

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

National Aviation University

**MAINTENANCE AND REPAIR OF AIRCRAFT AND
AIRCRAFT ENGINES**

Guidelines

**to perform and execute the qualifying work applicants for higher
education educational degree "Master"
graduates of specialty 272 "Aviation Transport", educational and
professional program "Maintenance and Repair of Aircraft and
Aircraft Engines"**

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Methodical recommendations for the implementation and design of the qualifying work are given. For students of specialty 272 "Aviation Transport", educational and professional program "Maintenance and Repair of Aircraft and Aircraft Engines".

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ENTRY

The purpose of the methodological recommendations is to systematize the main provisions of the Ministry of Education and Science of Ukraine, state, interstate standards and provisions of the National Aviation University on the design of qualifying work (QW).

Guidelines consist of three sections. The first sets out the general provisions: the purpose and objectives of the QW, recommendations for the implementation of the QW. As an example, thematic directions of QW and directions of scientific research, which at the Aircraft Continuing Airworthiness Department are proposed, as well as the topics of QW of the following departments of the Aerospace Faculty.

- aircraft designs;
- aircraft engines.

In addition, a typical structure and volume of the explanatory note of the QW is presented.

The second section provides methodological recommendations for the design of QW in accordance with the requirements of the state standard ДСТУ 3008:2015 "Reports in the field of science and technology. Structure and rules of registration", ДСТУ 1.5: 2015 "Rules for the development, teaching and design of national normative documents", "Regulations on diploma works (projects) of graduates of the National Aviation University" approved by the order of the acting rector № 594 / od of 14.12.17 and other normative documents, standards related to higher education.

The third section summarizes recommendations for preliminary protection of QW. Guidelines are intended for:

- students (students) - graduates of full-time, part-time and distance learning and second higher education, who will defend the QW in the Examination Commission (EC) of the Aerospace Faculty NAU;
- teachers of the departments that manage the QW of Aerospace Faculty graduates, the Educational and Scientific Institute of Continuing Education and the Educational and Scientific Institute of Innovative Educational Technologies of NAU;
- specialists and heads of organizations and enterprises involved in EC during the defense of QW by graduates.

Execution (registration) and defense of QW is carried out in the state language, with the exception of foreign students who carry out registration and defense in Russian. Graduate students of the English-

language project draw up and defend QW in English.

It should be noted that all accompanying documents (certificate of success, feedback from the head, review) are drawn up in all three of these cases exclusively in the state language.

1. MAIN PROVISIONS

The implementation and defense of QW is the final stage of a student's training at a higher education institution. When performing it, the student must show the ability to systematize and creatively use scientific, general technical and special knowledge, practical skills obtained during the period of study at the university, gaining experience in presenting and publicly defending the results of research.

The main goal and main tasks for the implementation of QW are given in [1].

In the process of performing the QW, the student must show his professional maturity and show readiness for independent decision-making in scientific, pedagogical or managerial activities.

The main provisions on the organization of the implementation of the QW, the responsibility of the student-graduate, scientific supervisor and graduating department, general methodological recommendations for the implementation, design, procedure for protection and assignment of an educational degree by the decision of the EC are given in the "Regulations on diploma works (projects) of graduates of the National Aviation University" approved by the order of the acting rector № 594 / od of 14.12.17.

1.1 Theme of qualifying work

The main requirements to the topic of QW are its relevance for civil aviation and compliance with the requirements of the educational degree "Master" in specialty 272 "Aviation Transport", educational and professional program "Maintenance and Repair of Aircraft and Aircraft Engines".

The main grounds for the formation of the topic by the student are the directions of scientific activity of the department and the existing thematic areas. Thematic directions of QW are formed at the departments, considered at meetings of the department and approved by the Academic Council of the Aerospace Faculty.

In the process of work, they can be specified according to the statements of aviation enterprises.

Recommended thematic areas for graduates in the departments of

aerospace faculty:

– *Aircraft Continuing Airworthiness Department:*

- 1) ensuring or maintaining the reliability of aviation equipment;
- 2) efficiency of maintenance processes of aircraft and aircraft engines;
- 3) technical diagnostics of the aircraft and its components;
- 4) maintaining the airworthiness of the aircraft;
- 5) information support of aircraft maintenance processes and its components;
- 6) material and technical support of maintenance of aircraft and its components;
- 7) human factor in maintenance of aircraft;
- 8) international and state regulation of airworthiness of aircraft;
- 9) international and state regulation of objects of aviation activity (developer, manufacturer, operator, maintenance organization, aircraft instance, organization for training personnel on maintenance of aircraft and its components);
- 10) certification of aircraft and its components at different stages of its airworthiness;
- 11) lubricating ability of plastic and solid aviation lubricants;
- 12) increasing the life of aircraft components by modifying lubricants;
- 13) resistance of materials and coatings in conditions of fretting corrosion.
- 14) innovative coatings for surface hardening and restoration of aircraft parts;
- 15) resource of materials in non-stationary working conditions;
- 16) improvement of non-destructive testing methods for diagnosing aircraft parts.

– *Department of aircraft design:*

- 1) design and technological solutions aimed at ensuring the principles of "Safe destruction" and "Permissible damage";
- 2) application of numerical modeling technologies in the tasks of optimization of aircraft structures;
- 3) experimental substantiation of the methodology for controlling side effects when applying new methods of protecting structures from corrosion, in particular anticorrosive film-forming compounds;
- 4) scientific substantiation and development of methods for

determining fatigue damage to aircraft structures in the concept of Structural Health Monitoring of aircraft;

5) analysis of trends in improving the flight performance of rotary-winged aircraft;

6) analysis of problems and ways of converting passenger aircraft into cargo aircraft;

7) ensuring cleanliness of hydraulic and fuel systems of aircraft;

8) development and certification of aeroplanes, related products, components and equipment.

– *Department of Aircraft Engines:*

1) research of methods for improving the cooling of turbine blades of high-temperature turbojet bypass engines (turbofan engines);

2) investigation of damage to the supports of rotors of gas turbine engines (GTE) in operation;

3) study of durability and damage of blade alloys GTE under complex thermomechanical load;

4) research of methods for diagnosing the flow part of GTE by thermodynamic parameters;

5) research of methods and means of increasing the fuel efficiency of turbofan engines;

6) research of means of improving the system of monitoring the technical condition of aviation GTE;

7) research of methods for increasing the efficiency of traction fans of highly maneuverable unmanned aerial vehicles;

8) research of methods for improving the directing devices of traction fans of unmanned aerial vehicles;

9) study of the characteristics of materials and technologies for the manufacture of impellers of compressors and turbines of modern GTE;

10) investigation of aeroacoustic characteristics of two-row fan turbofan;

11) study of acoustic characteristics of turbofan engines;

12) study of environmental characteristics of turbofan engines;

13) investigation of aerodynamic characteristics of the axial compressor engine;

14) research of methods for improving the characteristics of the combustion chamber of turbofan engines;

15) investigation of characteristics of the automatic control system of turbofan engines using methods of mathematical modeling;

- 16) investigation of means for improving the reliability characteristics of the elements of the combustion chamber of turbofan engines;
- 17) research of means for improving the technical condition monitoring system of aviation turboshaft GTE;
- 18) study of aeroacoustic characteristics of helicopter power plant;
- 19) research of methods for integrating power plants with lethal vehicles of various types;
- 20) research of methods for improving lubrication systems of aviation turbofan engines.

1.2 Choose a theme

Students are given the right to formulate the topic of QW according to the approved list of thematic areas, as well as applications received from objects of state regulation of aviation activities (developer, manufacturer, operator, maintenance organization, etc.).

The topic of QW is chosen by each student and assigned to him by making a corresponding application at the end of the 1st academic semester of the 1st year.

The student has the right to independently propose the topic of QW according to the scientific work that he performs in the student scientific and technical society. Also, it provides for the possibility of implementing real QW, that is, the development of specific measures (algorithmic, methodological or methodological support) aimed at improving the efficiency of aircraft maintenance processes, in the implementation of which specific aviation enterprises are interested. The topics of such QW must be coordinated with the aviation enterprise where the student works or undergoes research and pre-diploma practice.

Assignment of the topic of QW to the student is carried out after filling out the appropriate application form in the prescribed form, coordination with the head of the thesis, approval by the head of the department and submission to the dean's office of the aerospace faculty or the directorate of the Educational and Scientific Institute of Continuing Education or the Educational and Scientific Institute of Innovative Technologies.

The topic of the student's QW and the head of the thesis are approved by order of the rector of NAU on the provision of the dean of the aerospace faculty in the case of full-time education of the applicant for higher education.

It is allowed to perform complex QW under the guidance of one or more managers both within the graduating department and at the interdepartmental

level. Comprehensive QW is performed by a group of students, usually by two from the same faculty. At the same time, it is envisaged to develop independent questions of the selected and approved topic. More detailed requirements for complex QW are given in [1].

The scope and content of each student's developments must meet all the requirements for the implementation of the QW. The defense of such QW is carried out in a logical sequence by each student separately according to his completed or composed part of the work. In accordance with the approved topic, the student is given a task to perform the QW, which indicates the name of the topic, technical specifications (initial data), containing the calendar plan for the implementation of the main stages of work.

Due to the fact that the design of the QW software is carried out in accordance with the requirements of the standard [2] and other regulatory documents, there is no cipher, main inscription and frames in the software sections.

1.3. Typical structure and scope of an explanatory note

General characteristics of requirements, scope of QW and content, volume and method of presentation of illustrative material are described in subsections 1.2-1.4 [1]. The number of sections of the QW software is formed by the author independently, but it should be noted that the following separate sections are added to the main sections of the work: "Labor Protection" and "Environmental Protection".

The explanatory note should contain elements of a thorough information analysis of the experience of operation and maintenance of aircraft parts, elements of mathematical modeling of processes (phenomena), there should also be elements of computer modeling or field tests, calculations, descriptions of the developments performed and accompanied by illustrations, graphs, diagrams, diagrams, tables, etc., given in sections and appendices to the work.

The software should not contain text copied from scientific publications, textbooks, instructions, technological instructions and other literature used in the implementation of the QW, but with the obligatory reference to literary sources at times when the information component of the source is borrowed. The explanatory note should reflect the independent work of the graduate, performed by him to achieve the goal in solving the formulated scientific problems.

For example, the structure QW with an approximate volume of each of its sections may look like this:

1. Title page	1 p.
2. Individual assignment for the thesis	2 p.
3. Abstract	1 p.
4. Content	1–3 p.
5. List of abbreviations, symbols, units and terms	1–3 p.
6. Entry	3–5 p.
7. The main content of QW by sections	70–80 pp.
8. Conclusions to the section	1 p.
9. Occupational Safety	8–10 p.
10. Conclusions to the section	1 p.
11. Environmental protection	8–10 p.
12. Conclusions to the section	1 p.
13. General conclusions	2 p.
14. List of bibliographic references of used sources	1–7 p.
15. Applications	necessarily, in the required volume

Requirements for the design of the title page, individual assignment and abstract are given in appendix. A–B of these guidelines. When making QW software, the hyphenation sign is not allowed.

The structural element of the Table of Contents software starts on a new page immediately after the Abstract structural element. The name of the structural elements of the software in the "Table of contents" is identical to the names of these elements in the software itself by sections, subsections, paragraphs and subparagraphs, a sample design of this element is given in appendix.

The structural element of the software "List of abbreviations, symbols, units and terms" is compiled on a separate sheet in alphabetical order (Appendix K), placed after the content. The name of this structural element is determined by the author of the work in accordance with what exactly is given in the list.

The structural element of the software "Introduction" should contain motivation for choosing a topic, justifying its relevance, linking the topic of work with the prospects for the development of target audience, problems of aircraft maintenance processes and issues of ensuring or maintaining airworthiness of the aircraft and its components; formulates the purpose and specific scientific tasks that are implemented in the decisions of the QW, the

object and subject of research, research methods, scientific novelty, reliability and practical significance of the results obtained in conducting scientific research, data on approbation of the results of scientific research, which are reflected and set forth in the QW with the presentation of the number of publications with the obligatory explanation of the personal contribution of the author of the QW.

It should be noted that the author of the QW, together with the review, feedback from the head and certificate of success, provides copies of all published scientific works (title page of the collection, table of contents, the article itself and editorial page).

In QW, the introduction can take up to 5 pages.

General characteristics of the requirements, scope and content of the main sections with the results of scientific research in the QW are described in subsections 1.2-1.4 [1]. The number of main sections of the QW software is individual.

The content of the sections "Labor Protection", "Environmental Protection" is determined by the requirements set forth in the methodological recommendations of the relevant departments, depending on the topic of the QW.

Each section of the software must end with a conclusion placed on a separate sheet. General conclusions in the QW should include:

- general assessment of the state of development (research) taking into account the scientific task;
- results of qualitative and quantitative assessments of the process of modeling a process or phenomenon, system);
- results of solving scientific problems;
- scientific and practical significance;
- degree of influence on the level of safety;
- compliance with the requirements of labor protection and environmental protection.

The structural element "General conclusions" is placed after all sections of the QW software, starting with a new page according to the requirements [2].

The general conclusions state the most important scientific and practical results of the work and give:

- evaluation of the results obtained and their compliance with the modern level of scientific and technical knowledge;
- degree of implementation and possible areas of use of work results;

- information on the creation of new equipment, devices, etc. and the development of methods for their measurements;
- scientific, scientific and technical, socio-economic significance of the work;
- expediency of continuing research on relevant topics, etc.

The text of the conclusions can be divided into paragraphs.

The structural element of the QW software "List of bibliographic references of used sources" should consist of the main scientific, scientific-technical and normative literature on the topic of QW, as well as additional literary sources of a reference, informational and methodological nature, as well as Internet resources used in conducting scientific research.

The list of bibliographic references of the sources used, which are referenced in the software sections, is given from the next page according to the structural element "General conclusions" before the appendices [2].

In the list of references, references are given in the order in which sources are first mentioned in the text. The serial numbers of bibliographic descriptions in the list of sources should correspond to references to them in the text of the software (numbered references) [2].

Bibliographic descriptions of sources in the list are given according to the requirements given in [3-6].

Sources referenced only in the appendix are given in a separate list, which is placed at the end of this appendix.

2. THE MAIN PROVISIONS FOR THE DESIGN OF THE EXPLANATORY NOTE

2.1 Software rules

The main provisions establish the form, size, placement and procedure for filling out the main documents in the QW and fully comply with the requirements of current standards for the design of scientific reports [1, 2, 7].

The explanatory note is drawn up on sheets of white paper of certain sizes or sizes. Font – Times New Roman – 14 pt.

State standard ДСТУ 3008: 2015 "Reports in the field of science and technology. Structure and rules of registration" establishes the following formats that can be used during the registration of software and other related documents: A3 = 420×297 mm ; A4 = 210×297 mm ± 2,0 mm ± 2,0 mm

Within the framework of the QW, it is permissible to perform and submit to the protection of illustrative material the following formats:

A1 = 841×594 mm ;

A2 = 420×594 mm ;±3,0 MM±2,0 MM

There is no frame of the working field of the document everywhere on the software page, and there is no hyphenation sign.

It is recommended to use of the following width on the pages: top and bottom - not less than 20 mm, left - not less than 25 mm, right - not less than 10 mm. The paragraph indentation must be the same throughout the text of the software and equal to five characters, or - 12,5 mm. Line spacing is 1.5.

When designing the work, uniform saturation, contrast and clarity of the image shall be observed. All lines, letters, numbers and signs must be clear and vague throughout the software.

If it is necessary during the defense to demonstrate graphic material on paper of the appropriate format (kinematic scheme, structural units or structural elements of the research stand), the design of this material should be carried out according to the current standards of the Unified System of Design Documentation. Examples of encryption of the main inscription of the drawing or diagram should be performed according to the recommendations set forth in [8].

2.2. General rules

Typically, the work consists of text, illustrations, tables or a combination thereof.

Illustrations can be fragments of diagrams, graphics, photographs, etc.

Some information is provided in the form of formulas.

General requirements for software design are given in [1, 2, 7]. It is allowed to bold the names of the structural elements of the software, sections, subsections, paragraphs and subparagraphs.

Symbols in equations and formulas, inscriptions and explanatory data in figures, diagrams, graphs, diagrams and tables are created and entered into the text using appropriate computer program editors.

When designing the software, it is allowed to use illustrative material made in Microsoft Office Excel, Matlab, MathCAD, KOMPAS, AutoCAD and other mathematical and graphical application packages.

Only in the review section, as a rule, this is the first section of the QW, it is allowed to use scanned and clearly edited materials.

It is allowed to abbreviate words and phrases in the text of the work, except for headings, in accordance with spelling norms and ДСТУ 3582.

It is not allowed:

- Leave a heading without text on the previous page.

- Leave line from paragraph without next line at the end of page.

In the presence of errors and graphic inaccuracies detected during the execution of the work, it is allowed to correct by erasing or painting over with a white corrector and applying the corrected text (graphics) in the same place in black ink, paste or ink in a handwritten way. Damage to software text sheets, blots and remnants of not completely removed former text (graphics) are not allowed.

Sections must have serial numbers within the work, indicated by Arabic numerals without a period and written from a paragraph. Subsections must be numbered within each section. The subsection number consists of section and subsection numbers, between which a dot is placed. There is no dot at the end of the unit number.

Sections, like subsections, can consist of one or more paragraphs.

Examples

1 First section heading

1.1 Heading of the first subsection of the first section

1.1.1 Heading the first paragraph of the first subsection of the first section

1.1.1.1 Heading of the first subparagraph of the first paragraph of the first subsection of the first subsection

If the document does not have subsections, then the numbering of paragraphs in it should be within each section, the item number should consist of section and paragraph numbers, between which a dot is placed.

If a section or subsection consists of one paragraph, it is also numbered. If the text of the document is divided only into paragraphs, they are numbered by serial numbers within the document.

Structural elements: "Abstract", "Table of contents", "List of abbreviations, symbols, units and terms", "Introduction", "General conclusions", "List of reference sources" are not numbered, and their names are headings of structural elements.

Within paragraphs or sub-paragraphs enumerations may be given. Each enumeration position should be displayed by a marker, numbering or, if necessary, a reference in the text of the document to one of the enumerations in lowercase letter, followed by a bracket.

For further detailing of the listings, it is necessary to use Arabic numerals, after which a bracket is put, and the entry is made from a paragraph.

Examples

- a) —
- b) —
 - 1) _____
 - 2) _____
- c) —

For sections and subsections, the presence of a header is required. Paragraphs and subparagraphs can have headings.

Headings of software structural elements and section headings shall be printed in capital letters in bold without a dot at the end. It is allowed to place them in the middle of the line (symmetrically text).

Headings of subsections, paragraphs and subparagraphs of the work shall be printed with a capital letter without a dot at the end.

Paragraph indentation must be the same throughout the text of the work and equal to five characters, or – 1,25 cm

If the title consists of several sentences, they are separated by a period. Breaking words with a hyphen in headings is prohibited.

The distance between the title, note, example and subsequent or previous text must be at least two line spacing.

The distance between the bases of the header lines, as well as between the two headings, is assumed to be the same as in the software text.

It is forbidden to place the name of a section, subsection, as well as a paragraph and subparagraph on the last line of the page.

Each chapter begins with a new page.

The work pages are numbered continuously in Arabic numerals (font identical to the work font), covering applications.

The page number is put to the right in the upper corner of the page without a dot at the end. Page numbering begins with the structural element "Abstract", while taking into account the pages of the title page and the individual task with the abstract.

The pages on which figures and tables are placed shall be covered by the general pagination of the work.

The title page is the title page of the document (its cover), its structural elements meet the requirements specified in the works [1, 2, 7]. An example of the design of the title page is given in appendix A.

In the individual task, indicate the topic of the QW, the initial data for the work, the list of tasks to be solved, the list of illustrative material that must be presented based on the results of research. A schedule of work on the stages of research is formed and recorded by the signatures

of consultants from individual sections of the software, the applicant and the head of the QW (Appendix B).

After the last sheet of the individual task, such a structural element of the software as the "Abstract" is drawn up, an example of which is given in appendix. A. The name of this structural element is printed in capital letters symmetrically to the text.

The abstract should contain:

- information about the volume of software, the number of figures, tables, applications, sources according to the list of references;
- list of keywords;
- brief description of the software text.

The description of the work text in the abstract shall reflect the information provided in the work in the following sequence:

- object of study;
- purpose of the work;
- subject of research;
- research methods and a possible list of equipment;
- results and their novelty;
- implementation information;
- recommendations for the use of work results;
- scope of application;
- practical significance of the work;

If some of the above information in this list is missing, all other information is provided while maintaining the sequence of presentation.

The list of keywords that are decisive for disclosing the essence of the software should contain 5-15 words (phrases). It is recommended to submit them before the text of the abstract in capital letters in a line with direct word order in the nominative case singular, arranged alphabetically in the software language alphabet and separated by commas.

The abstract is recommended to be submitted on one page of A4 format.

The structural element of the Table of Contents software is printed from the next page immediately after the abstract. The name of this structural element is printed in capital letters symmetrically to the text.

The structural element of the software "Contents" contains the following structural elements: "List of abbreviations, symbols, units and terms", "Introduction", sequentially list the names of all sections, subsections and paragraphs (if they have a name) of the content of the software, "General conclusions", "List of bibliographic references of

sources used", "Appendices" with their name and indication of the page number of the beginning of the structural element. The name of these structural elements is printed in capital letters symmetrically to the text.

It is not recommended to break words with a hyphen in the "Table of Contents".

An example of the design of the element "Table of contents" is given in appendix.

The next structural element of the work is the "List of abbreviations, symbols, units and terms".

The main requirements for the content of this element are given in subsection. 1.3, a sample of design is provided in appendix.

The next structural element of the work is the "Introduction".

The text should be brief and highlight the relevance and current level of research and purpose of the QW (see subsection 1.3).

It is allowed to begin to use abbreviations of words or phrases in the text, but it is recommended to use generally accepted abbreviations.

The main (content) part of the QW contains all the necessary developments and justifications of decisions, which are accompanied by appropriate calculations based on the results of mathematical, computer modeling (including using computers), illustrations, references to literary sources, results of their own experimental and theoretical research.

The structural elements of the main part are sections, subsections, paragraphs, subparagraphs, lists and notes.

It is allowed to place text between the headings of the section and subsection, between the headings of the subsection and paragraph.

The phrase "Conclusions to Part 4", for example, is printed with a capital letter, the next ones are lowercase from a paragraph of a new page in bold.

Reference in the text to sections is performed in the form: "... is given in section 3".

When performing certain sections of the QW software, the phrases "Labor Protection" and "Environmental Protection" are printed from a new page. The name of these structural elements is printed in capital letters symmetrically to the text.

These sections of the software also end with conclusions to the section, which are drawn up identically to the conclusions on the main sections of the software.

The structural element of the software "General conclusions" is

drawn up from a new numbered page, starting in capital letters symmetrically to the text. The substantive part of this element is given in subsection. 1.3.

The next structural element of the software is – "List of bibliographic references of references", the title of this section is made according to the recommendations [3-6].

The next structural element of the work is the "Applications".

In order to avoid overloading the presentation of the text of the main part of the work, the structural element "Appendices" contains information that complements or visualizes the results of research in the sections of the main part of the QW, which:

- are necessary for completeness of the software, but incorporating them into the core of the QW software can change the orderly and logical idea of the work;
- cannot be sequentially placed in the main part of the work due to the large volume or methods of reproduction;
- are necessary only for specialists in a specific thematic area of research.

Applications shall be placed in the order of reference to them in the text of the work.

Applications may contain:

- auxiliary figures and tables;
- documents relating to the conducted studies or their results, which, due to the large volume, specifics of presentation or form of submission, cannot be included in the main part of the software (photos; intermediate calculations, formulas, mathematical proofs; list of measuring instruments that were used during the research; test reports; conclusion of metrological examination; copy of the terms of reference or replacement document; instructions and techniques, developed in the course of work, etc.);
- description of new equipment, devices that were used during research, measurements, tests, etc.;
- an additional list of sources that were not referenced in the software, but to which users of the software may be interested;
- other information.

The appendices to the software, which include patent research, include a report on patent research, drawn up in accordance with ДСТУ 3575, and a bibliographic list of publications and patent

documents developed in the course of work, drawn up in accordance with ДСТУ ГОСТ 7.1.

2.3 Rules for writing the text of the explanatory note

When designing the text, the following rules should be observed:

- the text must be covered concisely;
- When covering mandatory materials in the text, the words "shall", "necessary", "need to", "be decided only", "not allowed", "prohibited", "not worth it" should be used.

When covering other provisions, words such as "may be", "as a rule", "if necessary", "possible", "in case", etc. should be used.

In this case, you can use the narrative form of presentation of the text of the document, for example, "apply", "indicate", etc.

The text of the shall use scientific and technical terms, designations and definitions established by the relevant standards, and in their absence – generally accepted in the scientific and technical literature.

If specific terminology is used in the text, the beginning of the explanatory note (immediately after the "Table of Contents") shall contain a list of accepted terms with appropriate explanations.

The list of accepted terms is included in the content of the work.

In the text of the QW it is not allowed:

- use of conversational style of speech;
- application for the same concept of different scientific and technical terms, similar in meaning (synonyms), as well as words and terms of foreign origin in the presence of equivalent words and terms in the Ukrainian language;

- the use of arbitrary phrases;
- the use of abbreviations of words, except for those established by the rules of Ukrainian or English orthography, the relevant state standards;
- abbreviation of the designation of units of physical quantities, if they are used without numbers, with the exception of units of physical quantities in the heads and sidewalls of tables, in decoding letter designations that are part of formulas and figures.

In the text of the work, except for formulas, tables and figures, the following shall not be allowed:

- the use of a mathematical minus sign (-) before negative values of quantities (the word "minus" should be written);
- the use of the sign "Ø" to indicate the diameter (the word

"diameter" should be written). Indicating the size or maximum deviations of the diameter on the drawings placed in the text of the document, the sign "∅" should be written before the dimensional number «∅»

- the use of nonnumeric values of mathematical signs, such as > (greater), < (less), = (equals), (greater than or equal to), (less than or equal to), (not equal), and signs No (number), % (percent), and °C degrees Celsius;
- use the unit sign of a physical quantity without giving its numerical value; if necessary, this unit is given in full words, and not conditional;

- application of indices, standards, specifications and other documents without a registration number.

The index and standard number should be placed on the same line.

If the text uses explanation inscriptions that are applied directly to the manufactured product (for example, on strips, plates to controls, etc.), they are highlighted in font (without quotes), for example, ON, OFF, or quotation marks, if the inscription consists of numbers and (or) characters.

The names of commands, modes, signals in the text should be highlighted in quotation marks and printed in the original language, for example, "Release the chassis".

If a special system of abbreviations of words or names is adopted in the work, it shall contain a list of abbreviations, the location of which is given earlier in the work (section 5).

Symbols, images or signs must comply with current legislation and state standards. In the text of the software, before designating the parameter (at the first mention), its explanation is given, for example, "... specific fuel consumption C_{sfc} ".

Numbers with dimension should be written in numbers, and without dimension – in words (distance – 5 mm, conduct three iterations).

The designation of units should be written in a line with a numerical value without transferring to the next line. Between the last digit of the number and the unit designation, a space should be made (17 MPa).

The designation of values with tolerances is given as follows:

$(70 \pm 2) \%$, $90 \text{ mm} \pm 4$, or $(90 \pm 4) \text{ mm}$, or 90^{+4}_0 mm 90^{+4}_{-10} mm .

Ordinal numerals should be written in numbers with case endings (2nd week, 3rd rib); if several ordinal numbers are indicated, then the case ending is written after the last (3rd, 4th, 5th graph); quantitative numerals are written without case endings (on 20 sheets); do not write endings in dates (October 23) and after Roman numbers (XX century).

If it is necessary to use symbols, images or signs not established by current standards, they should be explained in the text or in the list of accepted abbreviations. For example, "... technical condition monitoring system...(TCMS)".

Standardized units of physical quantities, their names and designations in accordance with ДСТУ ISO 80000-1: 2016 should be used in the text of the software.

Together with the units of the measurement system SI (SI), if necessary, the units of systems that were used earlier shall be indicated in brackets. The use of various systems for designating physical quantities in the QW is not allowed.

In the text of the QW software, numerical values of quantities with the designation of units of physical quantities and units of counting should be indicated by numbers, and numbers without designation of units of physical quantities and units of counting from one to nine should be indicated by words.

Examples

1. Dismantle three engines, each weighing more than 2 tons.
2. Select 10 engineers to test your knowledge of English.

The unit of physical quantity of the same parameter within the same document must be constant. If the text contains a series of numerical values expressed by the same unit of physical quantity, then it is indicated only after the last numerical value, for example, 1.50; 1.75; .2,00 m.

If the software text contains a range of numerical values of a physical quantity expressed by the same physical quantity, then the unit of physical quantity is indicated after each numerical value of the range.

Examples

1. From 1 mm to .5 mm
2. From 10 l to 50 l
3. From minus 15 ° C to plus 56 ° C.
4. From 600 K to 850 K.

It is impossible to separate a unit of a physical quantity from a numerical value (transfer it to separate lines or pages), except for units of physical quantities that are placed in tables.

Giving the largest or smallest values of quantities, the phrase "should be no more (not less)" should be used. For example, the mass fraction of sodium carbonate in technical soda ash should be at least 99.4%.

Using permissible values of deviations from the specified norms, requirements, the phrase "should not be more (less)" should be used.

Numerical values of quantities in the text should be indicated with the degree of accuracy that is allowed to ensure the required properties of the product, while the number of decimal places is aligned in a number of quantities.

The rounding of numerical values of quantities to the first, second, third, and so on decimal places for different sizes and the like for products of the same name must be the same.

For example, if the gradation of thickness of hot-rolled steel tape, then the entire row of tape thickness should be specified with the same number of decimal places, e.g. 1.50; 1,75; 2,00.0,25 MM

If it is impossible to express a numerical value as a decimal fraction, then it is allowed to write as a simple fraction in one line through a slash, for example, 3/4.

In work it is forbidden:

- apply professional dialectisms and expressions (technicisms);
- after the name of the month, write the word "month" (not "in the month of October", but "in October");
- use the phrases: "this year", "last year", you should write a specific date "in June 2009";
- use the designation of units of physical quantities without numbers, it is necessary to write in full: "Number of kilograms" (except for the design of tables and formulas);
- connect the text with the symbol of physical quantities using mathematical signs (not "speed = 125 km / h", but "speed is equal to 125 km / h", not "temperature is equal to -25 ° C", but "temperature is equal to minus 25 °C");
- use mathematical signs <, >, °, №, %, sin, cos, tg, log, etc. without numeric or alphabetic designations. The text should be written with the words "zero", "number", "logarithm", etc.

If two or three measurements should be specified, they are presented as follows: 95 mm × 30 mm × 50 mm, and not 95 × 30 × 50.

2.4 Design of formulas and equations

In formulas and equations, the designations established by the relevant state standards, for example, ДСТУ IEC 60027-1: 2017, should be used as symbols.

Each formula or equation is written from a new line, immediately after the text in which they are mentioned, symmetrically to the text. One line is skipped between the formula, equation and text.

Explanations of symbols and numerical coefficients included in the formula, equations, if they are not disclosed in advance in the text, should be given directly under the formula, equation.

To do this, after the formula or equation, put a comma and write down explanations for each symbol from a new line in the sequence in which they are given in the formula or equation, separated by semicolons. The first line of explanation should begin with the word "where" without a paragraph and without a colon after it.

Explanations of each symbol should be given from a new line in the sequence in which the symbols are given in the formula or equation. The unit of measurement, if necessary, is written in square brackets.

For example, the density of each sample ρ is calculated by the formula:

$$\rho = \frac{m}{V} [\text{кг/м}^3], \quad (1)$$

where m – sample mass, kg;

V – sample volume, м^3 .

It is also allowed to write the above formula as

$$\rho = m/V.$$

Numerical substitution and calculation are performed from a new line, without numbering. The unit of measurement is written in parentheses. For example

$$\rho = \frac{30}{2,3} = 13,04 (\text{кг/м}^3).$$

Recommended parameters for typing formulas in MS Equation: normal – 12 pt, large index – 10 pt, small index – 8 pt, large symbol – 16 pt, small symbol – 12 pt, style – bold italics font, text – Times New Roman, function – Times New Roman, variable – Times New Roman, small Greek – Symbol, large Greek – Symbol, symbol – Symbol, matrix – Times New Roman, numbers – Times New Roman.

It should be noted that the elements of formulas typed in Cyrillic are indicated by regular font, Greek – straight, Latin – italics.

It is not allowed:

- use in a set of formulas of graphic objects, frames, symbols;
- Use * instead of \times or \bullet .

The formula is a member of the sentence, so the same rules of grammar are applied to it as to other members of the sentence. If the formula is at the end of the sentence, then put a full stop after it. Formulas are arranged one after the other and are not separated by text, separated by a comma.

Formulas can be transferred to the next line only on the characters of the operations performed, and the sign at the beginning of the next line is repeated. When transferring a formula on a multiplication sign, use the \times sign, subtract $--$, addition $-+$. Hyphenation on the \div sign should be avoided.

Formulas are numbered within the section in Arabic numerals, but only those referenced in the text. The formula number consists of the chapter number and the sequence number of the formula in the section, separated by a dot.

It is allowed to perform numbering throughout the document. References in the text to the sequence numbers of formulas are given in parentheses, for example, "... in formula (1)", "in formulas (1.1)–(1.4)...". References to the formulas given above are indicated with the abbreviated word "look" (see formula (1)).

In multi-line formulas or equations, their number is put down at the level of the last line. The design of chemical formulas and equations is given in ДСТУ 3008: 2015.

In formulas or equations, superscripts, as well as exponents, in the entire text software must be the same size, but smaller than the letter or symbol to which they refer.

Several formulas or equations given and not separated by text are written one under the other and separated by commas.

Formulas arranged in appendices are numbered separately in Arabic numerals within each application with the addition of an application designation before each digit, for example, formula (B.1), which means the first formula of Annex B.

The order of inducing mathematical equations in documents is the same as the formulas.

2.5. Design of illustrative material.

To explain the material presented in the software, it is recommended to illustrate it with graphics, diagrams, drawings, fragments of diagrams, etc., which can be performed with computer graphics.

Place illustrations in text or applications.

In the text, the illustration is placed symmetrically to the text after the first reference to it or on the next page, if it does not fit on this one without rotation. The number of illustrations should be sufficient to explain the text presented. Illustrations can be located both in the text of the document (as close as possible to the relevant parts of the text), and at the end of it. Illustrations must be made in accordance with the requirements of ДСТУ 1.5: 2015. Illustrations, With the exception of application illustrations, it should be numbered in Arabic numerals through numbering. If there is only one figure, then it is indicated by "Figure 1".

Illustrations of each application are indicated by separate numbering in Arabic numerals with the addition of the designation of the application before the number. For example, Figure A.3.

It is allowed to number illustrations within the section. In this case, the illustration number consists of the chapter number and the sequence number of the illustration, separated by a period.

For example, Figure 1.1.

All illustrations in the text of the QW must be referenced.

When referring to illustrations, you should write "... According to Figure 1" with continuous numbering and "... According to Figure 1.1" when numbering within a section or in brackets according to the text (Figure 1.1), on part of the illustration: "... shown in Figure 1.1, b". References to the previously given illustrations are given with the abbreviated word "look" (see Figure 1.1).

One line is skipped between the illustration and the text.

Illustrations, if necessary, may have names and explanations (figure text).

If necessary, explanatory data (figure text) to the figure are submitted immediately after the graphic material before the title of the figure.

The word "Figure" and the name are placed after these explanations symmetrically to the text like this: "Figure 1 – Units of the hydraulic system", the dot at the end is not put, the hyphenation sign is not used.

If the name of the picture is long, then it is continued in the next line, starting from the name or written taking into account the numbering in the section "Figure 1.1 – Fuel system units".

If the illustration consists of parts, they are indicated by lowercase letters of the Ukrainian alphabet with a bracket a), b) under the relevant part. In this case, after the name of the illustration, put a colon and write down the name of each part in the form:

a) – name of the first part;

b) – the name of the second part, or in the course of naming the illustration, taking the letters in brackets "Figure 1.2 – Throttle characteristic a) compressor characteristic b) engine".

If parts of the illustration do not fit on one page, they are transferred to the next. In this case, the title of the figure is indicated only on the first page, explanatory data – and those pages to which they relate and below them are printed: "Figure ___ sheet _____".

If the text of the document contains an illustration depicting the components of the product, then it should indicate the position numbers of these components within this illustration, which are arranged in ascending order, except for repeating positions.

If necessary, it is allowed to store the number of the component part of the product in the illustration within the document.

If the illustration is a fragment of the complete developed scheme, then for all components indicate those positional designations that are indicated on the diagram.

If the illustrations are photographs, the latter should be pasted on standard sheets of white paper and marked as drawings.

2.6. Making notes

Notes are provided in documents if explanations or reference data are required to the content of the text, tables or graphic material.

Notes should not contain requirements.

Notes should be placed directly after text, graphic material or in tables to which these notes belong, and printed with a capital letter from a paragraph. If there is only one note, then after the word "Note" a dash is put and the note is also printed with a capital letter. One note is not numbered. Several notes are numbered in order of arrangement in Arabic numerals. A table note is placed at the end of the table above the line indicating the end of the table.

Examples

Note. _____

Notes
1 _____
2 _____

Times New Roman font is used within the QW software, size – 12 pt and single line spacing.

2.7. Link design

References to standards, specifications and other documents may be permitted in the QW, provided that they fully and unambiguously define the relevant requirements and do not cause difficulties in the use of the work.

In case of reference to structural elements of the software itself, the numbers of sections, subsections, paragraphs, subparagraphs, positions of lists, figures, formulas, equations, tables, appendices shall be indicated accordingly.

When referring, the following expressions should be used: "in section 3", "see. 2.4.1", "according to 1.5.2", "(Figure 1.2)", "according to table 2", "according to the formula (4.1)", "in equations (1.12) – (1.14)", "(Appendix B)".

It is allowed to use generally accepted and standardized abbreviations in references according to ДСТУ 3582, for example: "according to Fig. 1.2", "see. Table. 2" etc.

Reference to the source used is made after the first mention in square brackets with the number, according to the serial number in the bibliography, for example: "... necessary for their effective operation [16]...", "In works [3] – [7]".

2.8. Building tables

Tables are used for better clarity and convenience of comparing indicators. In software, it is allowed to use a font size of 12 pt.

The table is placed symmetrically to the text after the first link on this page or on the next, if it does not fit on this page, and so that it is convenient to consider it without rotation or with a rotation of 90 degrees clockwise.

All tables should be referenced in the form: "shown in Table 1.1..."; "... in tables 1.1 – 1.5..." or in brackets in the text (table 1.6). References to the table above are given with the word "look" (see Table 1.4) along or at the end of the sentence.

The name of the table, if available, should reflect its contents, be accurate, short. The title should be placed above the table, on the left. Tables are numbered within sections and marked to the left above the table with the form: "Table 1.2 – Table name". Do not put an end to it. If the name of the table is long, then it continues in the next line, starting from the word "Table". When moving part of a table to other pages, the name is indicated only above the original part of the table.

Tables, with the exception of application tables, should be numbered in Arabic numerals through numbering.

The tables of each appendix are indicated by separate numbering in Arabic numerals with the designation of the annex before the number. If there is one table in the document, it must be marked as "Table 1" or "Table B.1" if it is listed in Appendix B.

You can number tables within a section.

In this case, the table number consists of the section number and the table sequence number, separated by a dot: "Table 1.1".

The column "No salary" is not recorded in the table. If numbering is required, the numbers are indicated in the sidewall of the table before the row name.

The headings of graphs and rows of the table should be capitalized symmetrically, and subheadings of graphs – with a lowercase letter, if they constitute one sentence with a title, or with a capital letter, if they have an independent meaning. There are no dots at the end of table headings and subheadings. The headings and subheadings of the graph are indicated in the singular.

It is forbidden to separate the headings and subheadings of the sidewall and graph with diagonal lines.

Horizontal and vertical lines delimiting the rows of the table can be omitted if their absence does not complicate the use of the table.

Column headers, as a rule, are written parallel to the rows of the table. If necessary, perpendicular arrangement of graph headers is allowed.

The table header must be separated by a line from the rest of the table.

The height of the rows of the table must be at least .8 mm

If at the end of the page the table is interrupted and its continuation will be on the next page, then in this case its head and sidewall are repeated.

When transferring parts of the table to other pages, repeat or continue the name of the column.

You can number the columns at the beginning of the table and when transferring its parts to the next pages, repeat only the numbering of the graph.

In all cases, the name (if any) of the table is placed only above the first part, and above the other parts on the left write: "Continuation of table 1.2", or "End of table 1.2" without a dot at the end.

Tables must be filled in according to the rules that comply with ДСТУ 1.5: 2015.

2.9. Design of applications

Material supplementing the text of the work may be placed in appendices.

The applications may contain graphic material, large format tables, calculations, descriptions of equipment and devices, descriptions of algorithms and programs of tasks solved on a computer, listing of calculation programs, etc.

All applications must be referenced in the text of the QW. The degree of obligation of the application when linking is not indicated. Applications are arranged in the order of references to them in the software.

Annexes are designated with capital letters of the Ukrainian alphabet, starting with A, with the exception of the letters Г, Є, І, Ї, О, Ч, Ђ, for example, ANNEX B. After the word "Appendix" write a letter denoting it. It is allowed to designate applications with letters of the Latin alphabet, with the exception of the letters I and O.

In case of exhaustion of the use of letters of the Ukrainian and Latin alphabets, it is allowed to designate applications with Arabic numerals.

If there is one appendix in the document, it is indicated "APPENDIX A".

The text of each part, if necessary, can be divided into sections, subsections, paragraphs, subparagraphs, which are numbered within each application. The number is preceded by the designation of this application.

Applications must have continuous page numbering in common with the rest of the software.

All annexes must be listed in the table of contents of the document with their designations and headings.

More detailed information on the design of applications is given in ДСТУ 1.5: 2015.

The rules for drawing up general conclusions are given in paragraph 2.1.8 [1].

2.10. List of bibliographic references of used sources

The list of bibliographic references of the sources used should include only the sources used in the QW.

The used literature is placed in the order of reference to it in the text.

The numbering of references should begin with one and then in order.

In the list, each source used is written from a paragraph and numbered in Arabic numerals.

The list of bibliographic references of the sources used is recorded in the language in which it was published.

The list of bibliographic references of used sources is submitted in accordance with the requirements of ДСТУ 8302: 2015 and ДСТУ 3582: 2015.

3. GENERAL PROVISIONS FOR THE PREPARATION OF THE THESIS FOR DEFENSE

In order to comply with the principles of academic integrity, quality of performance and design of QW at the graduating department, maintaining the airworthiness of aircraft, preliminary defense of QW by higher education students is carried out, regardless of which department the QW was performed.

By order of the Dean of the Aerospace Faculty, a commission is formed for preliminary protection of QW and consideration of works for possible plagiarism.

During the preliminary defense, the commission is provided with a completed and fully executed QW with all signatures on the title page, namely: the author of the work, the head, consultants on individual sections of software, the normocontroller of the department where the work was performed and the head of the relevant department.

Illustrative material is submitted to the commission on sheet formats A3 or A4 in the required quantity determined by the author of the work.

Together with unstitched software, the commission provides a review of the head, a letter of success of the applicant and a review of the QW.

Also, an electronic copy (file in .doc or docx formats) of the work performed as a single file is provided to the commission to ensure the process of checking the work in an automated mode in the anti-plagiarism system.

In case of successful preliminary defense and in the absence of comments on the quality (compliance with the requirements of current standards) of registration of the QW, the applicant receives the seal and signature of the norm controller of the graduating department.

Certified by the seal and signature of the normocontroller of the graduating department of software QW, gives the applicant the right to wash the software, at the same time, the author of the work is considered to be admitted to the protection of QW according to the protection schedule.

The applicant admitted to defense has the right to choose the date of protection of the QW.

It should be noted that the author of the QW provides copies of all published scientific works (title page of the collection, table of contents, the article itself and editorial pages) to the commission for preliminary defense, together with the review, feedback from the head and certificate of success.

The graduate defends QW meeting in accordance with the recommendations given in [1].

Sample design of the title page of the thesis

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL AVIATION UNIVERSITY

Aircraft Continuing Airworthiness Department

ADMIT TO PROTECTION

Head of the Department

Cand. Techn. Sci., Assoc. Prof.

_____ Oleksandr POPOV

« _____ » _____ 2023

QUALIFYING WORK

(EXPLANATORY NOTE)

GRADUATE OF EDUCATIONAL DEGREE

«MASTER»

ACCORDING TO THE EDUCATIONAL AND PROFESSIONAL
PROGRAM

«MAINTENANCE AND REPAIR OF AIRCRAFT AND AIRCRAFT
ENGINES»

Topic: «Maintaining the reliability of turbofan bypass engines»

Performed by: _____ **Ivan IVANOV**

Supervisor: Dr. Techn. Sciences, prof. _____ **Mykola PETROV**

Consultants on individual sections of the explanatory note:

Occupational safety

Cand. techn. Sci., Assoc. Prof. _____ **Petro SIDOROV**

Environmental protection

Cand. techn. Sci., Assoc. Prof. _____ **Viktor SALO**

Norm controller: _____

Kyiv 2023

Sample design assignment for the thesis

NATIONAL AVIATION UNIVERSITY

Aerospace Faculty
Aircraft Continuing Airworthiness Department
Educational degree "Master"
Specialty 272 "Aviation Transport"
Educational and professional program "Maintenance and Repair of Aircraft and Aircraft Engines"

APPROVED

Head of the Department
Cand. techn. Sci., Assoc. Prof.
_____ Oleksandr POPOV

« ___ » _____ 2023

TASK

to perform the qualifying work

IVANOV IGOR LEONIDOVYCH

1. Theme of work: "**Maintaining the reliability of turbofan bypass engines**" approved by the order of the rector dated November 2, 2023 No 2676/ст.
2. Duration: from October 25, 2023 to February 13, 2023.
3. Initial data for work: statistical data on failures and malfunctions of the high-pressure turbine of turbofan bypass engines, experimental data of thermocyclic durability of samples of blade melt according to test results.
4. The content of the explanatory note: analysis of the experience of operating gas turbine engines, analysis of methods for applying protective coatings, development of the coating process, selection of equipment, improvement of equipment, certification of the coating process, development of a method for maintaining engine reliability, development of measures for labor protection and environmental protection
5. The list of mandatory graphics (illustrative) material: research scheme, results of analysis of operating experience of gas turbine engines, coating scheme, vacuum-plasma installation, experimental plan, mathematical model of maintaining engine reliability, algorithm for maintaining reliability, method of maintaining reliability of turbojet bypass engines.

6. Schedule

Task	Term execution	Completion mark
Literary review of materials in the scientific direction of the thesis	27.10 – 30.10.2023	(signature author)
Analysis of engine reliability of the register fleet of aircraft of Ukraine	08.11 – 15.11.2023	
Analysis of statistical data on failures and malfunctions of the high-pressure turbine of gas turbine engines	20.11 – 01.12.2023	
Development of a method for maintaining the reliability of turbofan bypass engines	01.12 – 25.12.2023	
Development and design of illustrative material	25.12 – 29.12.2023	
Execution of separate sections: Occupational Safety Environmental protection	29.12 – 03.01.2023	
Preliminary defense of the thesis	05.01 – 10.01.2023	

7. Individual section consultants

Section	Consultant (scientific degree, position full name)	Date, signature	
		Task Issued	Task Took
Occupational Safety	Cand. Techn. Sci., Assoc. Prof. P.V Sidorov		
Environmental protection	Cand. Techn. Sciences, Assoc. Prof. V.S Salo		

8. Date of issue of the task: " ___ " ___ 2023.

Thesis supervisor

(signature)

(Full name)

The task was accepted for execution

(signature)

(Full name)

Sample design of the abstract of the explanatory note

ABSTRACT

Explanatory note to the thesis: "Maintaining the reliability of turbofan bypass engines":

113 p., 36 figs., 14 tab., 35 sources.

The object of research is maintenance of gas turbine engines.

The subject of research is the reliability of gas turbine engines.

The purpose of the thesis is to increase the durability of high-pressure turbine blades and maintain the reliability of gas turbine engines.

Research method – to solve the tasks, methods of analyzing the operation of aircraft engines were used to identify the causes of their failures, experimental data from literary sources on the properties of the protective coating system, mathematical modeling method to predict the resource of the proposed coating.

The practical significance of the results of the qualifying work is determined by increasing the efficiency of technical operation, reliability of aircraft engines due to an increase in the durability of turbine blades.

The materials of the thesis are recommended to be used in the educational process and practical activities of specialists of design bureaus.

**AIRWORTHINESS, GAS TURBINE ENGINE, RELIABILITY,
MAINTENANCE**

Sample design of the content of the explanatory note

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Sample design of the list of abbreviations, symbols, units and terms

LIST OF ABBREVIATIONS, SYMBOLS, UNITS AND TERMS

AE – aircraft engine;

AGTE – aircraft gas turbine engine;

BECS – on-board engine control system;

IGA – input guide apparatus;

MF – is the main factor;

DM – diagnostic model;

DS – diagnostic sign;

HPC – high pressure compressor;

MM – mathematical model;

P_i – pressure of the working fluid in the i -th section of the flow part;

T_i – temperature of the working fluid in the i -th section of the flow part;

F – area;

V – volume;

I – internal circuit of a turbofan bypass engine;

II – external circuit of a turbofan bypass engine;

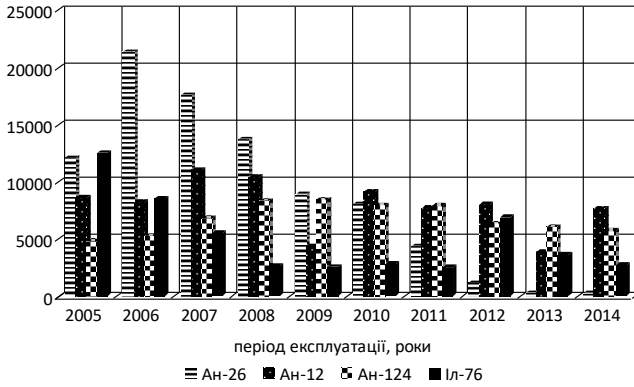
sp – specific parameters;

* – parameters of inhibited flow;

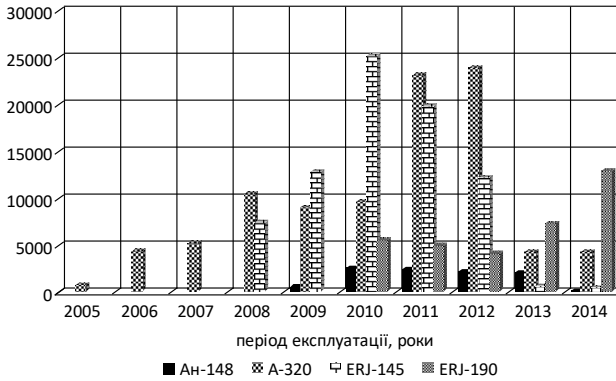
sup – summary parameters;

PC – transition channel;

Sample design of illustrative (graphic) material



a)

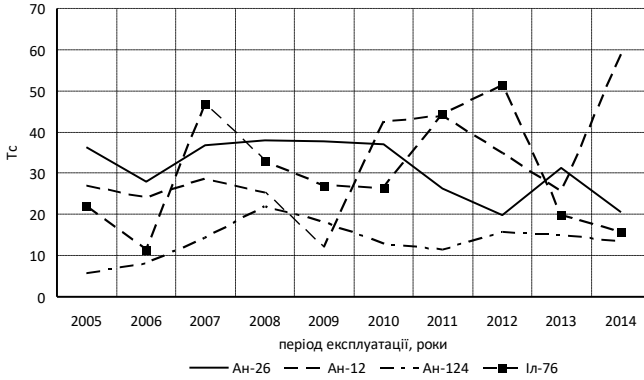


b)

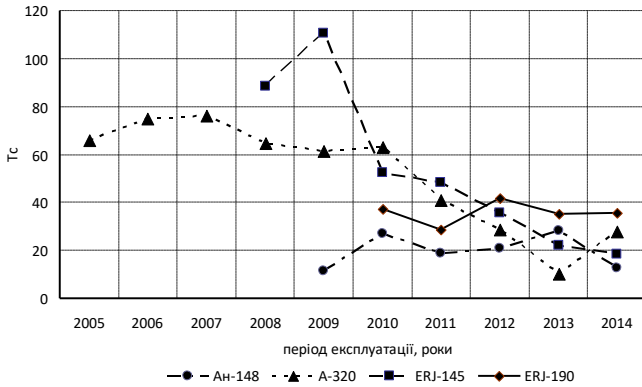
a) – cargo aircraft; b) – passenger aircraft;

Figure 1.1 – Flight dynamics of selected aircraft types for the reporting period

Continuation of Appendix L



a)



b)

a) – cargo aircraft; b) – passenger aircraft;
 Figure 1.2 – Dynamics of change T_c selected types of aircraft

Continuation of Appendix L

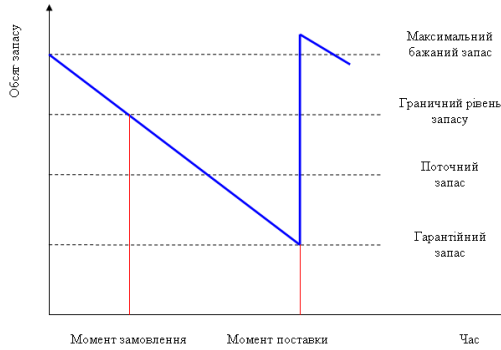


Figure 1.3 – Classification of stocks by accounting time

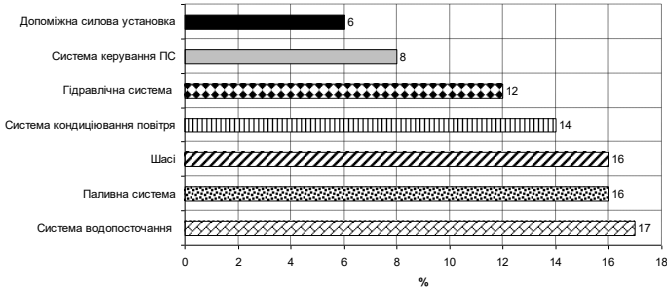
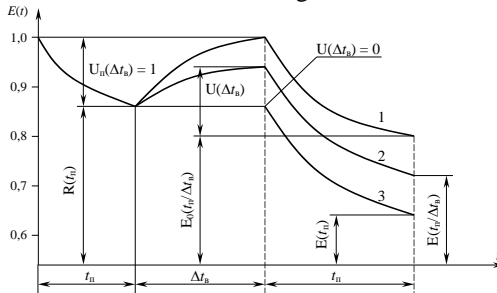


Figure 1.11 – Increase in the total parking time during linear maintenance due to FS failures of Boeing-737 aircraft



1 – efficiency in full recovery after the previous flight; 2 – efficiency after recovery in real conditions; 3 – efficiency in the absence of recovery

Figure 2.2 – Change in the efficiency of the complex

Ending Appendix L

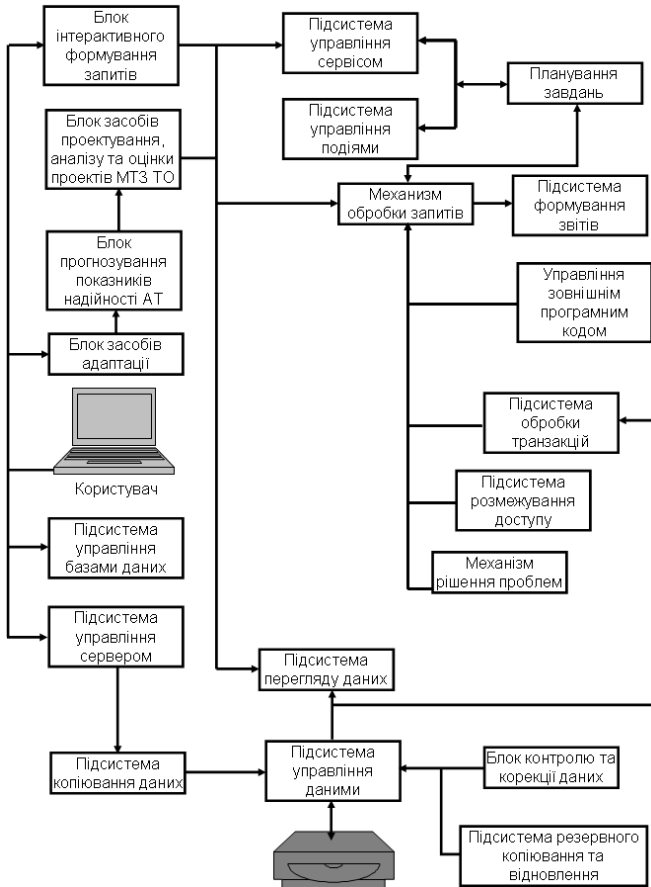


Figure 2.7 – Diagram of interconnections of the main program modules ICS

LIST OF RECOMMENDED LITERATURE

1. Положення про дипломні роботи (проекти) випускників Національного авіаційного університету: затверджено наказом т.в.о. ректора від 14.12.2017, №594/од. – К. : Вид-во НАУ, 2007. – 63 с.

2. Звіти у сфері науки і техніки. Структура та правила оформлювання: ДСТУ 3008:2015. – На зміну ДСТУ 3008-95; [Чинний з 2017–07–01]. – К. : ДП «УкрНДНЦ» 2016. – 26 с.

3. ДСТУ ГОСТ 7.1:2006. Бібліографічний запис. Бібліографічний опис. Загальні вимоги та правила складання (ГОСТ 7.1–2003, ІДТ). – [Чинний від 2007–07–01]. – Київ : Держспоживстандарт України, 2007. – 47 с.

4. Бібліографічне посилання Загальні положення та правила складання: ДСТУ 8302:2015. – [Чинний від 2016–07–01]. – К. : ДП «УкрНДНЦ» 2016. – 16 с.

5. Бібліографічний опис документів відповідно до ДСТУ 7.1:2006, запровадженого в дію в Україні 01.07.2007 : метод. реком. / Харків. нац. ун-т міськ. госп-ва ім. О. М. Бекетова ; уклад.: Н. Б. Давидова, В. О. Статкус ; відп. за вип. О. М. Штангей. – 3-тє вид., перероб. і доп. – Харків : ХНУМГ ім. О. М. Бекетова, 2015. – 23 с.

6. ДСТУ ГОСТ 7.1:2006. Бібліографічний запис, бібліографічний опис. Загальні вимоги та правила складання : метод. рекомендації з впровадження / уклали: Галевич О. К., Штогрин І. М. – Львів, 2008. – 20 с.

7. Правила розроблення, викладання та оформлення національних нормативних документів: ДСТУ 1.5:2015. – На зміну ДСТУ 1.5:2003; [Чинний з 2017–02–01]. – К. : ДП «УкрНДНЦ» 2016. – 61 с.