

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