МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

АЕРОКОСМІЧНИЙ ФАКУЛЬТЕТ

КАФЕДРА ПІДТРИМАННЯ ЛЬОТНОЇ ПРИДАТНОСТІ ПОВІТРЯНИХ СУДЕН

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач кафедри
к.т.н., доцент
___________О.В Попов
«__»_________2020 р.

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА

ЗА ОСВІТНЬО-ПРОФЕСІЙНОЮ ПРОГРАМОЮ
«ТЕХНІЧНЕ ОБСЛУГОВУВАННЯ ТА РЕМОНТ ПОВІТРЯНИХ СУДЕН І АВІАДВИГУНІВ»

Тема: «Модифікація конструкції ПС транспортної категорії при виконанні капітального ремонту»

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Київ 2020

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL AVIATION UNIVERSITY

AEROSPACE FACULTY

AIRCRAFT CONTINUING AIRWORTHINESS DEPARTMENT

AGREED
Head of Department
PhD, associate professor
___________O.V. Popov
«__»_________2020

DIPLOMA WORK

(EXPLANATORY NOTE)

MASTERS GRADUATE

ACCORDING TO THE EDUCATIONAL PROFESSIONAL PROGRAM
"MAINTENANCE AND REPAIR OF AIRCRAFT AND AIRCRAFT ENGINES"

Topic: "Modification of the design of the transport category aircraft during the overhaul"

Completed by: _________ **M.S.Podreza**

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Kyiv 2020

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"

PERMIT TO DEFENSE
Head of Department
Ph. D., Assoc. Professor
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«___» _____________ 2020 year

THE TASK
to complete the thesis
PODRIEZA MYKHAILO S.

1. Theme of work: **: "Modification of the design of the transport category aircraft during the overhaul"** approved by the order of rector of October 10, 2020 No. 1950/st.
2. Term of work performance: from October 5, 2020 till December 21, 2020.
3. Initial data for work: .
4. The content of the explanatory note: development of measures for labor and environmental protection.
5. List of mandatory graphic (illustrative) material: research scheme, results of analyzing the experience of operating gas turbine engines, the impact of damage on engine performance, development of neural network architecture, block diagram of the neural network learning process, diagnosis algorithm, diagnosis and recognition results. Graphic (illustrative) material was made using Microsoft Office Excel, Power Point and presented in the form of presentations.

6. Timetable

Task	Due date	Mark of executio
Analysis of An-32 Indian Air Force fleet	05.10.20 – 13.10.20	
Analysis of corrosion damage	14.10.20 – 20.10.20	
Analysis of defects of each batch of An-32	21.10.20 – 26.10.20	
Analysis of overhaul process	27.10. 20 – 02.11. 20	
Research of modernizations made during overhaul	03.11. 20 – 15.11. 20	
Development of optimization of overhaul process	16.11. 20 – 27.11. 20	
Implementation of separate sections of work: occupational Safety and Health, environmental protection.	28.11. 20 – 07.12. 20	
Execution of an explanatory note and illustrative material.	08.12. 20 – 12.12. 20	
Preliminary defense of the thesis	13.12. 20 – 15.12. 20	

7. Section-specific consultants

Chapter	Consultant	Data, signature	
		The task given	The task accepted
Labour Protection	candidate of engineering sciences, docent Konovalova O.V.		
Environment Protection	candidate of engineering sciences, docent Radomska M.M.		

8. Date of issue: «___»____________ 2020 year.

Principal of diploma paper ________________ ________________

The task was accepted for execution ________________ ________________

REPORT

Explanatory note to the thesis "Modification of the design of the transport category aircraft during the overhaul": --- p., --- fig., -- sources.

The object of research -----.

Subject of study –.

The aim of the thesis is ----

Research methods.

To solve the set tasks, elements of the theory of aircraft design, methods were used: mathematical, natural, computer modeling and network classification.

The practical significance of the results of the thesis is to increase the efficiency of the technical operation of aircraft by.

The recommendations developed by the author can be proposed for improving the methods and.

CONTENT

INTRODUCTION

Taking into account the technical equipment of the enterprise, the qualifications of the personnel, sufficient experience in the overhaul and modernization of aircraft of the "An" type at the enterprise, it should be noted that, since 1992:

- a full cycle of overhaul of An-32 aircraft has been worked out and mastered;
- worked out and mastered the complex of works on modernization of An-32 aircraft in accordance with the documentation of the Developer;
- the execution of resource bulletins No. 515-BE-B, No. 515/1-BE-B, as well as repair bulletins on An-32 airplanes was worked out and mastered;
- fully certified technological processes, personnel, production and quality management system, which is confirmed by the Certificate of the Ministry of Defense of Ukraine No. UAR - MAA- 145.0112, License of the Ministry of Economic Development and Trade, series AB No. 597938 for the right to repair and modernize military aviation equipment, Certificate of Approval organizations for TO No. UA .145.0023 for compliance with the Rules PART- 145 of the State Aviation Service of Ukraine, Certificate No. HTI / 130-55 / 2011 for compliance with NATO Standard AQAP -2120 on the quality system for repairing military aircraft, issued by the Hungarian Ministry of Defense.

Analyzing the state of the An-32 aircraft of the Indian Air Force, there is full reason to assume that in order to ensure operational reliability and flight safety, the Customer deliberately provided to the enterprise for repair aircraft that had previously been repaired at the Customer's base. Taking into account the actual technical condition of these aircraft, which have been in operation since 1984, as well as the technical capabilities to ensure the quality of repair and modernization of the enterprise and the base of the Customer, it should be noted a positive trend of sending the An-32 aircraft for repair to the enterprise after the previous repair at the Customer's base. ...

The results of the assessment of the actual technical condition of the aircraft arriving for repair indicate that the mass number of critical defects in the structure, systems and assemblies were not fully eliminated or prevented during the previous repair at the Customer for objectively explainable reasons, due to the significant volumes of these repairs. lack of experience in overhaul, a sufficient number of qualified personnel, a fully documented quality system, an insufficient amount of equipment, spare parts and technical capabilities to perform high-quality repairs in full.

Objective information on the actual state of the market for aircraft repair services developed by ANTONOV SE shows that the enterprise is currently the only large company certified in accordance with International Aviation Regulations and Standards, which has the ability to perform a full range of work on overhaul, maintenance and modernization of aircraft of the type An-32 and their components.

Implementation of automated systems for flaw detection and repair of airframe and aircraft systems, taking into account flaw detection tools, non-destructive testing using detailed nominal operational fault detection cards.

Dissemination of positive experience in the implementation of registered operational fault detection and repair cards for An-26 aircraft units of registration of the European Union, developed in accordance with the EU Aviation Rules PART- 145 for the An-32 aircraft.

Dissemination of experience in the manufacture of spare parts for An-26 aircraft registered by the European Union for An-32 aircraft with the issuance of individual technological passports and certification of special manufacturing processes.

Introduction of painting the outer surface of An-32 aircraft with the promising AERODUR- 5000 enamel from Akzo Nobel, APS - A washes and environmentally friendly E series washes.

The use of the automated control panel PKZH-3000 in the manufacturing process, installation and control of electrical harnesses in the process of repair and modernization of the An-32.

Complete replacement of aircraft electrical harnesses of the SPUT system in zones 5, 6, 7, 8.

Modernization of the flight information registration and processing system in terms of replacing the Tester-U3 product with the BUR-4-1.

Agreeing with the Aircraft Developer of the decision to replace the R-800 radio station with a more modern and reliable one.

1. ANALYSIS OF AN-32 FLEET

1.1 Brief comparative analysis technical condition, organization of overhaul and modernization of An-32 aircraft of the Indian Air Force for the enterprise and BRD-1 (India)

Analyzing the technical condition of 35 An-32 aircraft of the Indian Air Force, which entered for repair among 7 batches of B1-B7, the experience of their repair at the enterprise (Kiev) and BRD-1 (India), the conditions of maintenance and operation of the aircraft in India, one can make a number of conclusions, namely:

1.1.1. The first AN- 32 RE aircraft , which underwent repair and modernization in 2010-2011, will require overhaul in 2 years due to the expiration of the overhaul life. Thus, starting from 2015. 5 to 10 AN- 32 RE aircraft will require major overhaul every year. At the same time, 64 An-32 aircraft, which are in operation with significant operating time, already now require overhaul with modernization for the AN- 32 RE configuration with the implementation of bulletins, including the resource number 515/1-BE-B.

1.1.2. The experience of repairing the An-32 in India on the BRD-1 shows the objective difficulties that the Indian side faced in the implementation of such bulletins as resource bulletins No. 347, No. 515-BE-B, as well as complex bulletins, such as No. 450, No. 104 and others (see Appendix 5).

1.1.3. The technical condition of the aircraft received at the SE "PLANT 410 GA after repair on the BRD-1, also shows the difficulties associated with the quality of defect detection during the previous repair, the quality of riveting work, the quality of electrical work, the quality of repairs of units, insufficient anti-corrosion protection of the aircraft body, especially the lower parts of the fuselage. The technical condition of the aircraft is also aggravated by severe operating conditions, including those related to climatic conditions. Figures 5.1, 5.2, 5.3 of Section 5 show diagrams of typical corrosion damage to structures, as well as cracks, including damage to aircraft controls, on the example of An-32 aircraft K-2681, K-2733, K-2684 of batches B-1, B-5, B-6, revealed during defect detection and in the process of repair. Moreover, the number of these critical defects when comparing aircraft of batches B -1, B-5, B-6 increased by 1.4-1.52 times, and the trend of their further growth is still stable.

1.1.4. Taking into account the significant amount of work and the conditions under which bulletins and additional work will be carried out to eliminate a significant number of corrosion damage and critical structural defects, the need to have a developed infrastructure for these purposes, as well as spare parts, a large number of qualified personnel of performers, it is advisable to decide on which These aircraft, having serious problems related to their technical condition , were overhauled and refined at the enterprise , which is a specialized center for the repair and maintenance of An-32 aircraft and their components certified in accordance with International Standards. The list of bulletins requiring execution in a large specialized aircraft repair center is given in Appendix 5.

1.1.5. The natural conclusion on the essence of the above problematic issues is that in order to ensure trouble-free operation, operational reliability and maintain airworthiness of the An-32 aircraft of the Indian Air Force, it is necessary to bring closer, combine and harmonize the systems of maintenance, overhaul and modernization operating both at the enterprise and and at the bases of maintenance and repair in India. In our opinion, this is the only effective and productive way of further work on the repair of An-32 aircraft.

1.2. Generalized results of the analysis of the technical condition of the structure of the An-32 aircraft of the Indian Air Force and the plant's actions to restore their technical characteristics during overhaul

1.2.1 In accordance with the bulletin No. 515-BE-B entered into force on September 21, 2010, and later replaced by the bulletin No. 515-BE-B with amendment No. 1 dated 06/15/2012, An-32 aircraft operated by the Indian Air Force and passed the next overhaul with work:

- according to the basic program of aging control PR-32-10-674 and additions to it;

- **on the installation of reinforcing linings on the lower panels of the center section;**

- for applying anticorrosive preventive compositions;

- on the modernization of on-board radio-electronic equipment, hydraulic systems, chassis, fire, oxygen, rescue and household equipment,

receive the name AN-32RE, and the assigned service life in stages (in stages of 5 years with overhaul and a basic aging control program at each stage) can be increased to 40 years. The assigned resource of the AN-32RE aircraft is 20,000 flight hours, 15,000 flights, <u>overhaul life after overhaul of 4,000 flight hours, 3,000 landings, 5-year overhaul life</u> . The maximum take-off weight of the AN-32RE aircraft is 28,500 kg.

According to notice No. 32.30.03.0010.569, the lower panels of the center section of the aircraft are reinforced with overlays with a thickness equal to the thickness of the panel leaf (3.5 mm). In order to facilitate the installation process, we proposed, and approved by the Developer, to make a plate of two D16ATV sheets with a thickness of 1.5 and 2 mm, due to the large dimensions of the plates (up to 6200 mm).

Also, this revision implies the replacement of bolt-rivets along the side members of the center sections and bolts along the tie-straps and fuselage arcs and the implementation of the vertical current inspection of the inner surfaces of the holes.

If there are corrosive lesions on the lower panels of the center section, the configuration of the linings is changed individually for each case (≈20% of aircraft being repaired).

On each aircraft being repaired, foci of corrosion were found on the load-bearing elements of the center section, SChK, OCHK, empennage (spars, upper, lower and removable panels, ribs), the repair of which is not provided for by the overhaul manual.

The power elements of the airframe are repaired according to the documentation developed by the CDP and agreed with the Developer. This documentation includes repair drawings, sketches, technical instructions, etc., developed individually for each aircraft.

CDP were developed and agreed with the TU Developer (technological instructions) for repair:

- removable center section panels 15 TU (for 15 aircraft);
- lower panels of the center section 10 TU (for 10 aircraft);
- upper panels of the center section 27 TU (for 27 aircraft);
- front and rear side members of the center section of 5 TU (for 5 aircraft);
- lower panels SCHK 5 TU (for 5 aircraft);
- front and rear side members OCHK 3 TU (for 3 aircraft);
- connector profile 12 ribs OCHK 1 TU (for 1 aircraft).

Below in Fig. 1.1, 1.2, 1.3 show diagrams of corrosion damage and cracks in the structure of An-32 aircraft of the Indian Air Force of batches B1, B5, B6 using the example of aircraft No. K-2681, No. K-2733, No. K-2684.

In summary table 5.1 and in Fig. 5.4 shows the data of the statistical analysis of defects in the technical condition of aircraft of batches B1-B5. On average, the number of critical aircraft design defects increased 1.46 times.

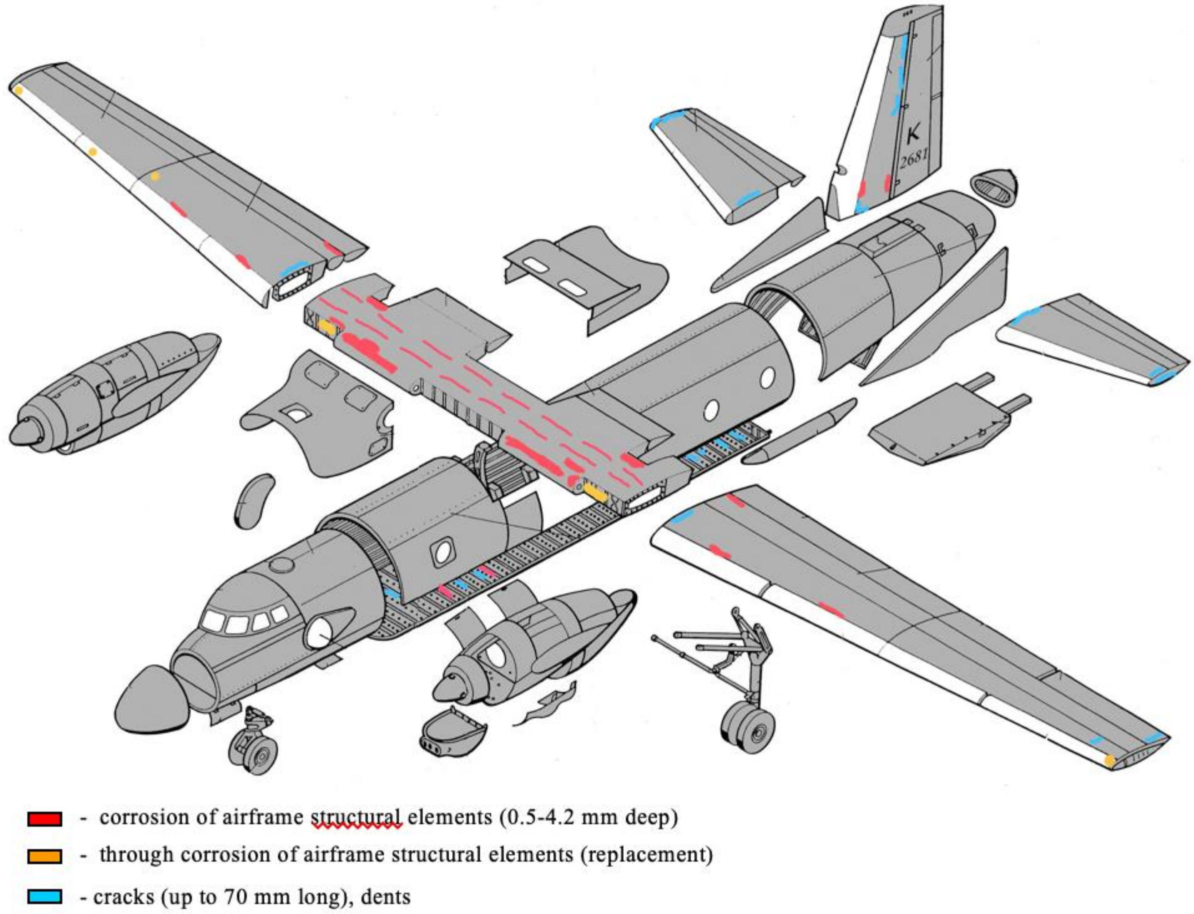

Fig 1.1: Diagram of corrosion damage and cracks An-32 K-2681 Batch B1

K-2681 (batch B1)

Center section

1. Corrosion (1.2 mm deep) of the upper front panel (between ribs # 3-4 and stringers # 2-3.

2. Corrosion of the upper (1.2–2.6 mm) rear panel (between ribs # 5-7 near stringer # 9).

3. Corrosion (through) of the upper front technological panel (between ribs No. 4-7 near the SPUT hatch).

4. Corrosion (0.8 mm) of the upper flange of the 1st spar (near rib No. 5).

5. Corrosion (through) of the upper chord of the upper flange of the beam between ribs No. 5-6.

6. Corrosion (1.2–1.4 mm) of the inner surface of the top panel between ribs # 3-4 and stringers # 2-3.

7. Corrosion (0.3 mm) of the inner surface of the bottom panel between ribs # 3-4 and stringers # 2-3.

8. Corrosion (0.7–2.5 mm) of the outer surface of the removable panel between ribs No. 1-7 and stringers No. 3.7.

9. Cracks (20-30 mm) in the skin in the tail section.

10. Corrosion (0.6 mm) of the rear spar wall near rib No. 11.

Stabilizer

1. Crack (10 mm) in the tail section of the stabilizer.

2. Crack (5-6 mm) in the tail section of the stabilizer.

3. Crack (10-20 mm) in the end fairing skin.

4. Crack (25 mm) of the end fairing rib.

5. Crack (8-12 mm) in the diaphragm of the removable stabilizer nose.

Fin

1. Crack (10-15 mm) of the front side member strut.

2. Corrosion (0.2–0.8 mm) of the walls of the front and rear spars near the end rib.

3. Crack (10-40 mm) in the tail plating.

4. Crack (10 mm) in the tail rib.

Wing

1. Corrosion (0.3 mm) of the SCHK slats stringers.

2. Crack (14 mm) of the root rib of the main part of the SCHK flap.

3. Corrosion (through) of the OCHK slat stringer.

4. Corrosion (through) of the final profile of the OCHK slat.

5. Crack (45 mm) of the panel near rib No. 22 of the left OCHK.

6. Crack (10 mm) in the edge of the upper skin of the final aileron.

Fuselage

1. Crack (10-15 mm) in the ramp superstructure skin.
2. Crack (25 mm) in the outer planking of the ramp deck.
3. Corrosion (0.2 mm) of floor sheathing between frames No. 4-7.
4. Crack (10 mm) in the sheathing of the bulkhead of frame No. 7.
5. Corrosion (1.0 mm) of the upper chords of frames No. 9, 13, 18, 25, 29, 31, 32.
6. Crack (23 mm) of the upper chord of frame No. 45.
7. Crack (20 mm) of frame No. 46 rim.
8. Corrosion (0.15 mm) of the bottom panel skin between frames No. 1a-11.
9. Corrosion (0.15 mm) of the bottom panel sheathing between frames No. 46-48 and stringers No. 0-3.
10. Corrosion (0.1 mm) of the upper rear panel skin between frames No. 7-8 and stringers No. 35-36.
11. Corrosion (through) of the upper rear panel skin between frames No. 24-25 and stringers No. 36-37.
12. Corrosion (0.15 mm) of the upper panel skin between frames No. 31-33 and stringers No. 31-35.
13. Corrosion (0.3-0.8 mm) of profiles on the longitudinal wall of the hatch.
14. Crack (12 mm) in the profile of the upper panel of frame No. 46.

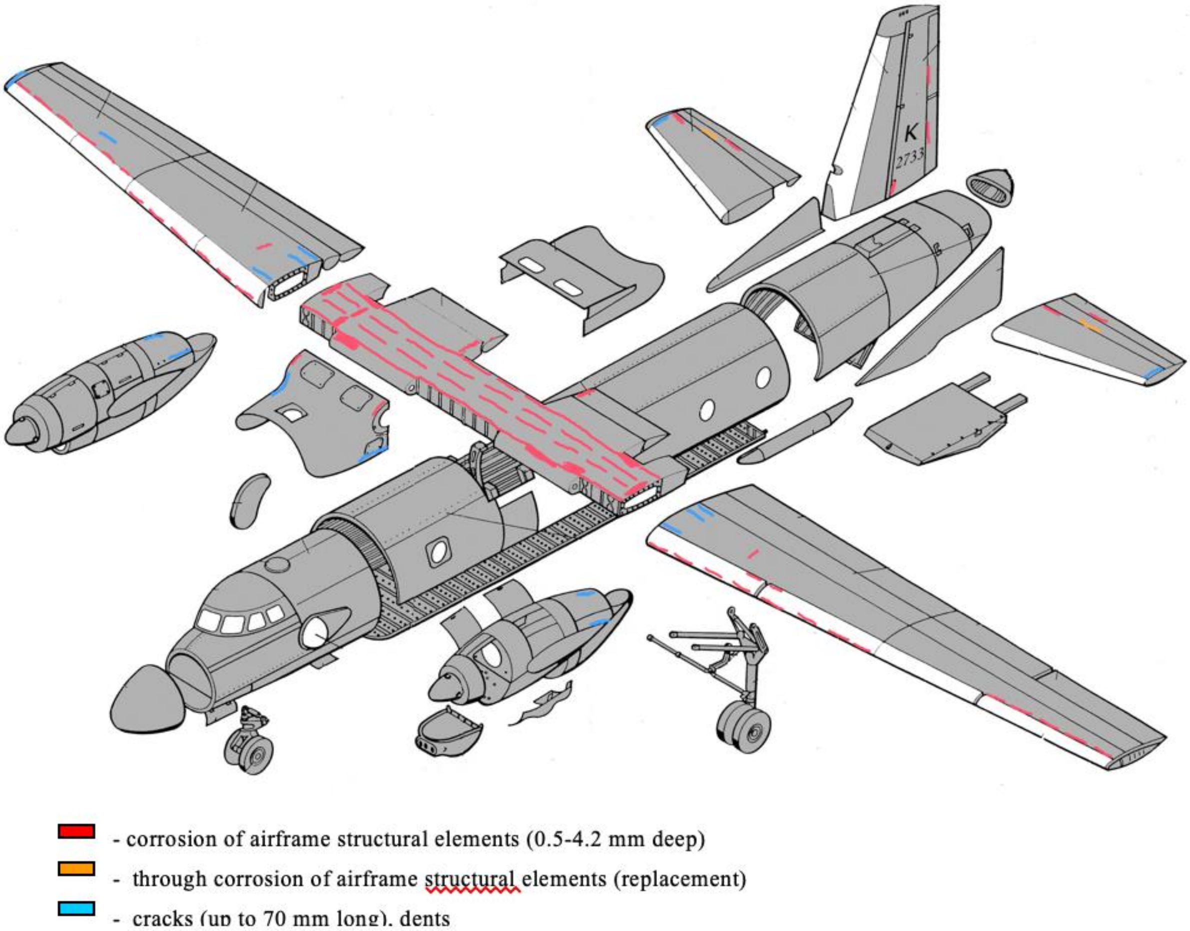

Fig 1.2. Diagram of corrosion damage and cracks An-32 K-2733 Batch B5

K-2733 (batch B5)

Center section

1. Corrosion (0.5-1.2 mm) of the upper front panel blade between ribs No. 2-4 and stringers No. 2-3.

2. Corrosion (through) of the fabric of the upper rear panel between ribs No. 1-7.

3. Corrosion (0.6 mm) of the bottom panels between ribs # 4-7.

4. Corrosion (0.8 mm) of the lower rear panel under the rib 6 shelf between stringers # 7-8.

5. Corrosion (1.0-2.9 mm) of the outer surface of the removable panel between ribs No. 4-7.

Stabilizer

1. Corrosion (0.5 mm) of the upper belt of the rear spar near the end rib.
2. Corrosion (through) of the wall of the rear spar between ribs No. 8-10.
3. Cracks (5.5 mm) in the tail skins of the right and left stabilizers.
4. Cracks (8 mm) in the end fairing skin.
5. Cracks (5-9 mm) in the diaphragms of the removable toe.

Fin

1. Corrosion (0.6 mm) of the keel panel fitting.
2. Corrosion (through) of the walls of the rear spar near ribs No. 8,12,13.
3. Cracks (10 mm) in the tail skin.
4. Corrosion (0.8 mm) of the elevator tip.
5. Corrosion (through) rudder stopper.

Fuselage

1. Cracks (10-15 mm) in the walls of frames No. 46.47.
2. Cracks (10 mm) in the ramp support.
3. Corrosion (0.8 mm) of the bracket under the floor.

Engine nacelles

1. Corrosion (0.2-0.5 mm) of the top panel profiles.
2. Corrosion (0.6-1.0 mm) of the tail section profiles.
3. Cracks (10 mm) in the skin of the tail panels.

Wing

1. Cracks (5-8 mm) of the rims of the front wing fairings.
2. Cracks (5 mm) in wing fairing skins.
3. Corrosion (0.8-1.0 mm) of the front wing fairing skins.
4. Cracks (15 mm) of the frontal fairing of the wing.

5. Corrosion (0.15-0.25 mm) of wing fairing liner skins.

6. Corrosion (1.0 mm) of the nose profile of the left SCHK.

7. Cracks (5-8 mm) in the skin of the right and left SCHK panels between ribs No. 7-8 and stringers No. 1-2, No. 8-9.

8. Corrosion (0.8 mm) of the upper panel bracket of the right SCHK near rib 11a.

9. Corrosion (0.5-1.9 mm) of the bottom panels of the right and left SCHK between ribs No. 7-10 and stringers No. 2-8.

10. Crack (50 mm) in the plating of the SCHK tail section between ribs No. 7-8.

11. Corrosion (through) of the end profiles of the SCC slats.

12. Corrosion (through) of the slats stringers SCHK.

13. Crack (10-20 mm) in the center section flap skin.

14. Corrosion (0.9 mm) of the OCHK slat stringer.

15. Crack (15 mm) of the front non-removable panel near rib No. 16 of the right OCHK.

16. Corrosion (0.2 mm) of the lower belt 2 of the spar between ribs No. 18-23 of the right and left OCHK.

17. Corrosion (0.2 mm) of the upper belt 1 of the spar between ribs No. 16-18 and No. 20-23 of the left OCHK.

18. Corrosion (0.6 mm) of stringer No. 2 between ribs No. 20-23 of the left OCHK.

19. Cracks (8-20 mm) in the profiles of the tail section of the OCHK.

20. Crack (8 mm) of the rib of the end fairing of the right OCHK.

21. Corrosion of the inner flap mechanism rod 32.02.3715.030.000.

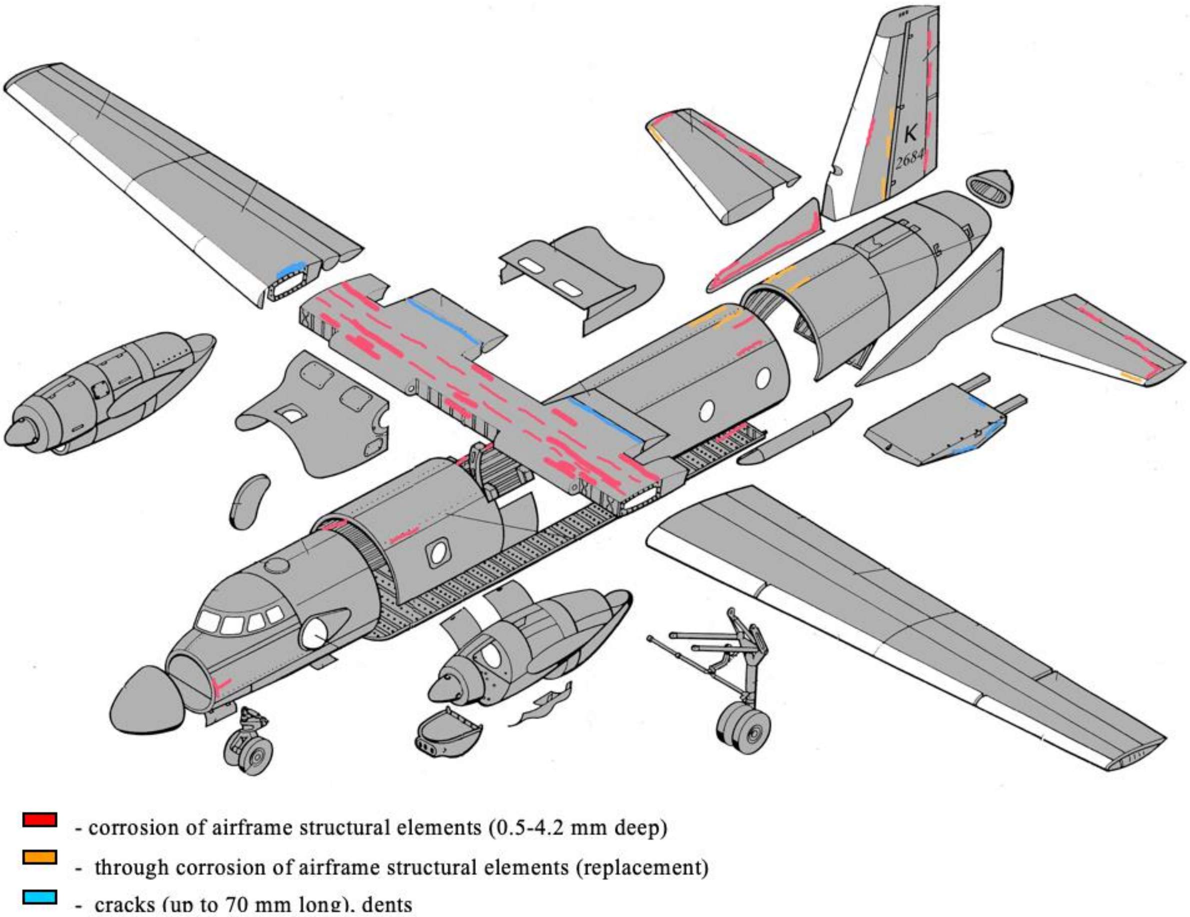

Fig. 1.3 Diagram of corrosion damage and cracks An-32 K-2684 Batch B6

K-2684 (batch B6)

Center section

1. Corrosion of the front upper panel between the 2nd spar and ribs No. 1-1a.

2. Corrosion (1.1 mm) of the inner and top panel between ribs # 3-4 and stringers # 2-3.

3. Corrosion of the outer surface of the panel between ribs No. 1-3, 5-7 and stringer No. 8 of the 2nd spar.

4. Corrosion (0.2 mm) of the front fairing skins.

5. Cracked front fairing beam.

6. Corrosion of the upper belt of the 1st spar between ribs No. 2-3.

7. Corrosion (0.7-1.2 mm) of the inner surface of the beam between ribs No. 3-5.

8. Corrosion (1.2-1.4 mm) of the inner surface of the panel between ribs No. 2-4.

9. Corrosion (1.2-2.0 mm) of the outer surface of the panel between ribs No. 5-7 and between the 2nd spar and the 9th stringer.

10. Crack (60 mm) in the tail section of the center section.

11. Corrosion (0.8-1.0 mm) of the surface of the removable center section panel between stringers No. 3-5, 6-7 and ribs No. 2-5.

Stabilizer

1. Corrosion (through) of the side member 1 wall in the area of the end rib.

2. Corrosion of the upper and lower chord of the end rib of the end fairing.

3. Corrosion (through) of the wall in the area of the end rib of the left stabilizer.

Fin

1. Corrosion of the wall 1 of the spar in the region of the rib No. 12-14.

2. Corrosion (through) of the wall of the rear spar in the region of the rib No. 2,8,13.

Fuselage

1. Corrosion (up to through) of the lower right panel sheathing between the frames. No. 2-4, stringers No. 4-10.

2. Dent (more than 2 mm) in the trim of the right side panel between the frames. No. 34-35, p. No. 24-23.

3. Dent (more than 2 mm) of the top right panel trim between splines. No. 38-40, p. No. 26-27.

4. Dent (more than 2 mm) of the left side panel trim between splines. No. 33-34, p. No. 18-19.

5. Deformation, cracks of the lower plating of the beam of the cargo hatch opening between the shp. No. 39-41.

6. Deformation, crack of the profile of the right beam of the cargo hatch between the frame. No. 40-41.

7. Non-drawing docking plates on the right fixed rail between shp.№32-33.

8. Corrosion (up to through) of the upper left rim between shp. No. 1a, p. No. 38-34.

9. Corrosion of the lining of the right longitudinal wall of the front support niche between the shp. No. 2-3.

10. Corrosion of the sheathing of the upper right panel between shp. No. 13-14, p. No. 31-37.

11. Mechanical damage to the rail.

12. Corrosion (through) of the upper right panel of shp. No. 26-27, p. No. 35-37.

13. Corrosion (through) of the upper right panel of shp. No. 30-33, p. No. 36-37.

14. Corrosion (through) of the left upper panel of shp. No. 32-33, p. No. 35-37.

15. Corrosion (through) of the left upper panel of shp. No. 33-34, p. No. 35-37.

16. Corrosion of the side panel between shp. No. 1a-2, p. 13,14.

17. Corrosion (1.2 mm) of the upper rear panel sheathing on the left and right between the splines. No. 30-32, p. No. 36-37.

18. Corrosion (1.2 mm) of the top panel sheathing on the left and right between the splines. No. 35-37, No. 37-39, p. No. 35-37, No. 36-37.

19. Corrosion of the left forkil skin.

20. Corrosion of the upper left rim of shp. No. 1a.

21. Corrosion (through) sheathing of the right and left panels of shp. No. 13-14, p. No. 31-37.

22. Corrosion of the upper chord of frame No. 13,25,29.

23. Cracks in the walls of frames No. 46.47.

24. Ramp fairing crack.

25. Cracked stringers under the skin.

26. Crack of the ramp superstructure rib.

27. Crack in the fairing of the ramp support.

Engine nacelles

1. Corrosion of the top panel profiles.

2. Corrosion (0.2 mm) of the sheathing of the outer and inner bottom panels in the area of shp. No. 3a-11.

3. Corrosion of the tail section.

Wing

1. Crack in the slat bracket.

Information on the number of defects found in the process of flaw detection and overhaul on aircraft of the Indian Air Force, batch B-1, B-2, B-3, B-4, B-5

Table 1.1

System name	B-1	B-2	B-3	B-4	B-5
Air conditioning system	5	5	6	7	8
Auto control equipment	1	1	1	2	3
Communication equipment	1	1	2	2	3
Power supply system	16	18	21	19	24
Fire-fighting equipment	5	4	4	6	8
Aircraft control system	2	3	2	3	5
Fuel system	5	6	7	7	9
Hydraulic system	9	7	8	6	12
Anti-icing system	5	6	7	6	11
Instrumentation equipment	10	11	10	12	15
Landing gear	7	8	8	9	11
Lighting and light signals	5	6	5	4	8
Navigation system	28	26	30	35	38
Auxilliary power unit	1	2	1	1	2
Airframe	16	17	19	15	24
Doors , hatches , sashes	7	8	11	9	14
Fuselage	33	31	34	35	42
Engines necelles	23	21	23	24	27
Fairing	14	13	16	14	21
Windows	3	3	4	3	4
Wing	35	34	38	37	44
Propellers	1	1	1	1	1
Power unit	1	2	1	1	2
Engine fuel system	1	2	1	2	3

Avionics	**3**	**4**	**5**	**4**	**7**
Radio equipment	**3**	**3**	**4**	**3**	**4**
Control pannel	**1**	**1**	**1**	**2**	**3**
TOTAL	**241**	**244**	**270**	**269**	**353**

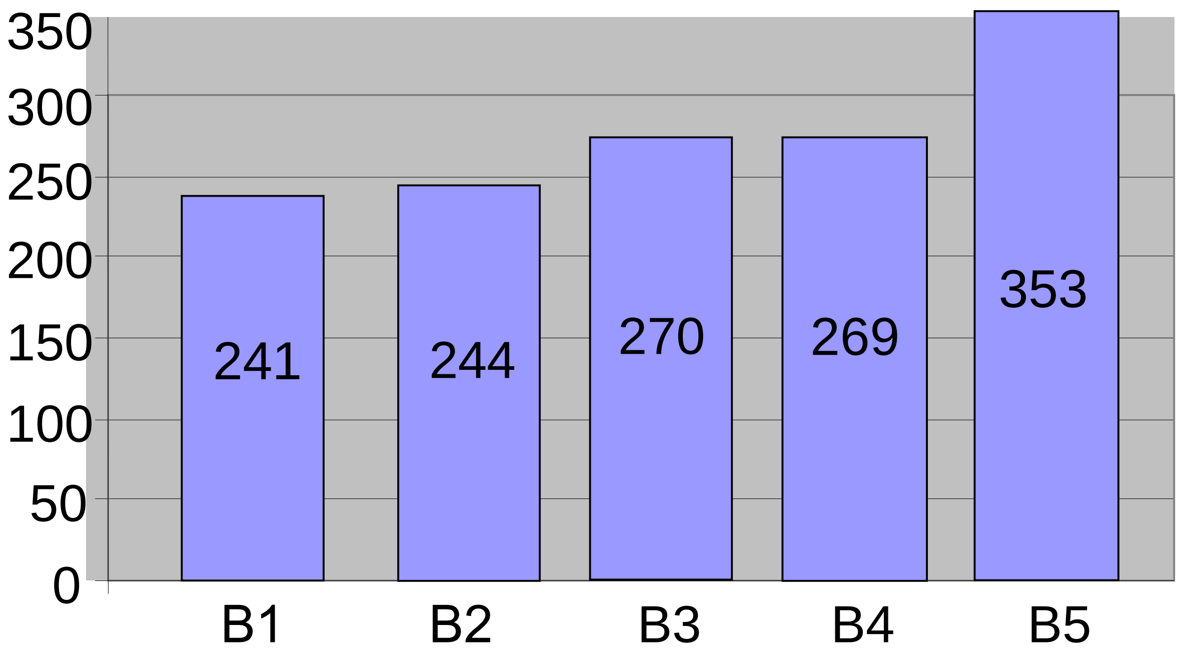

Figure 1.4: Distribution of the number of defects in the technical condition of the airframe and An-32 systems during repair and defect detection

Trends in the development of damage to the structure of the An-32 aircraft depending on the impact of the environment and cyclic loads

An-32 is a transport aircraft that was specially designed for operation in high mountains and aggressive climates and, accordingly, was supplied to the countries of Asia, Africa and Latin America.

As follows from the analysis of theoretical and experimental studies in this field [1, 2], in such operating conditions, the combined effect of static and cyclic loads, as well as climatic conditions aggressive environments gives rise to various corrosive and corrosion-fatigue damage, yn intensity which eventually increases.

Of great importance it is also the fact that in experimental studies elements skins glider having pre-corrosion damage, and elements fatigue damage that accompanies the development of the armature rozionnyh processes were obtained different depending tolerance emogo corrosion damage by stresses, as well as their influence on the probability of failure [1].

In fig. 1.5 shows a typical diagram of the dependence of the limiting depth on the cyclic loads at different probability of destruction for transport aircraft, obtained by calculation and experiment [1].

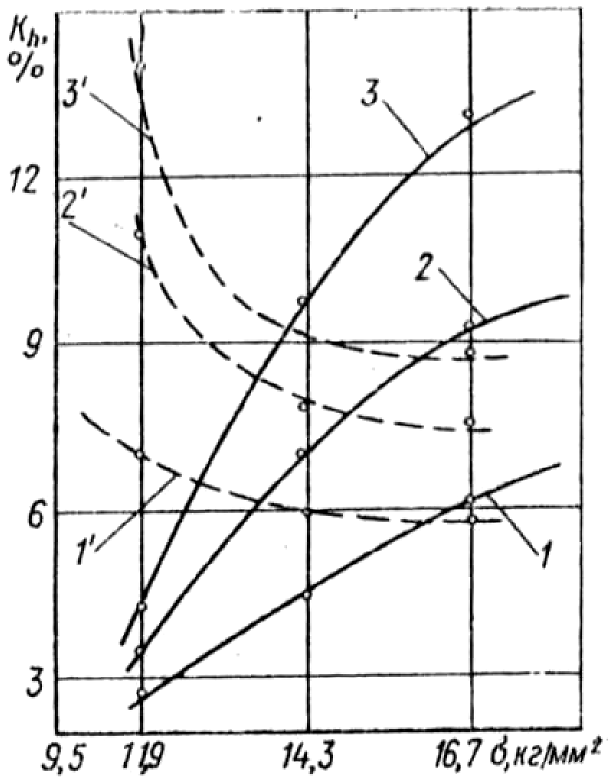

Figure: 1.5 Typical diagram [1] of the calculated dependence of the maximum corrosion depth on the nature of the operating medium and the cyclic load at different probability of structural failure for transport aircraft:
1 ', 2', 3 '- preliminary corrosion damage;
1, 2, 3 - simultaneous action of the environment and load.
Destruction probabilities
P = 0.01; 0.1; 0.5 respectively in arithmetic order.

Cyclic load

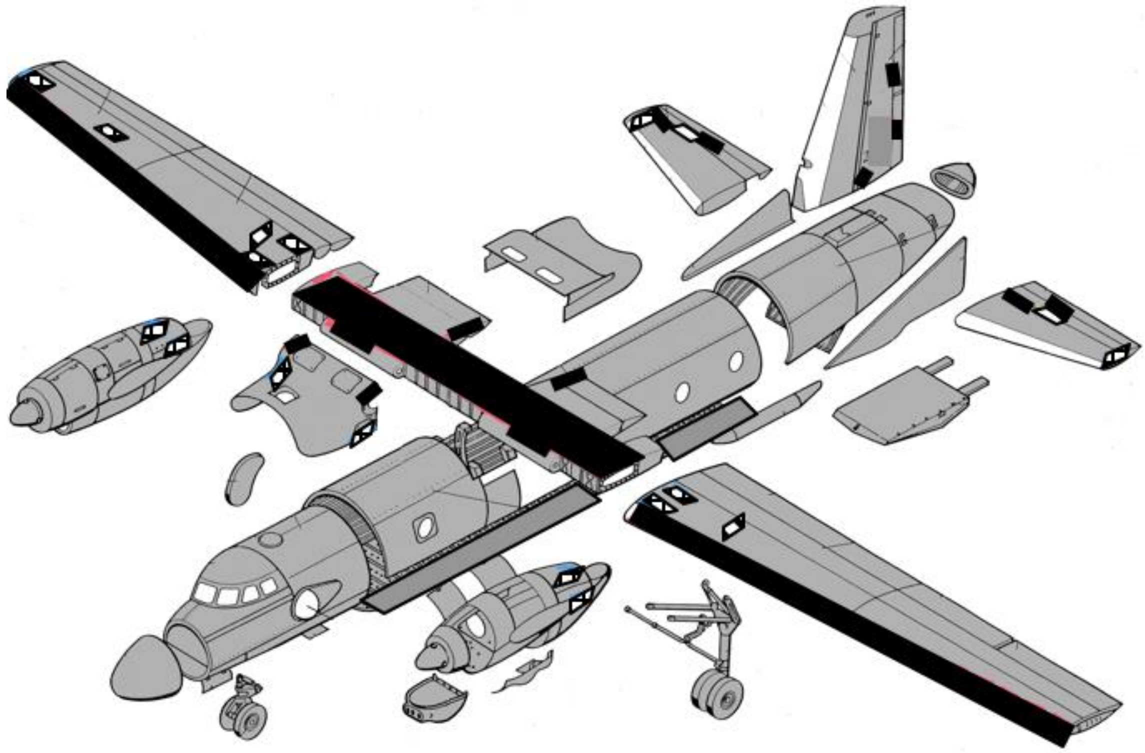

Figure 1.6: . Scheme of corrosion damage and cracks in the structure of the An-32 aircraft operated in a mountainous subtropical climate

- *corrosion of structural elements of the airframe and empennage (depth 0.5-1.62 mm)*
- *through corrosion of airframe structural elements (replacement)*
- *cracks (up to 70 mm long), dents*

The difficulty of diagnosing structural joints affected by corrosion is primarily due to the inaccessibility and inability to visually determine the location and nature of the lesion. Based on the results of defect detection during repair, corrosion usually spreads to several parts that are in contact, and the magnitude and nature of the damage may be different for them.

Especially often the airframe of the aircraft and the elements of the controls are exposed to corrosion and fatigue damage. Investigations of An-32 aircraft that have come for repair have shown that corrosion of aircraft parts can be both local and continuous. Most often, uniform corrosion occurs, which, with a significant amount of damage, is accompanied by the growth of individual foci. The depth of corrosion ranges from hundredths of a millimeter to through damage to the skin. Thus, the arithmetic mean value of the corrosion damage of aircraft that have been in operation for 25-28 years ranged from 0.87mm to 1.62mm in some cases. It is clear that these comparisons are not quite technically correct, since cannot be applied to the entire fleet of aircraft, nevertheless, they express a general trend associated with the technical condition of the aircraft in operation.

On each An-32 aircraft that came for repair, centers of corrosion were found on the power elements of the center section, SChK, OCHK, upper and lower removable panels, ribs, spars, tail, ramp and even on individual components located in the pilot's cabin, engine nacelles and the fuselage of the aircraft. The technical condition of aircraft is also aggravated by the difficult operating conditions, including those related to climatic conditions.

In fig. 1.3 shows a diagram of typical corrosion damage to structures, as well as cracks, including damage to control elements, revealed during flaw detection (determination of technical condition) and in the process of overhaul, using the example of the An-32 aircraft operating in a mountainous subtropical humid climate.

Figure:. Scheme of corrosion damage and cracks in the structure of the An-32 aircraft operated in a mountainous subtropical climate

In fig. 1.4 shows the sample data of the statistical analysis of defects in the technical condition of the An-32 aircraft operated in different climatic conditions. At the same time, as can be seen from the summary table 1, the number of critical structural defects of the airframe, fuselage, wing elements when comparing the data of 3 taken for the example of aircraft A, B and C - increased by 1.25 ÷ 1.3 times for aircraft operated in a mountainous subtropical humid climate.

Table 1.2

An example of the results of assessing the technical condition of three An-32 aircraft operated in different climatic conditions

Information	**plane board A**	**plane board B**	**plane board C**
Year of issue	1984	1985	1984
Operating time, hours	7337	5801	8839
Operating time, flights	7553	5385	7844
terms of Use	Humid, marine subequatorial climate, large temperature drops	Mountainous, subtropical humid climate, significant seasonal and daily temperature drops	
Number of corrosion damage to the structure			
Airframe structural elements	sixteen	nineteen	24
Doors, hatches, sashes	7	eleven	fourteen
Fuselage	33	34	42
Engine nacelles	23	23	27
Plumage	fourteen	sixteen	21
Wing	35	38	44
TOTAL	**128**	**141**	**172**

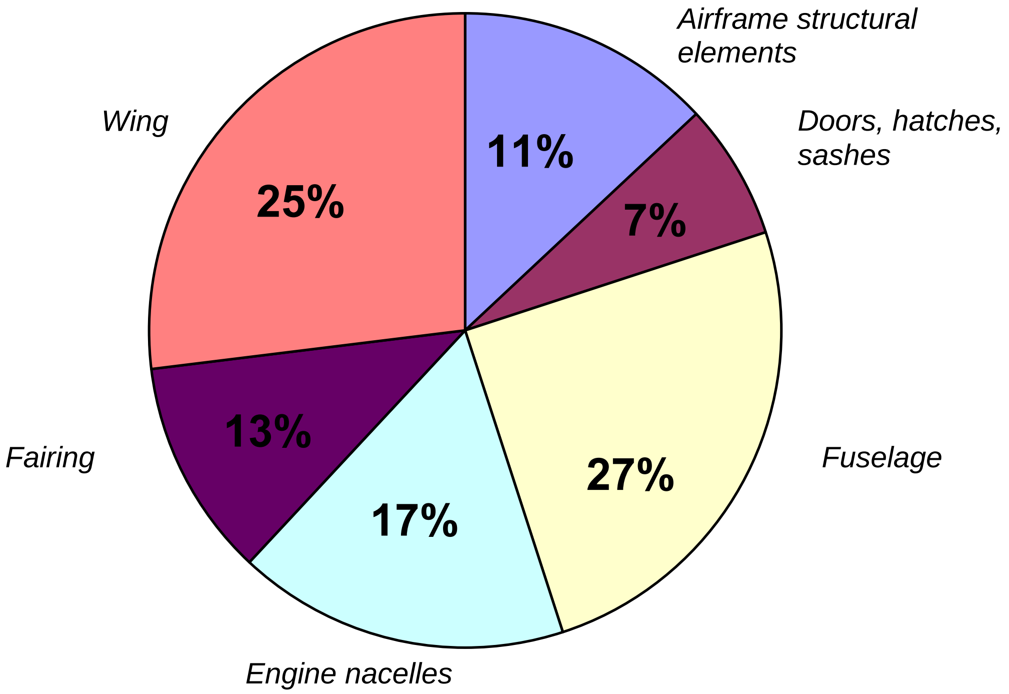

Figure 1.7: The average value of the distribution of defects in structural elements (corrosion, cracks) of An-32 aircraft based on the results of an assessment of the technical condition upon admission for repair (in%)

The data was taken based on the analysis of flaw detection and assessment of the technical condition of 40 aircraft.

In fig. 1.7 shows the comparative characteristics of the relationship between the values of local corrosion damage, cyclic loads and the probability of destruction of structural elements, obtained by extrapolating the actual average values of corrosion damage of structural elements of An-32 aircraft to the values of cyclic loads.

As seen from Fig. 1.5, for aircraft with damages of more than 30% of the skin thickness are critical with the probability of destruction of this structural element P = 0.5. Those. the hypothesis is confirmed that cyclic loads in themselves are not critical for the structure, but their combination with the corrosion depth, as well as with the conditions of the environment in which the aircraft is operated, is critical (Fig. 1.5, Fig. 1.8).

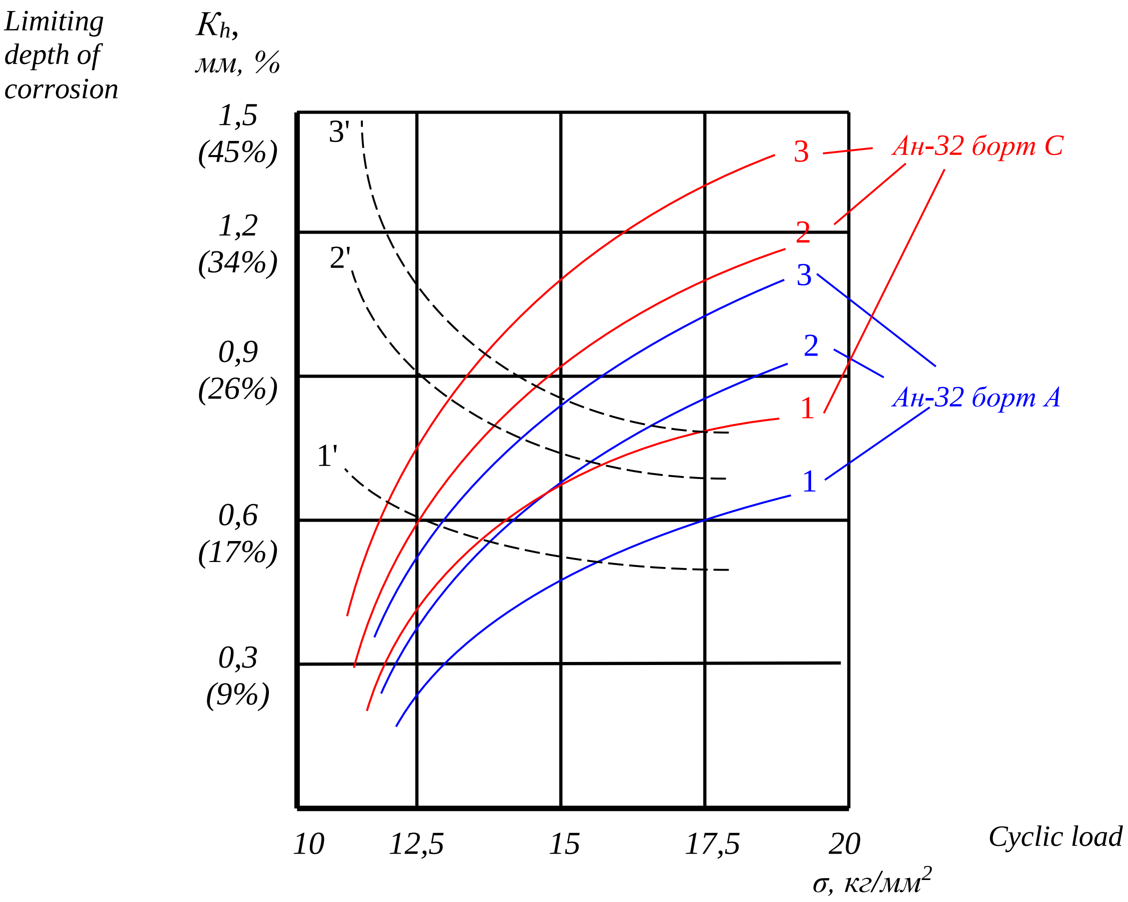

Figure 1.8. Diagram of the relationship between the average values of local corrosion damage, cyclic loads and the probability of their destruction, obtained by extrapolating the actual values of corrosion damage of structural elements of An-32 aircraft to the values of cyclic loads. The probability of structural failure: 1 - P = 0.01; 2 - P = 0.1; 3 - P = 0.5.

2. OVERHAUL PROCESS

2.1 ORGANIZATION OF THE OVERHAUL PROCESS

Taking into account the positive experience of the Indian side in alternating the repair of the An-32 to the BRD-1 with the obligatory subsequent overhaul at the enterprise, we propose to extend this repair organization scheme to the remaining 64 aircraft with the modernization of the AN- 32 RE configuration and the implementation of mandatory bulletins.

In the near future, the enterprise will send a team of specialists of 4-5 people to provide technical assistance in mastering the repair of An-32 at a repair plant in Kampur.

The specialists of the enterprise will provide technical assistance in carrying out a technical consulting audit in terms of the implementation of bulletins, overhaul of aircraft, as well as the very system of organizing repairs at the base in Kampur.

The enterprise will provide the Indian side with technical assistance:

2.1.1. In the development, implementation and certification of the quality system of the repair plant in Kampur in terms of repair of An-32 aircraft in accordance with International standards in the field of repair and maintenance of military aviation equipment.

2.1.2. In the development and implementation of a computerized system for recording defects, monitoring operational reliability, planning programs for maintenance and repair, determining the authenticity of aircraft components.

2.1.3. Implementation of a system for the development, accounting and management of technological documentation.

2.1.4. Organization of a computerized aircraft fault detection system and their components.

2.1.5. Organization of a system for evaluating, selecting and approving suppliers of materials and spare parts.

2.1.6. Organization of the system of training, retraining and training of personnel in the workplace.

2.1.7. Organization of certification (approval) of special (welding, electroplating, vulcanization, heat treatment) and especially critical technological processes with control of the I- th part.

2.1.8. Organization of technological processes for restoring parts and manufacturing spare parts.

Offers to improve the processes of repair and modernization of An-32 aircraft of the Indian Air Force in order to restore their technical characteristics:

- Implementation of automated systems for flaw detection and repair of the airframe and aircraft systems, taking into account the instrumentation for flaw detection, non-destructive testing using detailed nominal operational fault detection cards.
- Dissemination of positive experience in the implementation of registered operational fault detection and repair cards for An-26 aircraft units of registration of the European Union, developed in accordance with the EU Aviation Rules PART-145 for the An-32 aircraft as a whole (English-Russian text).
- Dissemination of experience in the manufacture of spare parts for An-26 aircraft registered by the European Union for the An-32 aircraft with the issuance of individual technological passports and certification of special manufacturing processes.
- Introduction of painting the outer surface of An-32 aircraft with the promising AERODUR-5000 enamel from Akzo Nobel, APS-A washes and environmentally friendly E-series washes.

- Use of the automated control panel PKZh-3000 in the manufacturing process, installation and control of electrical harnesses in the process of repair and modernization of the An-32.
- Complete replacement of aircraft electrical harnesses of the SPUT system in zones 5, 6, 7, 8.
- Modernization of the flight information registration and processing system in terms of replacing the Tester-U3 product with the BUR-4-1.
- Agreeing with the Aircraft Developer of a solution to replace the R-800 radio station with a more modern and reliable one.

Measures implemented at the enterprise to improve the quality of aircraft repair.

2.1.9 The plant has successfully passed certification and received Certificate No. UAR - MAA -145.0112 of the Ministry of Defense of Ukraine for the right to repair, maintenance and modernization of military aviation equipment.

2.1.10 A set of documentation for certification PART- 145 was developed and revised , including 3 books of the Manual of the Organization for Maintenance (MOE) for the State Aviation Service of Ukraine, EASA and the Ministry of Defense of Ukraine.

2.1.11 The retraining of the Certifying personnel (23 people) was carried out in accordance with the requirements of PART -66, as well as the European standard EN 4179 for non-destructive testing.

2.1.12 Personnel were trained for maintenance and repair of the TG-16M APU. The repair of TG-16M was mastered.

2.1.13 Completed works on re-certification of special processes and manufacturing of spare parts (welding, spraying, electroplating, heat treatment, vulcanization).

2.1.14 Works on the repair, reconstruction and re-equipment of the premises of the repair shops of units No. 1,4,5,6,8, warehouses of the Supply Department (UO) were carried out.

2.1.15 The system of selection, evaluation and approval of Suppliers of products and Subcontractors of works has been introduced.

2.1.16 A system of complete incoming control of spare parts, materials, components purchased and manufactured at the plant with functional tests in the shops was introduced.

2.1.17 A comprehensive system of identification and traceability of parts, materials, components, spare parts throughout the entire production cycle has been introduced .

2.1.18 An ordering system and operational charts (technological passports) for the manufacture of spare parts have been introduced.

2.1.19 Operational maintenance cards for all types of maintenance work for the An-32 aircraft, as well as personalized Russian-English cards for the repair of AiREO components and mech units were developed and implemented . systems.

2.1.20 Painting passports for An-32 and other types of aircraft have been developed and implemented.

2.1.21 A system for registration of maintenance documentation, as well as elimination of defects and additional work, in accordance with the requirements of PART- 145 and MOE, has been introduced.

2.1.22 A system of internal audits has been introduced, which provides not only an audit of the quality system, but also an audit of the MRO of the aircraft /

component. The system proves its effectiveness in practice, because tied to jobs.

2.1.23 Based on the results of repairs and flight tests of the V-4 An-32 batch, an action plan was introduced according to Order No. 295 dated September 25, 2012, aimed at improving the quality of repairs (report is given).

2.1.24 A new section for argon-arc welding with modern equipment was organized, a modern welding machine " Fronius " (Austria) was introduced .

2.1.25 The use of the LTK-150 laser technological complex in the repair has been mastered.

2.1.26 The service area for nickel-cadmium batteries of the NC SPB- 25/50 AN type was reconstructed using an automated installation UL- 10.

2.1.27 The automated installation PKZh-300 has been introduced into the technical process for monitoring electrical harnesses during modernization for products R-800, SSV, KURS-93M, GPS , SPU-8, SRPPZ-2000M, NPI No. 1,2, AD-32, BPK-2V, CAS -100.

2.1.28 In 2013. the painting of the outer surface of aircraft with Akzo - Nobel " AERODUR -5000" enamel was mastered.

2.1. 29 APS - A washes were introduced into production , as well as environmentally friendly washes of the "E" series, which make it possible to reduce the cleaning time and improve the sanitary and hygienic conditions on the site.

2.1.30 The areas for flaw detection of non-removable and removable aircraft equipment were combined in one shop.

2.1.31 A technical decision was made to completely replace the aircraft electrical harnesses of the SPUT system.

2.1.32 A mentoring system for newly enrolled young workers and specialists has been introduced, as well as a system for assessing the competence of performers with the presentation of the fulfillment of control tasks before admission to independent work or when the category is increased.

Below are the data of the statistical comparative analysis of defects revealed during the repair process, as well as during the I and II test flights of AN- 32 RE by the Customer's crews (Fig. 2.1, 2.2).

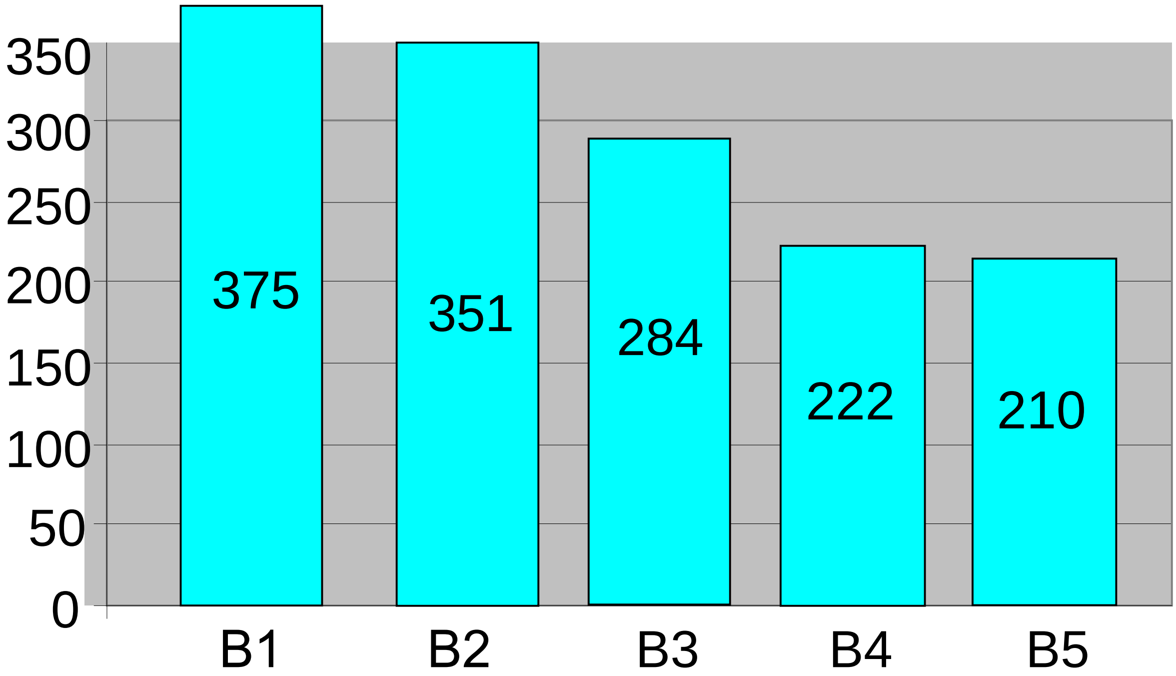

Figure 2.1 Distribution of the number of defects revealed during the repair, fine-tuning of aircraft, systems and flight tests of the An-32

The number of manufacturing defects in the repair cycle, as well as during flight tests, ***decreased*** on average for B1-B5 batches by ***1.78 times*** .

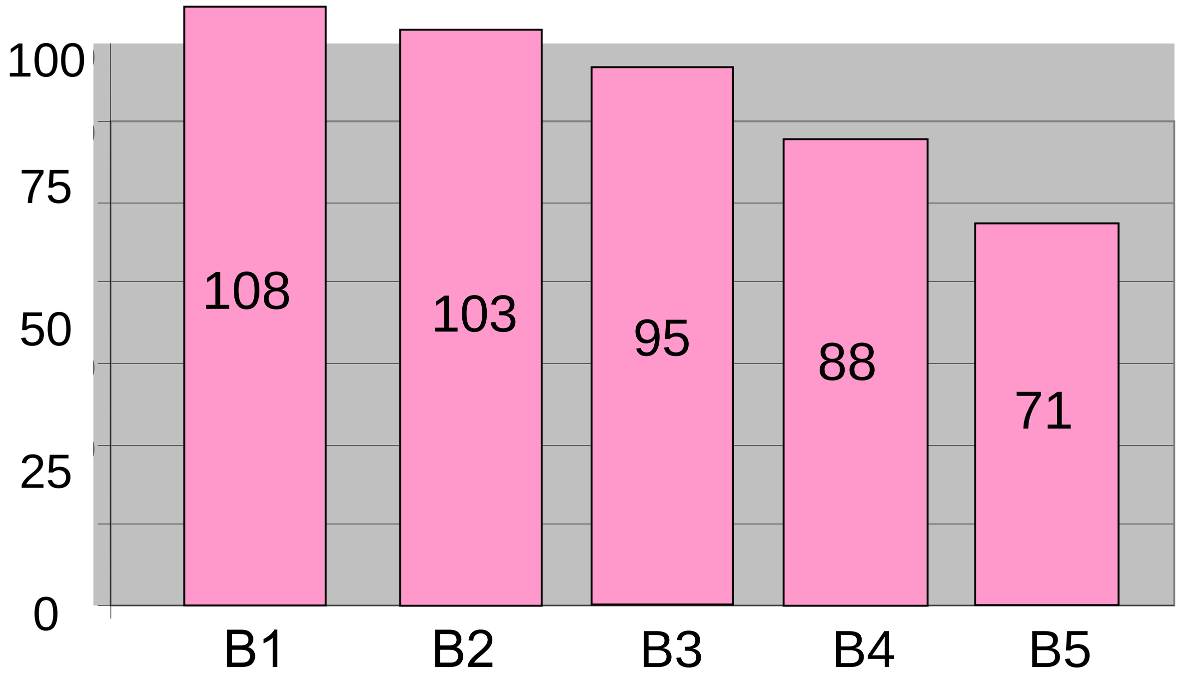

Figure: 2.2. Average number of defects detected by the Customer's crews (I and II flights) during flight tests of An-32 batches of B1-B5

On average, for batches B1-B5, the number of defects detected during flight tests of the An-32 by the Customer's crews ***decreased*** from 108 for the first batch of B1 to 71 for batch B5, i.e. ***1.52 times,*** or up to 14 per aircraft.

The list of bulletins requiring execution in a large specialized aircraft repair center

1. 515 BE-B "Resources and service life of AN- 32, AN - 32 RE aircraft and their components".
2. 45 BD-B "Wing - power set - reinforcement of the second spar of the center section near the 6th rib.

3. 80 BU-B "Option A. Airborne transport equipment - equipment for airborne cargo - installation of a D-5 parachute chamber limiter, increasing the reliability of fastening the lining in the flow separator holder".
4. 104 BU-B "Wing - control surfaces - replacement of brackets for hanging the inner flap on reinforcement".
5. 106 BD-B "Wing - structural elements of the wing - replacement of springs on the flap of the wing of the tail section of the SChK".
6. 111 BD-B "Refinement (repair) of the elevator in the area of the hinge nodes along 2,7,11 ribs".
7. 133 BD-B "1. Wing - power elements of the wing - reinforcement of ribs 1 and 1A of the center section at the fuselage junction. 2. Glider - control system - aileron control channel. Replacing the bracket with a roller of the steering gear".
8. 146 BU-B "Wing - spar II - elimination of the skewing of the heads of the bolts for attaching the flap mounting brackets".
9. 209 BU-B "Wing. Control surfaces. Modification of ailerons and their attachments".
10. 211 BD-B "Chassis. The main chassis and sashes. Replacing the levers of the sash control mechanism on the racks of the main support".
11. 402 BU-B "Wing - control surfaces - installation of struts when refining ailerons (Supplement to bulletin 209 BU-B)".
12. 414 BU-B "Doors, hatches, cargo hatches. Modification of forks of ramp locks and replacement of hooks on frame 40".
13. 416 BD-B "Fuselage. Power structure. Reinforcement of the fuselage in the area of frames 10,11,12".
14. 438 BD-B "Wing control surfaces. Replacing the slat attachment rockers on reinforcement."
15. 443 BU-B " Anti-icing system. Slat reinforcement. Reinforcement of micro-ejector pipes fastening".

16. 450 BU-B "Chassis. The main chassis. 1. Replacing the rear flaps of the main support on the reinforcement. Modification of the levers and installation of the brackets on the amortization of the main support".

The experience of operation and repair has shown that even small, but often repetitive loads have a great influence on the durability of the structure. At the same time, in fact, a stable tendency has been revealed, when the depth of corrosion damage was 1.25 ÷ 1.3 times greater on airplanes with significantly fewer flight hours and flights. As a rule, these aircraft were operated not in a subequatorial maritime climate, but in a mountainous subtropical humid climate with significant daily and seasonal temperature differences (Fig. 4, Table 1).

Analysis of the statistical data obtained indicates that further extension of the assigned resources and service life of An-32 aircraft without in-depth diagnostics of their technical condition and performance of repair work is not effective. The best option, taking into account economic feasibility, while ensuring the reliability and requirements for maintaining the airworthiness of the An-32 aircraft, could be their transfer to basic maintenance based on the performance of control and restoration or repair work with a simultaneous increase in the assigned resources and service life, as provided in Aviation Regulations PART- 145.

2.2 OPTIMIZATION OF THE OVERHAUL PROCESS

Since the introduction of new technologies and programs is highly appreciated in our time, a certain proposal has appeared to optimize the process of overhaul at the enterprise.

A special plan was developed. From the input, we have a straight line X indicating time. Along this straight line, blocks with tasks were located (receiving the aircraft, disassembling the aircraft, removing paint and further work moving from shop to shop, in other words, a chain of actions).

The new plan was named "Technological graph of optimization of overhaul process".

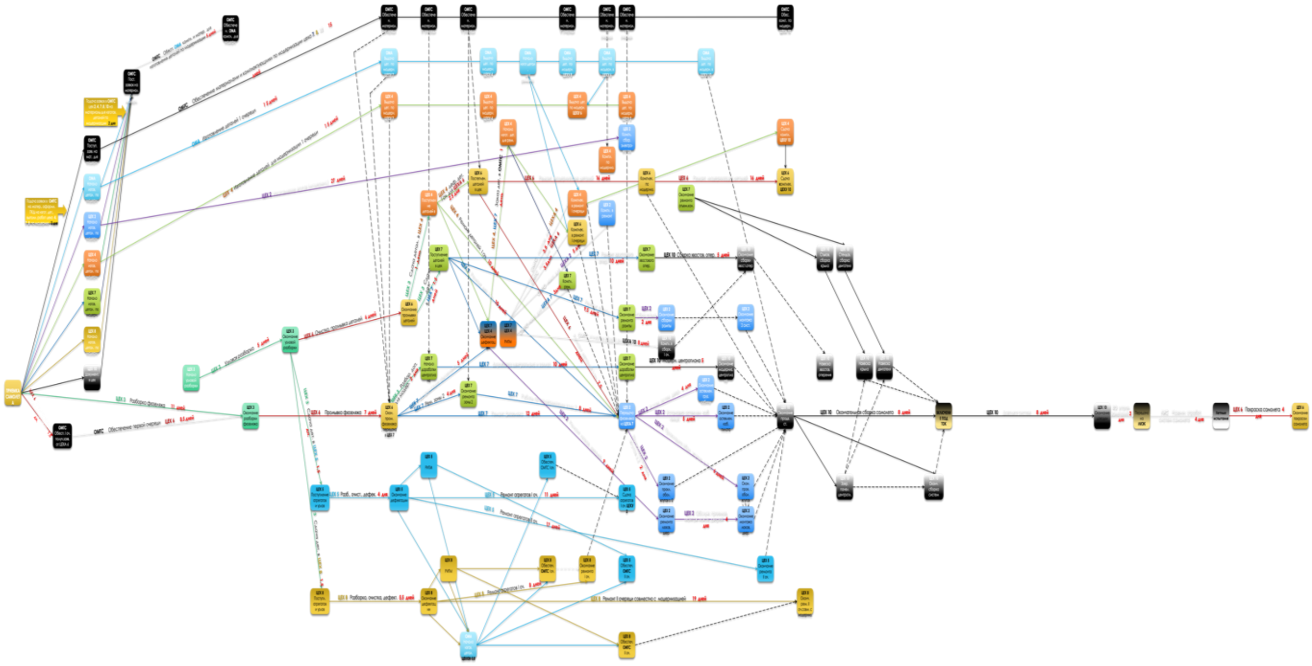

Figure 2.3 Technological graph of optimization of overhaul process

The introduction of this schedule opens up new opportunities for reducing the time spent by each aircraft under overhaul.

As we can see in the graph, the X-axis that indicates time is preserved. Cross processes are built on the X-axis. These processes run parallel to each other. This allows several workshops to do their job at the same time. Having large areas for the main workshop, which can accommodate 4 aircraft and a sufficient number of specialists, we can cross specialists between aircraft to perform various types of locksmith work.

The new schedule made it possible to develop new diagnostic methods for aircraft systems. Take wiring diagnostics, for example. The customer was tasked with preserving the original wiring, which is more than 40 years old. Naturally, for such a period of time and under such operating conditions, this unit cannot be preserved in its original form.

A special device was developed that could show the specialist in which part of the harness there is a short circuit, which in turn allows you to quickly replace the necessary wire in the harness without going through each wire separately. This implementation allowed to reduce the time spent wiring in the shop, as well as to reduce the number of defects associated with inoperative systems at the stage of final tests.

In addition to reducing the time, this schedule also has an economic effect. Focusing on it, you can contact the customer to receive the following parts of financing. Also, there is no need to maintain warehouses with spare parts. The schedule allows you to think ahead on what day you need to place an order for delivery or manufacture of new spare parts. Thus, there is a decrease in the cost of capital repairs.

2.3 BASIC PROGRAM AGING CONTROL OF AN-32 / AN-32RE AIRCRAFT OF THE INDIAN AIR FORCE

1. Introduction

Basic Aging Control Program(PCS) of the An - 32 / A N -32 RE aircraft of the Indian Air Force was developed within the framework of the concept of the phased establishment and increase of resources and service life based on the recommendations (requirements) for supporting the operation of a group of lead flight aircraft. PKS is performed with an interval not exceeding 5 years when performing work to establish the assigned service life over 25 years.

2. Purpose of work

The goal of the Program is to maintain the required level of flight safety for An - 32 / A N- 32 RE aircraft of the Indian Air Force with a maximum takeoff weight of 28,500 kg (maximum payload of 7,500 kg) with a phased development of the assigned service life of 40 years within the assigned resource of 20,000 flight hours, 15,000 flights.

3. Basic provisions

The assessment of the compliance of the rate and nature of aging with the calculated (design) parameters is carried out according to the results of the calculation and research works, which provide for:

–Investigation of the technical condition of the aircraft in order to identify individual design features (changes made to the design or acquired by it from the beginning of operation).

–Assessment of the degradation of the properties of materials used in the aircraft construction.

–Identification of factors (problems) that have not been taken into account in the design, which reduce flight safety.

–Analysis of changes to the typical design.

–Assessment of the conformity of the expected operating conditions (based on the analysis of operating data) to real conditions.

–Evaluation of the effectiveness and sufficiency of existing maintenance and updating (if necessary) operational documentation.

PKS includes:

–Structural aging control program;

–Aging control program for functional systems and onboard equipment;

–Supplement to the PKS, developed when it is necessary to take into account the individual characteristics of an aircraft instance.

4. Structural aging control program

4.1. Design conformity assessment

The typical design of the aircraft is determined by a set of working design documentation (RKD) and operational documentation (ED).

4.1.1. Aircraft design conformity assessment RKD

Evaluation of the conformity of the design of a specific aircraft copy with working design documentation are carried out in order to identify individual features (changes) made to the design or acquired by it during operation. Individual design features are classified into eight main groups:

1. Design improvements (according to bulletins or other documentation).
2. Repairs (reinforcement) of damaged structural elements.
3. Damage to structural elements (samples of corrosion, backlash / wear, permanent deformation, etc.).
4. Damage to protective coatings of structural elements.
5. Changes in the mechanical properties of structural materials.
6. Replacement of units or individual structural elements.
7. Violations of assemblies of structural elements.
8. Modifications and repairs of structural elements performed with deviations from the requirements of the design documentation (CD) of the Aircraft Designer (SE "Antonov").

Compliance with the design of the RKD is established in the process of performing work on the study of the technical condition of the aircraft and restoration work, including:

1. Study of aircraft forms and passports.
2. Measurement of backlash in accordance with Appendix No. 1.
3. Visual inspection of the aircraft structural structure, see Appendix 2.
4. Visual inspection of the aircraft control system parts made of magnesium alloy, see Appendix # 3.
5. Non-destructive testing of structural elements in the scope of RK-32 and Appendix No. 4.
6. Restoration work in accordance with the recommendations of RK-32 and completion (reinforcement) of the structure in accordance with Appendix No. 5.
7. Works under the Corrosion Prevention and Control Program.

4.1.2. Evaluation of the conformity of ED for the aircraft design

Operational documentation defines the aircraft's flight characteristics and operational limitations. The standard ED conformity assessment involves checking the timely and complete introduction of all additions and changes developed by Antonov SE.

4.2. Analysis of operating conditions

The analysis of the actual operating conditions for the previous period (one to two years) and the forecast for the next operating period (one to two years) are carried out to assess their compliance with the calculated parameters.

The conformity assessment of the operating conditions is carried out on the basis of information provided by the Indian Air Force about the main operational defects of the airframe's power structure and systems for the entire period of operation of the An - 32 / A N - 32 RE fleet and data on the operating conditions of the entire fleet or individual groups of aircraft for the previous operation period and forecast for the planned period (5 years).

The report on the main operational defects of the airframe load-bearing structure and systems for the entire period of operation should include:

1. Description of each defect and the circumstances of its detection (in the course of maintenance, overhaul, in flight, ...).
2. Service life and operating time (flight hours, flights) at which the defect was detected.
3. Defect occurrence rate (single or repetitive).
4. Measures to eliminate the defect and their effectiveness (whether the defect reappeared after elimination).

Operating conditions data should include:

1. Description of typical flights (typical tasks).
2. Plaque in hours and flights since the beginning of operation and after the last major overhaul.
3. Average statistical data on the number of rollbacks and rolls of the load carrier ramp in total and in the air.
4. For flights on the "conveyor", it is also necessary to indicate the number of approaches and the procedure for accounting for flights.
5. Flight profile.

The flight profile is set in the form of a set of ground and air modes with an indication of the characteristic parameters (takeoff and landing weight of the aircraft, takeoff and landing weight of cargo, takeoff and landing weight of fuel, flight altitude, distance or duration of flight, airfield coverage) and a description of the methodology for performing the modes. A description of the method of performing the modes is given if it differs from the recommended one, or is not specified in the RLE-32.

4.3. Evaluation of DE sufficiency for the aircraft design

The sufficiency of the ED recommendations to maintain the established level of airworthiness is confirmed in the course of the design and research work, which provides for:

- Analysis of changes made to the design during operation and repair.
- Clarification of the list of critical points.
- Determination (clarification) of the loading of critical places of the structure, taking into account the possibility of an unfavorable combination of accidental, fatigue and corrosion damage.
- Determination (clarification) of permissible operating time (before the start of inspections and between inspections) for all critical points of the structure.
- Analysis of problems unaccounted for in aircraft design.
- Determination of the minimum sufficient requirements (conditions) to maintain (ensure) the required level of flight safety.

The work on the assessment of the DE sufficiency is carried out based on the results of the design conformity assessment to the standard design and analysis of the aircraft operating conditions, see paragraphs 4.1 and 4.2.

5. Program for monitoring the aging of functional systems and aircraft onboard equipment

5.1. Conformity assessment of the design of functional systems and on-board equipment of an aircraft of a typical design

The typical design of functional systems and on-board equipment of the aircraft is determined by a set of working design documentation (RKD) and operational documentation (ED).

5.1.1. Conformity assessment of the design of functional systems and onboard equipment of the aircraft RKD

Evaluation of the conformity of the design of functional systems and on-board equipment of the aircraft with working design documentation are carried out in order to identify individual characteristics introduced during operation. The individual characteristics of functional systems and onboard equipment can be grouped into six main groups:

1. Improvements (by bulletins or other documentation).
2. Repairs (reinforcement) of damaged structural elements of functional systems.
3. Damage to communication elements (scuffs, embossing, corrosion or cracks in air ducts and pipelines, cracking of hoses and dyurits , leakage, damage to screens or insulation of electrical wires, failure to fix, burning or oxidation of connectors, etc.).
4. Violations of installations, which led to contact (unacceptable reduction of clearances) of pipelines or electric wires (electric harnesses) with each other, the frame of the structure or moving elements of the structure.
5. Changes in the properties (electrical, physical-mechanical, etc.) of rubber and electrical insulating materials, which can lead to multiple failures of one or more functional systems.
6. Replacement of individual elements of functional systems and onboard equipment.
7. Damage to protective coatings of structural elements.

Conformity of the design of functional systems and onboard equipment of the aircraft to the RKD is established in the process of performing work on the study of the technical condition of the aircraft and restoration work, including:

1. Study of aircraft, engines, APU and CI passports.

2. Visual inspection of aircraft systems.
3. Acquaintance with the results of the overhaul (defect detection , restoration work, etc.).
4. Investigation of electrical, physical-mechanical and diagnostic parameters of wires BPDO, BIF, BPGRL-T.
5. Works under the Corrosion Prevention and Control Program.

5.1.2. Evaluation of the conformity of ED for functional systems and on-board equipment of a typical aircraft

Operational documentation defines the aircraft's flight characteristics and operational limitations. The standard ED conformity assessment involves checking the timely and complete introduction of all additions and changes developed by Antonov SE.

5.2. Evaluation of DE sufficiency for functional systems and aircraft onboard equipment

The sufficiency of the ED recommendations to maintain the established level of airworthiness is confirmed in the course of the design and research work, which provides for:

- Analysis of changes made to the design during operation.
- Assessment of the impact of individual characteristics on special situations.
- Analysis of factors (problems) unaccounted for in the design of the aircraft.
- Analysis of failures of functional systems and onboard equipment.
- Determination of the minimum sufficient requirements (conditions) to maintain (ensure) the required level of flight safety.

The work on the assessment of the ED sufficiency is carried out based on the results of the assessment of the conformity of the design of functional systems and onboard equipment of the standard design, see clause 5.1.

6. Supplement to the Program

Based on the results of the analysis of the individual characteristics of the aircraft under study (see clauses 4.1, 4.2 and 5.1), the scope of work given in Appendices No. 1-6 may be clarified by the Supplements to this Program.

7. The order of work and performers

The work under the Aging Control Program is carried out in the process of overhaul of An - 32 / A N -32 RE aircraft of the Indian Air Force at the aircraft repair enterprises (ARP) Enterprise (Kiev, Ukraine) or BRD-1 (Kanpur , India).

PKS is performed with an interval not exceeding 5 years when the assigned service life of the aircraft is established over 25 years.

Specialists of SE "Antonov" perform the following works:

- study of the technical condition of the aircraft (see items 4.1, 4.2 and 5.1 of the Program ;
- development of Supplements (if necessary) in accordance with Section 6 of the Program;
    - participation in the performance of a visual inspection of the structural elements of the airframe, power plants, aircraft systems and A & REO;
- participation in the implementation of non-destructive testing in the scope of;
- participation in the selection of wire samples BPDO, BIF, BPGRL-T ;
- analysis of defects and malfunctions found on the aircraft in the process of investigating its technical condition within the scope of this Program;
- issuance of recommendations for the elimination of defects and malfunctions found on aircraft that go beyond the tolerances specified in the current "Manual for the overhaul of An- 32 aircraft " (edition 9.01.1989);
- preparation of the Act for the study of the technical condition of the aircraft;
- settlement and research work in accordance with paragraphs . 4.3 and 5.2 Programs.

ATM specialists carry out the following works:

- preliminary work;

- visual inspection of the load- bearing elements of the airframe structure, power plants, aircraft systems and A & REO with the participation of Antonov SE specialists;
- visual inspection of the parts of the aircraft control system made of magnesium alloy;
- non - destructive testing with the participation of Antonov SE specialists;
- improvements;
- application (renewal) of additional anticorrosive protection of the aircraft structure in accordance with the technological instructions given in the Corrosion Prevention and Control Program;
- verification of all forms (passports) of the airframe and components (CI), as well as duplicate passports;
- dismantling and assembly works, performance check and overhaul (if necessary) of foreign-made AiREO installed on aircraft ;
- overhaul in the amount of RK-32 (ed. 09.01.1989);
- elimination of defects and deficiencies identified during;
- selection of wire samples BPDO, BIF, BPGRL-T with the participation of specialists from SE "Antonov";
- Clarification of the "Album of repair of airframe structural elements " on the basis of the results of the next overhaul;
- execution of the Act of investigation of the technical condition of the aircraft.

Backlash measurements and visual inspection of the load-bearing elements of the airframe structure, power plants, aircraft systems and A & REO in accordance with Appendices No. 1 and 2 are performed at the stage of preliminary and dismantling works provided for by RK-32.

2.4 MODERNIZATIONS COMPLETED DURING OVERHAUL

Enterprise overhauls AN-32 aircraft to improve their performance, make crew members’ workplace more comfortable and promote aircraft operation on international air routes through:

- extending the assigned aircraft service life to 40 years;
- increasing the maximum takeoff weight to 28.5 tons;
- expanding the maximum payload to 7.5 tons;
- upgrading avionics;
- improving aircraft systems;
- reducing noise and vibration up to ICAO standards;
- strengthening aircraft structural units;
- updating electric equipment at customer's request;
- swapping BI-2A and SSP-2A fire warning system with BPS-32;
- overhauling.

Upgraded avionics:

- ACASII (TCAS - II (CAS - 67A) system, including radio altimeter, to improve flight safety in accordance with ICAO standards.
- superseded RAM-700A by A-053;
- RLS (RDR-2100);
- MFI (KDM 850-03);
- KPA-405B- 15;
- DME KDM 0706A-26;
- AD-32 altimeter;
- Temperature receiver (P/N 05257);
- GPS (CH -4312) for navigation accuracy improvement;
- KURS MP-2 with VOR/ILS (KURS-93M) for radio interference suppression and weight saving;
- BPK-2B unit;
- TAWS (SRPPZ-2000) , including two multi-functional indicators, for greater flight safety under ICAO standards; MVP-1- 1 air data module for automatic adjustment of receiver position errors; UVK-1FK barometric pressure altimeter, P-104 ambient sensor and SSVEK-1, ser.2, system;
- Selective Calling Radio System (SELCAL); Navigation-landing indicator (NLI);

- superseded VUC-201A radio station by VHF/UHF (R800L2E) to increase capacity from 10Watt to 20Watt under the ICAO regulation on 8.33 kHz channel spacing;
- stationary emergency locator transmitter (Artex C-406- 1);
- portable emergency locator transmitter (Kannad 406AS);
- radio station (IC-A24);
- adapter (OPC-499);
- radio station (HF-9000);
- fire warning system (BPS-32);

New tecnologies

Engine repair

Quality management system and certificates

Customization

Quality management system and certificates

Cabin crew seats:

- replaced pilot and co-pilot seats with fabricated ones (analogue to 72.04.7501.600.000 seats on AN-74).
- refurbished navigator seat with cover and head-rest.
- equipped flight engineer station with a folding chair, oxygen equipment and the CPU-AAZ interphone control box.
- fitted cabin crew station with inertia-reel shoulder harness.

Wing, fuselage and landing gear modification in:

installing endurance plate on the lower center wing panel and refining the upper wing-fuselage fairing member;

replacing navigator blister and cockpit canopy (besides electrically heated) with enhanced lightweight plate glass;

refining cockpit floor after pilot seat replacement and flight engineer seat installation;

upgrading cockpit noise reduction to 89-90 dBA, including vibration, due to:

VTP-1V soundproof materials (2...3 mm);

additional fuselage skin stringer simulation;

Microlite heat insulation-sound proofing;

floor and wall soundproofing elements at No 7 frame;

additional manual main landing gear (MLG) door control system (port and starboard) for MLG manual opening in the cargo cabin.

Hydraulic System Modification

superseded hydro pumps 435F (2 pcs) by NR-32 to improve reliability and extend aircraft TBO life from 1,500 to 4,000 flight hours;

upgraded hydraulic reservoir and superseded N5812-01 drain line filter by 8D2.966.515-03 to raise hydraulic fluid clearance quality.

Oxygen supply system

traditional crew member oxygen equipment is superseded by BKO-5K and KM-114K mask (4 pcs), BKP-2- 2-210, DKM-1M, KV -20 (2 pcs.), UZP-7A2, D30-1L (4 pcs.) for David Clark Headsets (USA);

at customer’s request, extra fifth BKO-5K, KM-114K and D30-1L is installed in the cargo cabin portside (frames 9-11).

Removing aircraft oxygen supply equipment:

KP-24M, KM-32, RD-24B, KR-24, KP-23, IK-18K, KSh-24 – 3 pcs. each;

KR-15 - 1 pcs.;

KV-15A - 4 of 5 pcs.

3. OCCUPATIONAL SAFETY

3.1 Analysis of harmful and dangerous production factors.

Harmful and dangerous production factors for aircraft technician according to the standard ГОСТ 12.0.003-74:

1) Physical;
   a) moving machines and mechanisms; moving parts of production equipment; moving products;
   b) the increased dustiness and gassiness of air of a working zone;
   c) increased or decreased temperature of surfaces of equipment, materials;
   d) increased or decreased air temperature of the working area;
   e) increased noise in the workplace;
   f) increased vibration level;
   g) increased voltage in the electrical circuit, the short circuit of which can occur through the human body;
   h) increased level of static electricity;
   i) lack or absence of natural light;
   j) insufficient lighting of the working area;
   k) sharp edges, burrs and roughness on the surfaces of workpieces, tools and equipment;
   l) location of the workplace at a significant height relative to the ground (floor);

2) Chemical;
   a) toxic;
   b) annoying;
   c) by penetration into the human body through:
      - respiratory organs;
      - skin and mucous membranes.
3) Psychophysiological.
   a) physical overload;

      - static;
      - dynamic.
   b) neuropsychiatric overload.
   - analyser overvoltage;
   - monotony of work;
   - emotional overload.

3.2 Measures to reduce the impact of harmful and dangerous production factors.

Artificial lighting calculation

Normal room illumination ($E_{\min}$) depends on the level of visual work performed in this room, which in turn is determined by the minimum size of the object of discrimination. Job Service Engineer IV refers to the OS level visual works. For general lighting engineer at the lowest room illumination by ДБН В.2.5–28–2006 "Природне і штучне освітлення" of at least 400 lx (lux). The actual value of light is 200 – 250 lx. Total light output is given by:

$$E_{gen} = \frac{E_n \cdot S \cdot k_1 \cdot k_2}{V} \quad (3.1)$$

where E_n – normalized illumination ($E_n = 400lx$);

S – area of application;

k_1 – Coefficient taking into account the aging of lamps and lighting pollution *(k_1=1,2)*;

k_2 – Coefficient taking into account the uneven illumination space *(k_2= 1.1);*

V – Ratio of luminous flux, defined according to the reflection coefficient of walls, work surfaces, ceilings, room geometry and types of lamps.

Room size up: A = 70 m, B = 40 m, H = 11.2 m.

$$S = A \cdot B = 70 \cdot 40 = 2800\ m^2 \tag{3.2}$$

Choose the table using the light flux ratios:

1. Reflection coefficient of whitewashed ceiling ($R_{ceiling}$ = 70%);$R_{стелі} = 70\%$;
2. Index of refraction of white walls (R_{wall} = 55%);
3. Reflection coefficient from the dark hardwood floors (R_{floor}= 10%);
4. Index space ($i = \frac{A \cdot B}{h_p \cdot (A+B)}$).

$$h_p = H - h_n \tag{3.3}$$

where h_n– work surface height over the floor (h_n=0.7 m).

Defining the room rate:

$$h_p = 11.2 - 0.7 = 10{,}5 m$$

The utilization of light flux:

$$i = \frac{70 \cdot 40}{10{,}5 \cdot (70+40)} \approx 1{,}78. \tag{3.4}$$

Now we define the value of the total luminous flux: (*V=0.7)*

$$E_{gen} \frac{200 \cdot 2800 \cdot 1{,}2 \cdot 1{,}1}{1{,}78} = 415280\ lm \tag{3.5}$$

To ensure total artificial lighting, selected LED bulbs LED Kedr СБУ 300W and replace fluorescent lamps 18W 990 lm. Luminous flux of one lamp LED-T8SE-180 (20W.). Thus, E_l=39000 lm.

Now we define the number of lamps required to illuminate the room:

$$N = \frac{E_{gen}}{E_l} = \frac{415280}{39000} = 11\ lamps \tag{3.6}$$

Thus, to provide light $E_{gen}=19800\ lm$ output the 12 lamps must be used, lamp instead of 20. Put in 2 rows. Power of 20 fluorescent lamps:

$$W_{gen}=W_N \cdot N=18 \cdot 20 = 360W \tag{3.7}$$

Savings from the use of LED lamps.

$$N = W_{gen} / (N_{LED} \cdot P_{LED})= 360/(12 \cdot 20)= 1.5 \tag{3.8}$$

3.3 Occupational Safety Instruction.

1. GENERAL PROVISIONS

1.1. In accordance with the Rules for the management and maintenance of lifts by the management of the enterprise (organization), the workshop, drivers are appointed who have a certificate for the right to operate a lift of this type.

1.2. The duties of drivers can be performed by persons who are at least 18 years old and who have no medical contraindications based on the results of a medical examination.

1.3. Training and certification of lift drivers are carried out in vocational schools, as well as courses in technical training schools that have a base for theoretical and practical training. The training of lift drivers is carried out according to training programs agreed with the State Technical Supervision of Ukraine.

Certification of lift drivers is carried out by a commission with the obligatory participation of a representative of the territorial bodies of the State Technical Supervision of Ukraine.

1.4. Driving a car lift can be entrusted to the driver of the vehicle after training him according to the appropriate program and certification by the qualification commission.

1.5. Persons who have passed the exams are issued a certificate signed by the chairman of the commission and a representative of the state technical supervision body. The driver's license must indicate the type of lift he is allowed to operate. A photo must be pasted in on the lift driver's license. During work, the operator of the lift must have a certificate with him.

1.6. The admission of drivers to independent work is formalized by an appropriate order for the enterprise (organization) after the issuance of an attestation certificate to them.

Before being admitted to work, the management of the organization (enterprise) or workshop is obliged to check with the drivers the knowledge of the operating manual of the hoist on which it is allowed to work, and hand it (against receipt) the operating manual. In addition, if there is a lifting device on the hoist, slingers must be appointed with an appropriate certificate.

1.7. After a break in work in his specialty for more than one year, the driver must pass a knowledge test in the commission appointed by the owner of the lift, and in case of satisfactory test results, he can be admitted to an internship to restore the necessary skills.

1.8. Re-examination of the knowledge of drivers is carried out by the qualification commission of the enterprise:

1) periodically, at least once every 12 months;

2) when moving from one place of work to another;

3) at the request of an inspector of Gosgortekhnadzor or an engineer and technical worker for supervision over the safe operation of lifts in an organization.

Re-examination of knowledge should be carried out in the scope of the production (typical) instructions and the lift operation manual. The participation of the Gosgortekhnadzor inspector when re-checking the driver's knowledge is not necessary.

1.9. A driver transferred from a lift of one type to a lift of another type (from automobile to crawler) must be trained and certified in the manner prescribed by the Rules. In this case, training can be carried out according to an abbreviated program agreed with the state technical supervision authorities.

1.10. The driver who is transferred from one lift to another of the same type, but of a different model, index or with a different drive (from the AGPM-18 / 9-7.5 car lift to the PT-11 car lift), must be familiar with the features of the device and maintenance such a lift and undergo an internship. After checking practical skills, the driver can be allowed to work independently.

1.11. The lift operator must know:

1) lift operation manual;

2) production (standard) instructions for safe operation for operators of hoists (towers);

3) Typical instructions for the safe conduct of work for the cradle workers located on the lift (tower);

4) the device and the main technical characteristics of the lifts subject to registration with the Gosgortechnadzor authorities;

5) purpose, principle of operation and arrangement of mechanisms and devices of the lift;

6) the main malfunctions arising during the operation of the lift;

7) the main work performed during the maintenance of the lift, the range and purpose of lubricants used to lubricate the rubbing parts of the lift;

8) devices and rules for the use of slings, containers and other lifting devices;

9) installed alarm when performing work operations;

10) the procedure for the installation and operation of the lift near the power transmission line (PTL);

11) plumbing in an amount sufficient for self-elimination of current problems and participation in the current repair of the lift;

12) the procedure for technical maintenance and scheduled preventive maintenance;

13) the procedure for performing work with a hoist;

14) instructions on labor protection, basic means and methods of preventing and extinguishing fires at their workplace, rules of sanitation and hygiene;

15) internal labor regulations.

The driver must be able to:

1) correctly install the lift for work;

2) control the lift when lifting, moving and lowering workers in the cradle, as well as the load;

3) determine the suitability of steel ropes, slings, lifting devices and containers;

4) inspect the lift, adjust the lift mechanisms and check the operation of safety devices;

5) carry out maintenance and operational repair of the lifts of the studied models;

6) identify malfunctions in the operation of the lift and promptly eliminate them;

7) keep the logbook correctly;

8) comply with labor protection rules and other requirements;

9) coordinate the work of slingers (if necessary) and work cradles;

10) act correctly and efficiently (stop the operation of the lift) in emergency situations.

2. RESPONSIBILITIES OF THE OPERATOR BEFORE STARTING THE LIFT

2.1. Before starting work, the driver is obliged to make sure that all mechanisms, metal structures, devices and safety devices and other parts of the lift are faulty. To do this, the driver must:

1) inspect the mechanisms and brakes of the lift, their fastening, as well as the chassis;

2) check the presence and serviceability of the enclosures of the mechanisms and the cradle;

3) check the lubrication of gears, bearings and ropes, as well as the presence of lubricants, oil seals and fluid in the hydraulic system;

4) inspect, in accessible places, the metal structures and joints of the boom knees, elements related to the knees (ropes, stretch marks, blocks, hydraulic cylinders and their fasteners, etc.), as well as the metal structure and welds of the chassis (chassis) and the slewing part;

5) inspect the condition of the ropes and their fastening on the drum, boom, as well as their laying on the drum and blocks at the auxiliary load lifting mechanism, if such a mechanism is provided on the hoist;

6) check the serviceability of the supports, elastic suspension switch and stabilizers;

7) check the serviceability of the hydraulic drive of the lift, flexible hoses, pumps and safety valves on the pressure lines, if any;

8) check the presence and serviceability of safety devices and devices on the lift (limit switches, limit load limiter, blocking systems, lift tilt angle indicator, emergency lowering system of the cradle, sound signal, etc.);

9) inspect the hook, if provided by the design, and its fastening in the cage;

10) check the serviceability of the electric lift (visual inspection without removing the covers and disassembling), electrical devices (switch, starting resistors, limit switches), as well as inspect the slip rings or collectors of electric motors and their brushes. If the lift is powered by an external network, the driver must check the serviceability of the flexible cable.

2.2. The driver is obliged, together with the slinger, to check the serviceability of the removable lifting devices and the presence of stamps or tags on them indicating the carrying capacity, test date and number.

2.3. When accepting a working lift, its inspection must be carried out in conjunction with the driver who hand over the shift. To inspect the lift, the administration of an enterprise, organization or workshop must allocate the necessary time at the beginning of the shift.

2.4. Inspection of the lift should be carried out only when the mechanisms are inoperative, when the voltage is disconnected or when the hydraulic system is off.

2.5. When inspecting the lift, the driver must use a portable lamp with a voltage of no more than 42 V.

After inspecting the lift before putting it into operation, the driver, having made sure that the required dimensions of the approach are observed, must test all the mechanisms at idle speed and check the correctness of the operation:

1) lift mechanisms;

2) safety devices and devices;

3) brakes;

4) hydro and electrical systems.

2.6. If, during the inspection and testing of the lift, malfunctions or deficiencies in its condition are found that impede safe operation, and it is impossible to eliminate them on their own, the driver, without starting to work, must report this to the specialist responsible for maintaining the lifts in good condition. The driver should not start working on the lift in the following cases:

1) in the presence of cracks and deformations in the metal structures of the lift;

2) in the event of a malfunction of the cradle orientation device, the service area limiter, the cradle emergency lowering system, support blocking systems, stabilizers and other devices;

3) in the presence of deformations in the fingers and cracks in the metal structures of the links of the lever systems;

4) in case of malfunction of the rope-block system, telescope, brake of the knee lifting mechanism, where there are defects that threaten the safety of work;

5) if the cradle, support parts are damaged or if they are incomplete;

6) in case of malfunction of hydraulic control valves, bypass and safety valves, as well as in case of violation of hydraulic cylinder seals;

7) in case of failure of the limit load limiter or sound signal (warning device) or its absence, as well as if the limit switches of the departure mechanism are faulty;

8) in case of malfunction of the fencing of mechanisms and cradles or their absence;

9) in the presence of non-insulated live parts of electrical equipment.

2.7. Before starting work, the lift driver must make sure that the workplace is sufficiently illuminated, when the lift is operating without supports, fix the stabilizer, and when the railway lift is operating without supports, jam the springs.

2.8. Before the start of the shift, the lift driver is obliged to make an appropriate entry in the logbook about the condition of the lift and, after receiving an assignment from the production manager, start work according to the received order.

2.9. Before starting work, the driver must check the availability of certificates for the right to work from the workers of the cradle and slingers, if the workers start work for the first time.

2.10. It is forbidden to use the lift that has not undergone maintenance and has defects. The administration of the enterprise has no right to require the driver to start working on an unchecked and faulty lift.

2.11. The driver is obliged to install the lift on supports in all cases; at the same time, he must ensure that the supports are in good order and that strong and stable linings are placed under them. In this case, railway lifts must be reinforced with all rail clamps. The pads are an accessory to the lift and must always be on it.

It is prohibited to place random objects under the supports.

2.12. It is forbidden for the driver to stay in the cab when installing the lift on the supports, as well as when raising the supports. If the manufacturer provides for the storage of pads for supports on the non-rotating part of the lift, then they must be removed before work and put in place by the driver working on the lift.

2.13. Installation of a hoist at the edge of the slope of a pit or trench (with the exception of the slopes of railway tracks) is allowed only with the permission of the administration, subject to the distances from the base of the slope to the nearest support provided for by the Rules. If it is impossible to maintain these distances, the slope must be strengthened.

When installing a railway elevator for work on a curved section of the track without moving, the driver must strengthen it with all available rail grips, and when installing it on a slope, in addition, place brake shoes under the wheels and secure the elevator with a hand brake.

It is forbidden to work on faulty railway tracks and in places where reliable stability of the lift is not ensured. The driver is obliged to inform the supervisor of works and the engineering and technical worker for supervision over the safe operation of the hoists about the noticed malfunctions of the railway track.

2.14. The installation of the lift for construction and installation work should be carried out in accordance with the work production project, which should provide for:

1) compliance of the installed lifts with the conditions of construction and installation or repair work in terms of carrying capacity, lifting height and reach;

2) ensuring a safe distance from power lines, places of movement of public transport and pedestrians, as well as safe distances for the approach of lifts to buildings and places of storage of building structures and materials;

3) the conditions for the installation and operation of lifts near the slopes of excavations or trenches;

4) conditions for safe operation of several lifts on one site;

5) measures for the safe performance of work on the site where the lift is installed (fencing of the construction, assembly sites or repair area, etc.).

3. OBLIGATIONS OF THE MACHINE DURING LIFT OPERATION

3.1. While working on the lift, the driver should not be distracted from his direct duties, as well as clean, lubricate and repair mechanisms.

3.2. When a hoist is operated with a trainee, the driver has no right to leave the hoist even for a short time.

3.3. Trainees and other persons are prohibited from operating the lift in the absence of the driver.

3.4. Before carrying out any movement with the hoist, the driver must make sure that the trainee is in a safe place, there are no strangers in the hoist operation area, and the working cradles are fastened with safety belts to the cradle guard.

3.5. In the event of a sudden shutdown of the electric or hydraulic drive of the lift, the driver must take measures to safely evacuate the working cradle.

3.6. It is forbidden to move the lift from one work platform to another with workers in the cradle.

3.7. Before starting the movement, the driver must give a warning signal.

3.8. The movement of the lift under the power line should be carried out only with the boom lowered (transport position).

3.9. When lifting, the maximum weight of the load (people and cargo) in the cradle must not exceed the rated lifting capacity of the lift.

3.10. When lifting the cradle with workers and moving it in difficult conditions, in poor visibility and other circumstances, when it is difficult to see, the driver must be guided by the following rules:

1) the hoist should be operated only at the signal of the signalman; however, if the signalman gives a signal, acting contrary to the production instructions, the driver should not perform the required maneuver with the lift boom. For damage caused by the operation of the hoist, as well as for the infliction of injuries to workers in the cradle due to the execution of an incorrect signal, both the driver and the signalman who gave the incorrect signal are responsible. The exchange of signals between the signalman, workers of the cradle and the driver must be carried out in accordance with the sign signaling established by the Rules. The driver must comply with the Stop signal regardless of who gives it;

2) when working with a cargo winch, if the hoist is equipped with it, the worker must be in the cradle near the load during its lifting or lowering, if the load is at a height of no more than 0.5 m from the level of the cradle rail. The weight of the load must not exceed the lifting capacity of the winch. Before lifting the load or workers in the cradle, the driver must warn the workers of the cradle and all persons near the lift about the need to leave the area of the lifted load;

3) when the hoist moves the load and workers in the cradle, work should be done only in the absence of people in the work area;

4) when the lift is in operation, the driver is prohibited from entering the non-rotating part, so as not to be caught between the rotary and non-rotating parts of the lift;

5) install the hook of the lifting mechanism above the load so that when lifting the load, the oblique tension of the rope is excluded;

6) when lifting and lowering a load on a hook or cradle with workers near a wall, column, stack, wall or other equipment, you must first make sure that there are no workers between the lifted load or cradle and the specified parts of the building or equipment, as well as the impossibility of touching the boom with a knee or a cradle behind the column walls or other equipment;

7) before lifting a load from a well, ditch, trench, foundation pit, etc. and before lowering the load in them, you should first make sure that at the lowest position of the hook on the drum there must be at least 1.5 turns of the rope, not counting the turns under the clamping device;

8) it is necessary to carefully monitor the ropes and in case of their fall from the drum or blocks, the formation of loops or damage to the ropes, suspend the operation of the hoist;

9) if the lift is equipped with a winch, then lifting workers and cargo in the cradle at the same time is not allowed.

3.11. The driver can install the lift and work with workers in the cradle or with a hook at a distance of at least 30 m from the extreme wire of the power transmission line only if there is a permit signed by the chief engineer or chief power engineer of the enterprise (organization) that owns the lift.

In this case, the work of a hoist should be carried out under the direct supervision of a person responsible for the safe performance of work with hoists, indicating his name in the work permit.

3.12. With the simultaneous operation of railway lifts on the same track, in order to avoid collisions, it is necessary to maintain a distance between the lift service areas of at least 5 m.

Drivers should alert each other with signals that their lift is approaching.

3.13. When performing work with railway lifts and when they move on electrified railway lines of industrial enterprises, in construction, etc. to maintain safety, you should follow the Rules.

3.14. When the hoist is operating, the distance between the turning part at any position and dimensions of buildings or stacks of cargo or other objects must be at least 1 m.

3.15. When lifting workers in a cradle or loads, the driver is prohibited from:

1) allow workers to work in the cradle who do not have a permit to work at a height and have not been instructed, and also use load-handling devices without tags or brands. In these cases, the driver must stop the lift;

2) make sudden movements of the cradle if there are workers or cargo in it;

3) lift an incorrectly tied load, which is in an unstable position, a restrained load, as well as a load in a container filled above the sides;

4) lay the load on electrical cables and pipelines, as well as on the edge of the slope of a foundation pit or trench;

5) transfer control of the lift to persons who do not have the right to operate the lift, as well as allow pupils and trainees to operate independently without supervising them;

6) lift cylinders with compressed or liquefied gas, which are not placed in special containers.

3.16. The driver is obliged to lower the cradle with people or the load and stop the lift in the following cases:

1) when a thunderstorm approaches, a strong wind, the speed of which exceeds the permissible speed for the operation of this lift and indicated in its passport; at the same time, the driver must follow the instructions of the lift operation manual to prevent the lift from being hijacked by the wind;

2) in case of insufficient illumination of the work place of the lift, heavy snowfall or fog, as well as in other cases when the driver does not distinguish well the signals of the slinger, the moving cradle or the load;

3) at an air temperature below the permissible (minus) one specified in the lift's passport;

4) when twisting the winch ropes, if the hoist is equipped with a winch.

3.17. If an accident or an accident occurs during the operation of the lift, the driver must immediately notify the specialist responsible for maintaining the lifts in good condition.

3.18. If a fire breaks out on the lift, the driver must immediately start extinguishing it, at the same time calling the fire department through one of the workers.

In the event of a fire on an electric lift, first of all, the switch that supplies voltage to the lift must be turned off.

4. OBLIGATIONS OF THE MACHINER IN EMERGENCY SITUATIONS

4.1. If the lift loses its stability (subsidence of the ground, breakdown of the outrigger, overload, etc.), the driver must immediately stop lifting, give a warning signal, lower the cradle to the ground or platform and establish the cause of the emergency.

4.2. If the elements of the hoist (boom, ropes) are energized, the driver must warn workers about the danger and take the boom away from the power transmission lines and, without touching the metal structures and observing personal safety measures against electric shock, move away from the hoist to a safe place.

4.3. If during the operation of the lift, the worker comes into contact with live parts, the driver must first of all take measures to free the worker from the action of electric current, observing personal safety measures, and provide the necessary first aid.

4.4. If a fire breaks out on the crane, the driver must immediately call the fire brigade, stop work and start extinguishing the fire, using the fire extinguishing means available on the lift. In the event of a fire on an electric lift, first of all, the switch that supplies voltage to the lift must be turned off.

4.5. In the event of natural disasters (hurricane, earthquake, etc.), the driver must stop work, lower the cradle to the ground and go to a safe place.

4.6. In the event of other emergencies, the driver must comply with the safety requirements set out in the lift operation manual.

4.7. If an accident or an accident took place during the operation of the hoist, the driver must immediately notify the person responsible for the safe performance of work with the hoist and ensure the safety of the accident or accident situation, if this does not pose a danger to the life and health of people.

4.8. The driver is obliged to make an entry in the logbook about all emergency situations and notify the specialist responsible for maintaining the hoists in good condition.

5. OBLIGATIONS OF THE OPERATOR AFTER THE END OF THE LIFT OPERATION

5.1. After finishing work, the driver must:

1) disembark workers from the cradle, unload tools and other cargo;

2) set the boom to transport position, raise the supports;

3) set the cradle and the hook, if the lift is equipped with it, in the position according to the lift operation manual;

4) stop the engine near electric lifts, turn off the switch supplying the lift with current, if the lift is powered from an external source;

5) put the lift in the designated parking place, brake the lift, and, in addition, install brake shoes under the wheels of the railway lift.

It is prohibited to leave the railway lift on an area with a slope.

5.2. When the lift is operating in several shifts, the driver who hand over the shift is obliged to inform the shift operator about all malfunctions in the operation of the lift and return the shift by making a corresponding entry in the logbook.

5.3. At the end of the work, the driver is obliged to lock the cab and hand over the key to the lift in accordance with the procedure established at the enterprise.

5.4. The driver is obliged to make an entry in the logbook of all detected malfunctions in the operation of the lift and inform the specialist responsible for maintaining the lifts in good condition.

4. ENVIRONMENTAL PROTECTION

Environmental impact when repairing aircrafts.

4.1 General information about impacts on environment

The impact of aircraft on the atmosphere is determined by the level of its pollution due to the emission of harmful substances from the exhaust gases of aircraft engines.

Aircraft move from one repairing enterprise to another during the flight, and the atmosphere is polluted on a global scale, ie significant pollution occurs both in the areas of repairing enterprises and on the routes of flight. Moreover, if on the flight paths (at an altitude of 8-12 km) the danger of this pollution is small (flights of aircraft at high altitudes and at high speeds cause the scattering of combustion products in the upper atmosphere and large areas, which reduces their impact on living organisms), in the repairing enterprise area can not be considered such pollution is impossible.

Gases are emitted into the atmosphere by engine nozzles and exhaust pipes, which is defined by the term "aircraft engine emissions".

Gases generated by aircraft engines account for 87% of all civil aviation emissions, which also include emissions from special vehicles and stationary sources.

The most unfavorable modes of operation are low speeds and "idling" of the engine, when pollutants are emitted into the atmosphere in quantities that significantly exceed the emission at load modes.

The main components of exhaust gases of modern aircraft engines that pollute the atmosphere are:

• sulfur oxides SOx;

• nitrogen oxides NOx;

• carbon monoxide CO;

• hydrocarbons that are not completely burned, SHNU (methane CH4, acetylene C2H2, ethane C2Hb, benzene SbNb, etc.);

• aldehydes (formaldehyde HCNO, acrolein CH2 = CH = CHO, acetaldehyde CH3CHO, etc.);

• soot (fine particles of pure carbon) - is released in the form of a train behind the engine nozzles during takeoff (soot is released in general a little).

The NOx content in the exhaust gases of an aircraft engine depends on:

• the temperature of the mixture in the combustion chamber (the higher it is, the more NOX is formed), and it is the maximum (2500 ... 3000 K) in the take-off mode;

• the residence time of the mixture in the combustion chamber (the larger it is, the more NOx is formed), and this occurs at low aircraft speeds.

Following from this, we can assume that during the testing of aircraft engines after overhaul, there is an enormous emission of harmful substances into the atmosphere.

The impact of repairing enterprises on air quality in settlements located near repairing enterprises usually depends on the type and scale of operations at the repairing enterprise and the distance of settlements from the repairing enterprise. The largest emissions of pollutants usually occur in the form of combustion products during the operation of aircraft. The main sources of repairing enterprise emissions are:

- gases formed during fuel combustion in aircraft engines;
- gases emitted into the atmosphere during refueling;
- gases formed during the combustion of fuel necessary for the operation of ground equipment, auxiliary and service aircraft on the ground;
- emissions from vehicles used for the carriage of passengers, staff and visitors to the repairing enterprise;
- emissions from the chimney of the central boiler house;
- emissions from the combustion of fuel by vehicles on the roads in the surrounding areas, a certain part of which is related to the operation of the repairing enterprise.

The main emissions from aircraft include carbon dioxide (CO_2) and vapor (H_2O), mixtures of hydrocarbon-based fuel combustion products. Other emissions are nitrogen oxides (NO_x), sulfur compounds (SOX and H_2SO_4), carbon monoxide (CO), volatile organic compounds (BOC) and soot (PM_{10}). By-products are also other gas mixtures charged with molecular clusters, including nitrogen acids (HNO_3 and HNO_2). The formation of characteristic compounds directly depends on the composition of the fuel, the conditions of chemical reactions, the mixing of gases with air, the cooling rate of the flare, the composition of the available aerosols in the air and so on.

Chemical compounds that are an integral part of aircraft emissions are generally divided into those that directly affect the climate, in particular CO_2, and those that act indirectly through chemical reactions, such as NO_x, which affects the balance of ozone and other gases. (eg methane) in the atmosphere. Progress in the field of aircraft engine construction has reduced the amount of pollutants emitted during the operation of aircraft engines, so ICAO, primarily through CAEP, insists on a policy of further reduction and limitation of emissions from aircraft engines that affect the environment.

Also, the biggest impact on environment made during overhaul – is the rubber materials, that are used in aircraft (tires, rubber fittings, etc.)

Tires contain a variety of synthetic chemicals that are extremely harmful to the environment. Burning tires does not solve the problem of recycling. As a result of the compound, toxic substances are released into the atmosphere, which poison the air, harming not only the environment, but also human health.

Old tires are often scattered around yards, on the side of the road, and many of them are thrown in forests or other inappropriate places. Few people ask themselves what happens to waste and how it affects the environment. It turns out that tires degrade very slowly, a consequence of properties required for strength and durability in service. Because of this, the negative impact of tires for a long time - more than 100 years. Used tires are one of the main types of industrial waste. Despite the fact that car enthusiasts still tend to discard tires like regular rubbish, car companies are legally required to hand them over for recycling.

This is absolutely correct, because the number of vehicles is constantly growing, which increases the amount of car waste. The prices for the disposal of tires and tires differ significantly, but now more and more organizations are appearing that offer the disposal of tires, tires, used oil, batteries and other waste. It seems that in a few years, motorists will be obliged to hand over hazardous waste for recycling.

The positive quality of recycling old tires is that as a result of their recycling, products can be obtained that are useful in many industries, for example, in construction, in the laying of roads, etc.

In particular, used tire crumbs are injected into the asphalt mixture for road surfaces, which increases the grip of the tires on the track surface.

The work of enterprises of the rubber industry, which includes the production of tires, rubber products, household and medical products, accompanied by release of significant amounts of various volatile substances into the air.

Among the latter are also substances of varying degrees of danger. Compared to metallurgical and chemical plants, and in cities - and vehicles, quantitative air pollution by rubber industry significantly less, but qualitatively it is so diverse that neglect they can't. In chemical plants that produce rubber products, the smell very harmful. Often, special masks and ventilation systems do not save from it.

Next impact – fuel and lubricants used in aviation industry.

Fuels and lubricants have a significant impact on the environment. The impact of fuels and lubricants is manifested in direct contact with the atmosphere, soil, water and living organisms at the stages of its transportation, storage and use. Such properties of aviation fuels and lubricants as toxicity, carcinogenicity, fire and explosion hazard pose a threat to living organisms. Once in the soil, fuels and lubricants disrupt the upper fertile layer due to its superficial and deep destruction. They penetrate the soil mainly under the action of gravity and surface tension. The distribution of fuels and lubricants depends on the type and structure of the subsoil, hydrological conditions and properties of fuels and lubricants (density, viscosity, wetting ability, content and types of additives and other properties).

Soil, surface water bodies, groundwater are polluted by industrial and surface runoff of rain, melt and irrigation water from contaminated areas of the repairing enterprises. Surface runoff from the repairing enterprises, primarily from the runway, taxiways and parking lots, is contaminated with petroleum products, PAHs, chemicals used to combat icing, various chemical compounds formed during engine operation.

A large amount of pollution products enters the soil and spreads over long distances together with surface and groundwater, disrupting the normal functioning of soils, polluting groundwater and surface water.

Impregnation of mineral oils depends on the composition and physical properties of sedimentary rocks. In the layers of high permeability, petroleum products are distributed mainly in depth.

Natural self-cleaning of the soil, depending on the natural and climatic conditions, requires at least 5-10 years, and in the Far North and Siberia - at least 15-20 years. In the latter case, petroleum products spread through the lens of permafrost, as a result of which the temperature balance and gas exchange are disturbed, the permafrost thaws, and the soil structure changes.

The impact of airport operations on the condition of soils, reservoirs and groundwater requires serious and careful study, as well as the implementation of measures to prevent soil contamination. Such measures should, first of all, include the rational use and prevention of spills of aviation fuel, oils and other harmful chemicals, the proper organization of collection and disposal of waste oil, as well as the collection, treatment and disposal of contaminated effluents [22]. In addition, the involvement of airlines in combating soil erosion is of great importance. It was shown [13] that in the soil immediately adjacent to the runways, there is an increased content of carcinogenic PAHs, primarily benzopyrene. Wastewater from fuel and lubricants warehouses must be treated in oil traps or flotation units before being discharged into the sewer.

After use, 60% of lubricants remain in the form of waste oils. Running engine oils can contain a variety of foreign impurities (water, solvents, oxidation products and other contaminants), which dramatically reduce their quality.

Used lubricating oils are one of the common man-made wastes that negatively affect all environmental objects - the atmosphere, soil, water. To solve environmental problems associated with the accumulation of waste oils, they are disposed of. Waste oils are usually collected and regenerated in order to preserve valuable raw materials, which is quite cost-effective. Low-contamination oils, which contain aging products in the form of sludge, moisture and mechanical impurities, but have not lost their effectiveness, are purified by mechanical and adsorption methods. Insoluble contaminants and foreign substances are isolated by precipitation, filtration and centrifugation. Purification of oils containing dissolved aging products is carried out with adsorbents, for example, natural or activated bleaching clays.

Oils with a high degree of pollution and oxidized oils are regenerated in special plants. Regeneration involves physical and chemical treatment, which almost completely removes suspended and dissolved foreign substances, aging products and products sensitive to aging, as well as additives preserved in the oil.

Elimination of water-soluble lubricating and cooling liquids and lubricating emulsions is associated with a number of problems and difficulties. Great attention should be paid to other hazardous substances (eg bactericides and emulsifiers). Special methods may be required to eliminate them. Thus, emulsions can be separated in settling tanks by precipitation, centrifugation in separators or hydrocyclones, filtration, ultrafiltration, coagulation, gas purging, by treatment with salt solutions using flocculants and adsorbents, heating, co-incineration or boiler.

The determination of petroleum products in the environment is a rather complex process, which usually includes more than one stage - sampling and concentration, separation from the substances that interfere with the definition and the actual quantification. Cartridges or columns with sorbents are widely used for selection. They are suitable for concentrating micro-impurities from large volumes of water, which improves the metrological characteristics of the analysis of the concentration of the analyzed vapor or gas. Accuracy of determination of concentration of harmful vapors and gases in the investigated air at atmospheric pressure from 0,96 to 1,0 kPa, at relative humidity of air no more than 90%, at temperature of the investigated air from 10 to 30 ° C and low content of dust, at careful preparation indicator tubes and filter cartridges.

4.2 Measures to reduce impact on environment during overhaul.

Among the main measures to prevent, reduce and mitigate the negative effects are the following:

- optimization of ground handling infrastructure at repairing enterprisess to reduce the movement of aircraft and ground vehicles on taxiways and at idle at the gates;
- renewal of the land vehicle fleet;
- minimization of fugitive air emissions from aviation kerosene and other fuel depots and from fuel handling;
- supply of electricity and air conditioning through ground equipment to minimize the use of NSU aircraft;
- initial use of mechanical methods of ice removal, such as sweepers and plows, supplemented with chemicals;
- providing a storm water management system for the collection and treatment of surface runoff, containing air and aerodrome fluids to protect against frost, including water from a pile of snow cleared of aprons and runways.

In addition, it is considered appropriate to inform the public through the media about the local and regional levels about the strategy being implemented.

Promote the use of renewable energy sources (such as photovoltaics) for street lighting or repairing enterprises and access road lighting.

Plan the repairing enterprises site (new construction and expansion of existing facilities), as well as the orientation of routes for arriving and departing aircraft, taking into account the actual and projected housing and other noise-sensitive receptors in the surrounding areas. This may include coordination with local authorities that have an impact on land use planning and overall transportation planning activities.

Plan flight routes, timing and altitude for aircraft (aircraft and helicopters) flying over residential buildings.

In areas with significant impacts, preferred procedures and routes for landing and take-off (LTO) should be implemented to minimize potential noise from aircraft approaching and moving away for noise-sensitive areas. These procedures may include instructions on the use of reduction profiles or “predominant noise” (NPR) routes, for example, a “continuous reduction approach” to avoid noise-sensitive areas, the use of a “low power / low drag” procedure (LPLD) fly the aircraft in a "clean" condition (for example, without flaps or wheels), if possible, to minimize aircraft noise and instructions for minimizing traction during landing. An alternative approach may include noise dissipation through the equal use of multiple flight paths, as opposed to the use of a preferred flight path.

It is also advisable to use night or other operating restrictions.

If necessary, establish cooperation with local authorities to identify and implement noise prevention and control strategies in noise abatement areas (eg soundproofing of buildings exposed to airborne noise above local government levels, or to limit the night-time operation of certain landing routes).

Implement waste management plans, which should include waste prevention / generation / minimization, segregation, reuse, recycling, transportation, disposal and monitoring of hazardous waste in accordance with Ukrainian and EU waste legislation.

Create a solid waste recycling program, depending on the availability of local facilities, including the placement of labeled waste containers in passenger terminals for metals, glass, paper and plastics. Passenger operators and cleaning contractors should be encouraged to separate waste in vehicles by separating rubbish from newspapers / papers, plastic and metal containers and used pillows.

5. GENERAL CONCLUSIONS

Taking into account the technical equipment of the enterprise, the qualifications of the personnel, sufficient experience in the overhaul and modernization of aircraft of the "An" type at the enterprise, it should be noted that, since 1992:

- a full cycle of overhaul of An-32 aircraft has been worked out and mastered;

- worked out and mastered the complex of works on modernization of An-32 aircraft in accordance with the documentation of the Developer;

- the execution of resource bulletins No. 515-BE-B, No. 515/1-BE-B, as well as repair bulletins on An-32 airplanes was worked out and mastered;

- fully certified technological processes, personnel, production and quality management system, which is confirmed by the Certificate of the Ministry of Defense of Ukraine No. UAR - MAA- 145.0112, License of the Ministry of Economic Development and Trade, series AB No. 597938 for the right to repair and modernize military aviation equipment, Certificate of Approval organizations for TO No. UA .145.0023 for compliance with the Rules PART- 145 of the State Aviation Service of Ukraine, Certificate No. HTI / 130-55 / 2011 for compliance with NATO Standard AQAP -2120 on the quality system for repairing military aircraft, issued by the Hungarian Ministry of Defense.

Analyzing the state of the An-32 aircraft of the Indian Air Force, there is full reason to assume that in order to ensure operational reliability and flight safety, the Customer deliberately provided to the enterprise for repair aircraft that had previously been repaired at the Customer's base. Taking into account the actual technical condition of these aircraft, which have been in operation since 1984, as well as the technical capabilities to ensure the quality of repair and modernization of the enterprise and the base of the Customer, it should be noted a positive trend of sending the An-32 aircraft for repair to the enterprise after the previous repair at the Customer's base. ...

The results of the assessment of the actual technical condition of the aircraft arriving for repair indicate that the mass number of critical defects in the structure, systems and assemblies were not fully eliminated or prevented during the previous repair at the Customer for objectively explainable reasons, due to the significant volumes of these repairs. lack of experience in overhaul, a sufficient number of qualified personnel, a fully documented quality system, an insufficient amount of equipment, spare parts and technical capabilities to perform high-quality repairs in full.

Objective information on the actual state of the market for aircraft repair services developed by ANTONOV SE shows that the enterprise is currently the only large company certified in accordance with International Aviation Regulations and Standards, which has the ability to perform a full range of work on overhaul, maintenance and modernization of aircraft of the type An-32 and their components.

Implementation of automated systems for flaw detection and repair of airframe and aircraft systems, taking into account flaw detection tools, non-destructive testing using detailed nominal operational fault detection cards.

Dissemination of positive experience in the implementation of registered operational fault detection and repair cards for An-26 aircraft units of registration of the European Union, developed in accordance with the EU Aviation Rules PART- 145 for the An-32 aircraft.

Dissemination of experience in the manufacture of spare parts for An-26 aircraft registered by the European Union for An-32 aircraft with the issuance of individual technological passports and certification of special manufacturing processes.

Introduction of painting the outer surface of An-32 aircraft with the promising AERODUR- 5000 enamel from Akzo Nobel, APS - A washes and environmentally friendly E series washes.

The use of the automated control panel PKZH-3000 in the manufacturing process, installation and control of electrical harnesses in the process of repair and modernization of the An-32.

Complete replacement of aircraft electrical harnesses of the SPUT system in zones 5, 6, 7, 8.

Modernization of the flight information registration and processing system in terms of replacing the Tester-U3 product with the BUR-4-1.

Agreeing with the Aircraft Developer of the decision to replace the R-800 radio station with a more modern and reliable one.

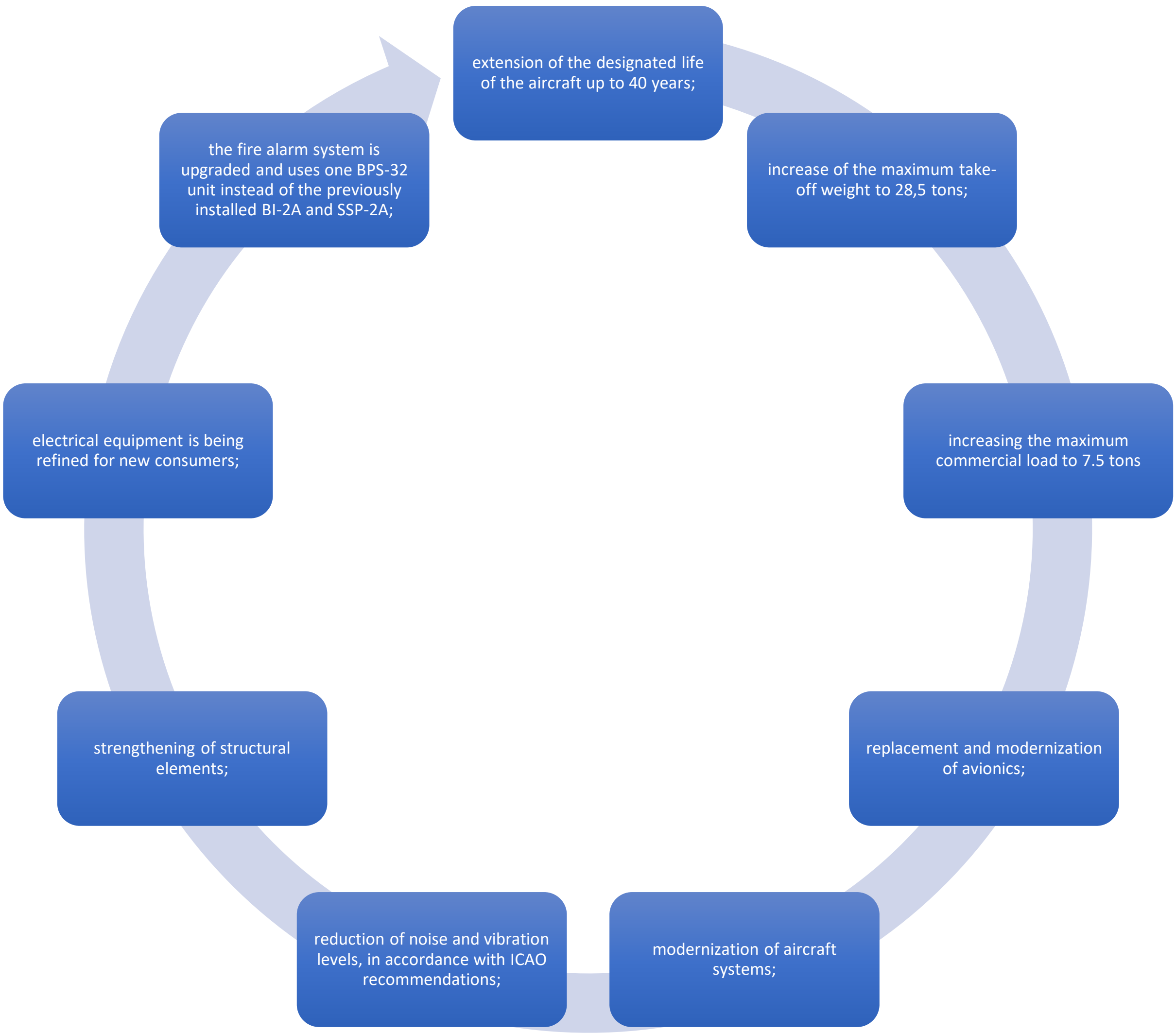

Fig. 5.1 Modernizations completed

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APPENDIX A

Center section corrosion (6 pads are installed)

Ramp opening (frame 39-42) - load profile crack, skin breaks

A ramp of another series has been installed in operation (it was 0209, now 0303).

Also in operation steel plates are installed

Corrosion and dents trim rudder trim 24-3707-0

Corrosion of elevator trim tabs 32.02.3210.000.001 (002)

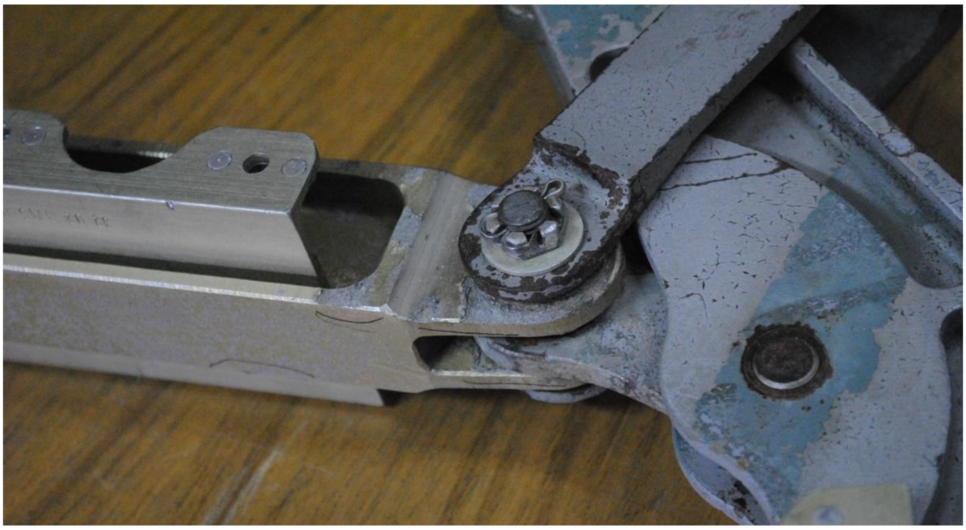
Правая мотогондола - обрывы проводки, коррозия клемм, шарниров

Right nacelle - wire breaks, corrosion of terminals, hinges

Slat bracket crack 32.02.3615.021.002

Множественные коррозионные повреждения панелей центроплана

Левая мотогондола. Обрывы проводки, коррозия клеммных колодок, ШР-ов СПУТ



Коррозия тяги механизма внутреннего закрылка 32.02.3715.030.000

APPENDIX B