МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
АЕРОКОСМІЧНИЙ ФАКУЛЬТЕТ
КАФЕДРА ПІДТРИМАННЯ ЛЬОТНОЇ ПРИДАТНОСТІ ПОВІТРЯНИХ СУДЕН

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувачкафедри
к.т.н., доцент
_____О. В. Попов
«_____»_____2021 р.

КВАЛІФІКАЦІЙНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ «МАГІСТР»

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

Тема:"Методи та засоби підтримання експлуатаційної надійності гідравлічної системи повітряного судна злітною масою 20-25 тон"

Виконав: **_____ Аль-Рубайє Хуссейн А. А.**

Керівник:
к.т.н., доцент **_____ Ругайн О. В.**

Керівник з охорони праці:
к.т.н., доцент **_____ КоваленкоВ.В**

Керівник з охорони навколишнього середовища:
к.т.н., доцент **_____ Саєнко Т. В.**

Нормоконтролер: **_____/_____**

Київ 2021

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
AIRSPACE FACULTY
Aircraft Airworthiness Continuing Department

DEFENCE PERMITED
The Head of the Department
Ph.D., associate professor
_____ O.V.Popov
«____» _____ 2021

MASTER DEGREE THESIS
(EXPLANOTARY NOTE)

GRADUATE OF EDUCATIONAL DEGREE "MASTER"

FOR EDUCATIONAL AND PROFESSIONAL PROGRAMS "MAINTENANCE AND REPAIR OF AIRCRAFT AND AIRCRAFT ENGINES"

Topic"Methods and means of the aircraft maximum take-off mass of 20-25 tons hydraulic system operational reliability maintaining"

Fulfilled by: **_____ Al-Rubaye Hussein A. A.**

Supervisor:

Ph.D., associate professor **_____ Rugain O.V.**

labor precaution:

Ph.D., associate professor **_____ Kovalenko V.V.**

environmental protection:

Ph.D., associate professor **_____ Sanenko T.V.**

Standards Inspector: **_____/_____**

Kyiv 2021

NATIONAL AVIATION UNIVERSITY

Airspace Faculty
Aircraft Continuing Airworthiness Department
Educational Degree "Master"
Speciality 272 "Aviation Transport"
Educational and professional programs "Maintenance andrepairof aircraft and aircraftengines"

APPROVED BY
The Head of the Department
Ph.D., associate professor

_____ O.V.Popov
“_____”_____2021

Graduation Project Assignment

Al-Rubaye Hussein A. A.

1. Topic:**"Methods and means of the aircraft maximum take-off mass of 20-25 tons hydraulic system operational reliability maintaining"**

approved by the Rector’s order of "11" October 2021 № 2196/СТ.

2. Period of accomplishing of the Graduation Project since October 25, 2021 until December 31, 2021.

3. Initial data for the project: searching for data and identifying faults that occur in the hydraulic system and reducing them to maintain the safety of the aircraft.

4. The content of the explanatory note: introduction about activity and principle usage of aircraft and the uses of other systems and units of the aircraft and the large capacity for energy consumption, especially the hydraulic system that provides systems and mechanisms for aircraft management that determine the safety of the flight.

5. The list of mandatory graphic materials: shows the work of the hydraulic, landing gear parts, marking pipeline, the sensor alarm water sludge. Exhaust systems in the aircraft llustrated material is completed with the help of Microsoft Office.

6. Time and Work Schedule

#	Stages of Graduation Project Completion	Stage Completion Dates	Remarks
1	Task receiving, selection of material	25.10.21– 31.10.21	Done
2	Analytical part, detailed analysis of factors influencing on aircraft operational reliability, serviceability	02.11.21-09.11.21	Done
3	Project part	12.11.21-18.11.21	Done
4	Scientific part	19.11.21-24.11.21	Done
5	Labor precautions	25.11.21-26.11.21	Done
6	Ecology	27.11.21-28.11.21	Done
7	Arrangement of explanatory note	29.11.21-06.12.21	Done
8	Preparing for project defend	13.12.21-20.12.21	Done

7. Advisers on individual sections of the project:

Section	Adviser	Date, Signature	
		Assignment Delivered	Assignment Accepted
Labor precaution	Ph.D., associate professor Konovalova O.V.		
Environmental protection	Ph.D., associate professor Radomska M. M.		

8. Assignment issue date "_____"_____ 2021.

Degree work supervisor: _____ Rugain O.V.
(signature)

Assignment is accepted for fulfillment _____Al-Rubaye Hussein A.A.
(signature)

ABSTRACT

The explanatory note to the diploma"Methods and means of the aircraft maximum take-off mass of 20-25 tons hydraulic system operational reliability maintaining"

73 pages,6 figures, 10 tables.

The diploma draft is the construction of different resources such as reliability, and inserts in the hydraulic system**.**

The purpose of the explorations is to provide the usefulness and scientific applications of the hydraulic system**.**

Purpose of the qualification work is to improve the quality and efficiency of the hydraulic system and the system management mechanism to maintain the safety of the trip**.**

The basic principle of this qualification work is to ensure that the output data is an influence on the flying experience nowadays**.**

The method for ensuring the effects will be described by the principle of hydraulic system efficiency**.**

Qualification work materials are recommended to use in educational process and practical activity of specialists of development laboratory.

Keywords**: RELIABILITY, HYDRAULIC SYSTEM UNITS, LANDING GEAR, BRAKING SYSTEM, FAILURES, REFUSAL, TECHNICAL OPERATION, CONTROLLABILIY, EFFCIENCY.**

CONTENT

LIST OF ACRONYMS AND TERMS

AC – aircraft;

ICAO – International Civil Aviation Organization;

MP – Maintenance programme;

SAA – State Aviation Administration;

APU – auxiliary power unit;

NTSB – National Transportation Safety Board;

NA – not accessible;

ECS – engine control system;

FOHE – fuel/oil heat exchanger;

FMU – fuel metering unit;

FMC – flight management computer;

FDR – flight data recorder;

FQIS – fuel quantity indication system;

ACMF – aircraft condition monitoring function;

EHM – engine health monitoring;

APM – aircraft performance monitoring;

EASA – European Aviation Safety Agency;

FAA – Federal Aviation Administration;

AMM – aircraft maintenance manual;

FBG – fiber bragg grating.

INTRODUCTION

For actuating aircraft control system and motor, and other systems and units for aircraft use various forms of energy with considerable power consumer. Depending on the type of energy used are hydraulic, gas and electric. Each grid has specific properties and has certain advantages. On modern airplanes is important hydraulic system, the rapid development and a sharp increase in capacity that is due to the extensive use of hydraulic actuators control surfaces. The hydraulic system provides aircraft management systems and mechanisms that determine the safety of the flight. Reliability, survivability and durability achieved perfection hydraulic design units, multiple redundancy, as a source of energy and hydraulic drives, automation control, monitoring and operation information of the crew. The use of hydraulic actuators on the aircraft due to the relatively small weight and size, great speed and low inertia of the actuator (unlike electric motors).

Weight and dimensions of the hydraulic unit is approximately 10-20 percent of the weight and dimensions of the electrical machine of this appointment and the same capacity. Hydraulic systems can develop a significant effort for a large speed, provide a simple fixation of the intermediate positions of the actuators. Hydraulic systems are used to control the stabilizer and rudder, for cleaning and landing gear, landing mechanization and other consumers.

The disadvantages of the hydraulic system may include a relatively small mass units, pipelines, and the working fluid, the dependence of the units on the ambient temperature. Damage to components and piping associated with the loss of integrity can result in the release of fluid from the hydraulic system, which will lead to failure hydro system.

The working body of the hydraulic system on most aircraft is aviation hydraulic oil АМГ-10. The nature of the system is largely determined by theproperties of the liquid. It is neutral to the steel and duralumin, and its viscosity

changes in temperature slightly. However, it is fire risk at a temperature over 120 degrees.

For aircraft of civil aviation is currently the most commonly used hydraulic pumps with variable performance-driven engines, electric or air driven. Less commonly used hydraulic pumps with constant performance. Many consumers are fed simultaneously from multiple hydraulic systems. This increases the reliability of their work, since the failure of one of the systems the consumer continues to receive power from another system. Each control surface is controlled by the maximum amount of hydraulic systems available on the aircraft and responsible consumers (flaps, landing gear, etc.) - at least two hydraulic systems. Less responsible consumers and consumers who work only on land controlled by a hydraulic system. Each addition to the main hydraulic pumps available with redundant power supplies. As such torque converters are used, arranged between the hydraulic system, as well as installation and electrically driven turbo pump pumping station. Torque converters are designed to create pressure in the hydraulic system in case of failure in her main pumps or engine failure due to power adjacent the hydraulic system. The transfer of power from one system to another occurs without exchange of working fluid. Based on the foregoing, we see that the hydraulic system has a very important place in the management of the aircraft and its operation as a whole. Therefore, this system need to pay attention and do all sorts of structural technological improvements.

PART 1. AIRCRAFT MAXIMUM TAKE-OFF MASS OF 20-25 TONS HYDRAULIC SYSTEM FAILURES AND MALFUCTIONS ANALYSIS

1.1 General information about the aircraft An-140

The plane is a cantilever high with two turboprop engines placed in nacelles below the wing and tricycle landing gear with the front and two main supports.Fuselage - sealed, circular cross-section semi-monocoque construction. It houses the crew cabin, cabin transport, including passenger seats, rear lobby and baggage and cargo compartments. Under the floor are placed baggage and cargo and the technical compartments, niches of the front and main landing gear. The aircraft are: trap door, service door, cargo door, top and side escape hatch and hatch underground baggage and cargo compartment. The aircraft is equipped with the necessary appliances, sanitary and rescue equipment.

Wing direct, high aspect ratio, trapezoidal in plan. The wing consists of a center section and two arm portions. The leading edge of the wing is not mechanized; mounted on the rear edge of the double-slotted flaps with fixed baffle, slotted ailerons with horn and axial compensation and spoilers.

Plumage - single-fin, fixed stabilizers fuselage. Rudders and height - singlelink with horns and axial compensation. The power plant includes two turboprop engines, lo-position in nacelles below the wing, ТВ3-117ВМА-СБМ-1 with propellers АВ-140. As an auxiliary power unit - installed on the aircraft gas turbine engine АИ9-3Б.

Auxiliary power unit - a gas turbine engine, located in a special compartment of the rear fuselage. The propeller - pull, 6-bladed feathering reversible type АВ-140.Landing gear - tricycle, retractable in flight from the front pillar.

Fuel on the plane located in the wing tanks-caissons (one in left and right half-wings).

The complex provides a means of fire protection detection, alarm and fire fighting in fire compartments of the aircraft, preventing the occurrence and spread of fire to adjacent compartments.

The chassis is made of three-point circuit from the front pillar and includes:

- single-front support;
- single column two main pillars;
- cleaning system and the landing gear;
- device management system of the aircraft taxiways;
- wheel braking system.

The hydraulic system provides power to the actuators of aircraft systems cleaning and landing gear, braking wheels, taxi devices, control flaps and spoilers, cleaning entrance stairs.

AN-140 is designed for the carriage of passengers, baggage, mail and freight at regional and near main routes with the possibility of exploitation, both on artificial and on unpaved runways.

The plane is a cantilever monoplane with a highly-placed right wing of the big lengthening trapezoidal shape in plan, single-fin empennage with fixed stabilizer mounted on the fuselage. The angle of the cross-stabilizer V + 15 °.

Auxiliary power unit - a gas turbine engine, located in a special compartment of the rear fuselage.

The propeller - pull, 6-bladed feathering reversible type AB-140.

Landing gear - tricycle, retractable in flight from the front pillar.

1.2 Basic data and characteristics

Table 1.1. Basic geometric data

Named of parameter	Modification of aircraft	
	An-140	An-140-100
Aircraft length, m	22.605	22.605
Wingspan, m	24.505	25.505
Height (empty aircraft), m	8.225	8.225
Fuselage diameter, m	2.82	2.82
The base chassis, m	8.125	8.125
Track chassis, m	3.180	3.180
The scope of the horizontal tail, m	9.126	9.126
Fuselage length, m	21.57	21.57
The length of the transport cabin, m	14.51	14.51
The volume of transport cabin, m^3	95	95
Wing area, m^2	55	56.36
The front door, mm	914x1680	914x1680
Cargo door mm	985x1290	985x1290
The service door, mm	622x1290	622x1290
Luc underfloor luggage compartment, mm	500x1012	500x1012
Onboard escape hatch, mm	1186x510	1186x510
Top escape hatch, mm	510x510	510x510
The maximum width of the transport cab and us, m	2.6	2.6
The width of the floor of the transport cabin, m	2.284	2.284
The height of the transport cabin, m	19	19
Minimum crew: - captain; - copilot; - flight attendant	 1 1 1	 1 1 1
Maximum number of passengers	52	52

Table 1.2. Basic weight data

Named of parameter	Modification of aircraft	
	An-140	An-140-100
The maximum taxi weight, kg	21100	21600
Maximum take-off weight, kg	21000	21500
Maximum landing weight, kg	21000	21500
Empty weight, kg	12710	12810
The maximum weight of the loaded airplane, kgf	19100	19200
The maximum weight of a commercial loading, kgf	6000	6000
The maximum weight of fueling (γ = 0,775 kg / cm^3) kgf	4370	4440
Weight equipment, kgf	400	400

Table 1.3.Flight performance

Named of parameter	Modification of aircraft	
	An-140	An-140-100
Maximum take-off weight, kg	21000	21500
Maximum level flight speed, km / h	535	537
Cruising altitude,	6000	6000
Time set cruising altitude, min	23	25
Flight range at H = 6000 m, cruiser speed of 450 km / h with “AH3” for 45 minutes. $G_{take-off}$ =21,000 kgf (21,500 kg), km:		
- with the maximum load (000 kg)	1000	1300
- with 52 passengers (4680 kg)	21 0	2340
- with a maximum of refueling (passengers)	3070 (37)	3080 (47)
- ferry	3700	3710

Fuel consumption, g / pass.km	23.4	23.1
Take-off data (N = 0, $G_{take-off}$ =19150 kg, t = +15°C)		
- lift-off speed, km / h	220	220
- the length of the run, m	880	880
- take-off distance to H = 10,7m, m	1040	1040
- required runway length, m	1300	1300
Landing data (N = 0, G_{land} =18,000 kgf)		
- approach speed, km / h	212	212
- landing speed, km / h	202	202
- length of run with wheel brakes and reverse thrust, m	530	530
- required runway length, m	1295	1315

1.3 Collection, processing and analysis of statistical data on failures and faults of aircraft An-140 hydraulic system units

Analysis of the technical condition of units conducted to determine the reliability characteristics of functional areas of the hydraulic system of the aircraft An-140.

Statistics for reliability analysis of structural elements hydraulic collected the results of tests on “Антонов”.

Static data are summarized in table 1.4 and used to characterize the reliability of the hydraulic units.In determining k^{i}_{1000} factor benefited during testing of aircraft overhaul resource.

$$k^{i}_{1000} = \frac{n^{i} \cdot 1000}{i \cdot T}, \qquad (1.1)$$

where: k_{1000}^{i} - the number of failures per thousand hours of flight;

n^{i} - total number of failures functional area (unit) for the period of time;

i - the number of similar sites (units) in the system;

T - total duration of aircraft for the considered period of time.

The results are summarized in Table 1.4.

Table 1.4. Reliability of the hydraulic system

Functional area	№ n/n	Aggregate	i	k_{1000}^{i}
Plot main power system	1	PS-140	2	0.155
	2	Hydro accumulator	1	0.105
	3	Hydro tank	1	0.158
	4	Hydrofilter	2	0.039
	5	Pipeline		0.013
Plot-release gathering flaps.	1	Spreader	2	0.066
	2	Shuttle valve	2	0.026
	3	Drive flaps	2	0.075
Plot main braking	1	Modulator	2	0.06
	2	Spreader	2	0.066
	3	Shuttle valve	2	0.013
	4	The unit braking	2	0.055
Plot boost	1	Drying filters	1	0.039
	2	Reducing valve	1	0.014
	3	Drain tank	1	0.09
Plot-release gathering front chassis legs	1	Hydraulic cylinder	2	0.013
		lock		0.011
	2	Power hydro cylinder	1	0.007
	3	Hydro accumulator	1	0.039
	4	Spreader	2	0.066

Functional area	Number n \ n	Aggregate	i	k^{i}_{1000}
Plot rotation control wheel front leg	1	Driving mechanism	1	0.055
	2	Crane inclusion	1	0.07
	3	Crane rotation	1	0.08
Plot-release gathering basic chassis legs	1	Hydraulic cylinders collect output landing gear	2	0.09
	2	Hydraulic cylinders lock output position	2	0.011
	3	Hydraulic cylinders lock cleaning position	2	0.011
	4	Spreader	1	0.066
	5	Hydraulic cylinders reserve of issue	2	0.055
Plot closing door in	1	A hydraulic cylinder of entrance doors	2	0.009
May and PA	2	Spreader	2	0.066

Analysis of table 1.4. shows that the unreliable hydraulic units An-140 should include the main areas of power units - PS-140, hydro accumulator and hydro tank.

In addition, a high percentage of faults occur in the same drain tank, brake unit, power cylinders and distributors.

Conclusion to part 1

In this section were given general information of the aircraft, its basic geometry, mass and flight characteristics. Collected statistics on failures and faults units hydraulic system. The hydraulic system of the aircraft provides control systems and mechanisms that determine the safety of the flight. Reliability, survivability and durability of hydraulic construction units achieved perfection and multiple redundancy. Therefore, the collection of statistical data is very important to maintain reliability.

After analyzing statistical data on failures and faults were discovered weaknesses that need to be given special attention at servicing and determining the technical condition of the system.

PART 2. STRUCTURAL ENHACEMENT AND MODIFICATION OF AIRCRAFT HYDRAULIC SYSTEM

2.1 Brief description of the hydraulic system

The hydraulic system of the aircraft is designed to supply hydraulic fluid drives:

- aircraft control system and mechanization of the wing;
- cleaning, the landing gear;
- braking wheels of the chassis;
- taxi unit front landing gear;
- reverse thrust;
- opening and closing the hatches luggage;
- closing the front door;
- cleaning of wind turbine;
- control flaps;
- cleaning and release spoilers;
- opening and closing the entrance stairs.

Working fluid - АМГ-10 (FH-B1 Gidronikol).

Nominal pressure - 150 kg / cm^2.

The total volume of the working fluid - (15,9±0,2) liters.

Filling the hydraulic system closed through a valve on the right side fairing chassis.

The alarm system gives information about the operation of the hydraulic system malfunctions and the crew in the flight recorder БУР -92А.

In hydraulic means autonomous accumulator, which is a source of pressure for the parking brake wheel chassis, as well as backup power supply for the main braking system. Power pump station is carried out from the main bus.

The source of pressure is a pump station PS-140 with a DC motor.

PS-140 is turned on automatically after installation switch "HC" to "ABT" and runs until the end of retracting the flaps and landing gear after takeoff.

After landing off manually after taxiing into the parking lot.

Pumping station into operation automatically and manually. Automatic start pumping station made in setting switch "HC" to "ABT" before taxying to take off and running before the end of harvesting gear and flaps.

After harvesting gear and flaps pumping station turns off automatically.

When landing pumping station is included in the issuance of the chassis and running to switch settings "HC" to "OTKJI" after taxing the parking lot. At other stages of flight pump station is closed.

Pressure line hydraulic electro-distributor is divided in two lines.

The first discharge line connected consumers networks:

- cleaning - release chassis;

- the main parking brake and wheel chassis (brakes through the hydro accumulator);

- cleaning - release flaps

- taxiway device front landing gear.

The second discharge line connected consumers networks:

- taxiway device front landing gear;

- emergency braking wheel chassis;

- close the door.

Power drives interceptors carried out by general pressure accumulator hydraulic line.

The pressure from the pumping station is fed into the first line included pumping at distributor; the second - disconnected.

Inclusion distributor occurs simultaneously with the inclusion of the pumping station.

Disabled distributor in three cases:

- working with the loss of hydraulic fluid to the level at which hydro tank lights up scoreboard “Г/СИСТ – РАЗГЕРМ”;

- when breakaway handle emergency brake wheel chassis from the original position;

- when you close the door;

Stock working fluid required for hydraulic contained in hydro tank, which in the pressurization creates overpressure.

Servicing hydro tank working fluid through the closed method produces valve-board refueling installed in the right chassis fairing panel attached to the drainage tank.

2.2 Functional purpose of controls

The functional purpose of controls are showing in Table 2.1.

Table 2.1. Purpose of controllers

Controls and monitoring	Appointment
The top panel Guard hydraulic	
Switch "НС" out - "АВТ" - "ОТКЛ" - "РУЧН"	Hydraulic pump station control. Automatic inclusion of PS: -a messy landing gear; -production and harvesting chassis; -production and harvesting flaps; -presence on a teamandstart each of the two interceptors. Disable pumping station. Manual switching pumping station. *Note:*PS additionally included on each of the two switches closing door regardless of the position switches of "НС".

Controls and monitoring	Appointment
Two indicators И1-250К with inscriptions: -"Давл.Г/АККТОРМ" -"Давл. СИСТ"	Control the pressure of working luquid: -in hydraulic accumulator brakes; -in the hydraulic system. *Note:* 1. In the absenceofpressure, the indicators showing of working liquid nitrogen charge pressure correspondingtohydraulic accumulator hydraulic system. 2. At work stations "Арлекин" in the mode of transmissionof passageperhapschange indicators "ДАВЛ. СИСТ" and "ДАВЛ. Г/АКК. ТОРМ" because at this time the control values of pressure in the hydraulic accumulator and not perform.
Indicator of ИТ-1П60/260andwith inscriptions "t ЖИДКОСТИ"	Temperature control fluid in hydro tank
Light scoreboard**"Д"**with a greenfilter.	Alarm worksatthe PS hydrosystem - lights when fluid pressure on the more than 80 kg /$cm^{2.}$
Light scoreboard "МАЛО ЖИДКОСТИ" with a yellow filter.	Alarm decreasing circlesbbones fluid in hydro tank to (8,2 ± 0,25) liters or less.
Light scoreboard "НЕТ НАДДУВА" with yellowfilter	Alarm of decreasepressurized in hydro tank to (1,25 ± 0,08) kg /cm^2 or less.

Controls and monitoring	Appointment
Light scoreboard "Г/СИСТ. ОТКАЗ" with yellowfilter.	Alarm refusalhydrosystem lights up in 20 sec., after reducing pressure behind HC in the general pressure line below 80khs/cm^2. Alert for refusalofhydrosystem "remember" and removewhen the pressure above 80 kgf/cm^2(on the scoreboardof hydro system lightning "Д"). At the level of liquid in hydro tank below 8.2 liters, 4.8 liters but higher signal to refuse extraditionhydraulic locks.
Light scoreboard "Г/СИСТ. РАЗГЕРМ" with yellow filter.	Signaling that ahydrosystem heldatthe loss working fluid. Pressure from PS gets to second discharge line.
Light scoreboard "Г/СИСТ - ПЕРЕВІР" yellowfilter	General alarm statushydro systemlightning at: - reducing the level of liquid in hydro tank below the allowable(scoreboardlights up"МАЛО ЖИДКОСТИ") - reduction in the boost pressure to hydro tank (1.25 ± 0.08) kg/cm^2 (lights up scoreboard "НЕТ НАДДУВА") -installation switch "НС" to "ОТКЛ" or "РУЧН"

Controls and monitoring	Appointment
	- do not disconnect the pump station in automaticallyregime 60 after cleaningofthe landing gear and cleaning flaps - the temperature is to 100 ° C and above

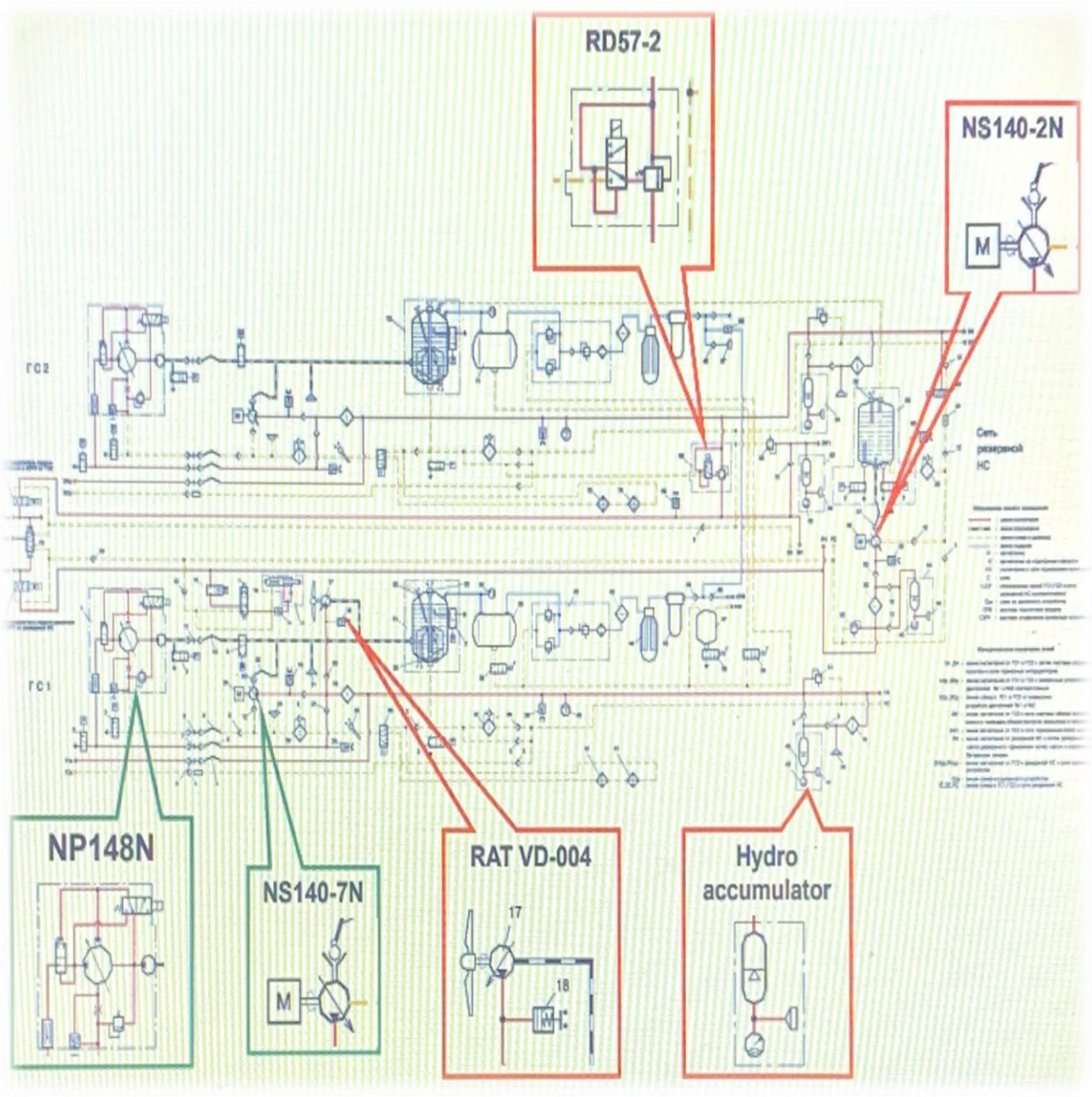

Figure 2.1 - Work of the hydraulic system

2.3 Hydraulic units and aggregates

2. 3. 1 Pumping station PS-140

Pumping station PS-140 is the main source of supply hydraulic working fluidobjects.PS-140 is an axial-plunger pump variable type of productivity etc., connected to the DC motor that feeds b be the network of direct current with nominal voltage 27V. The station consists of the following components:

- regulated pump performance;
- servomechanism;
- feeding pump;
- mechanical shaft seals and glands;
- the pump regulator;
- centrifugal, air wheels;
- filter;
- motor.

Main technical data:

- working fluid АМГ-10;
- ambient temperature from -60 ^{0}C to +60 ^{0}C;
- working fluid temperature from -60 ^{0} to 100 ^{0} C;
- pressure working fluid inlet from 0.05 to 3.3 kgf \ cm$^{2;}$
- the pressure in the drain line from 6.0 to 12 kgf \ cm$^{2;}$
- zero supply pressure at ambient temperature and the working fluid

(25±10)°C 150$\frac{+15}{-10}$ kg \ cm $^{2;}$

- working fluid supply station in steady state operation at the temperature of that environment and the working fluid (25 ± 10) ° C under voltage and power (27 ± 0.2) V, inlet pressure (0.7 ± 0.2) kg \cm^2, the pressure of the pressure (140$_{-5}$) kg\cm^2, input current not exceeding 110A at least 7l / min;

- flow of fluid in drain pump for cooling mode at close to zero supply not more than 2 L / min;

- consumed no more current station 110A;

- inrush current, the resistance line (0,03 ± 0,006) Om is not a 700A;

- cleaning fluid filters made 16 microns;

- Station weight without fluid and the transport caps no more 8,5kh.

Management of the PS is carried out with hydraulic shield installed in the cockpit on the upper console. The switch has three positions: "ABT", "OTKЛ", "РУЧН".

Pumping station operates automatically when its switch is in the "ABT".

In this case the PS turn on automatically:

a) Hydro system 1 at (one injection):

- including the reserve release of main landing gear;

- Release the front support;

- open lock harvested front landing gear position;

b) Hydro system 2 at (injection 2):

- breakaway handle emergency brake wheels of the home (including emergency braking);

- release gathering main landing gear;

- flap-release gathering.

After switching off the emergency brake wheels, or release the collection and flaps early shutdown in PS hydro system 2 is approximately 30 seconds. In addition, the PS in hydro system 2 additionally included two switches on the front door and coating ladder regardless of the position switch "PS".

When performing a flight from faulty hydraulic switch "PS" should is in the "ABT". After take-off the aircraft PS-140 after cleaning flaps automatically disconnected. Working PS-140 is controlled by an appropriate scoreboard **"Д"** on the name plate of the hydraulic system.

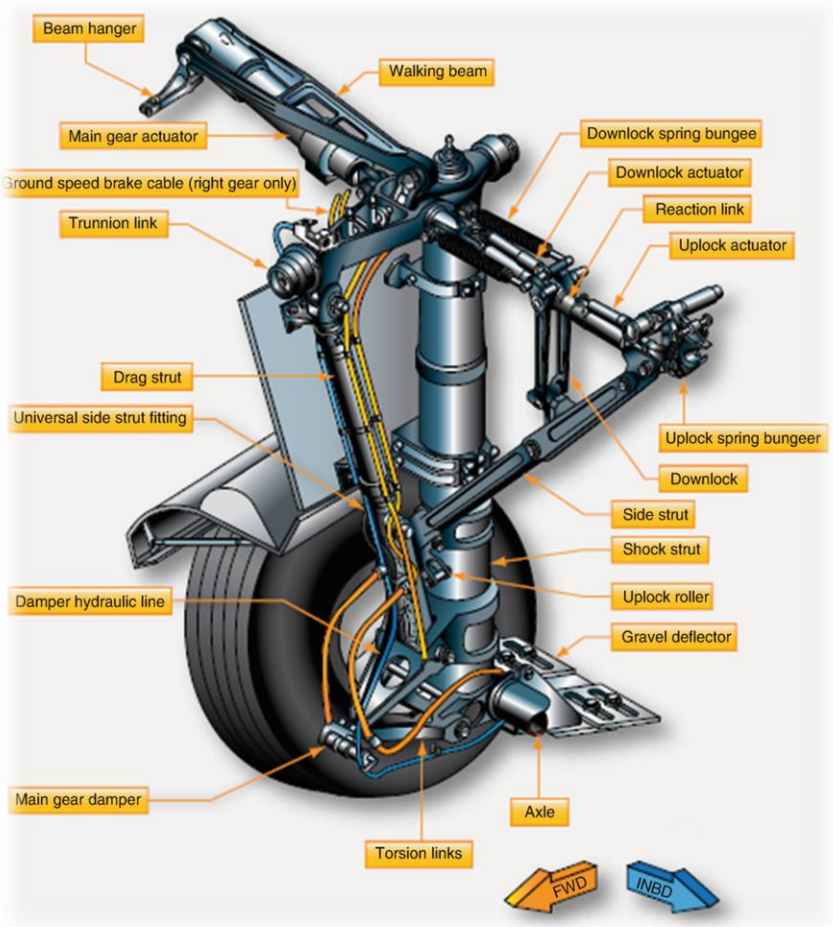

Figure 2.2 - Landing gear parts

2.3.2 Hydroaccumulator

Standing in the general discharge hydraulic discharge line for short-term high costs of working fluid in the system at the time of operation of the actuators andextinguishing maligns pressure in a sharp decrease in fluid flow stopping.

Service performed sneeze mechanisms. In addition, the discharge line installed standalone Accumulator (hydroaccumulators parking brake) which is cut off fromthe discharge line check valve for long term storage it is off pressure at the pumping station (a source of pressure for the parking brake wheel chassis and redundant power supply).

Pressure charging gas cavities hydroaccumulators monitored by pressure indicator, in the absence of fluid pressure in the hydraulic system. The pressure of the working fluid in the hydraulic lines in injection accumulator parking brake is controlled by the same devices that charge pressure nitrogen gas cavities hydroaccumulators. In addition, the design of the hydraulic system provides alarm systems failures while reducing the pressure below the allowable. If the reduction is whether the pressure PS-140 less than 80 kg / cm^2 and decreased hydraulic pressure of 80 kgf / cm^2, alarm installed in the discharge line 1 issues a signal to illuminate "Г/СИСТ. ОТКАЗ".

In the first five seconds of power on the National Assembly on the issue of signal failures PS -140 blocked.

Cleaning the working fluid in the hydraulic filters made of fineness of filtration - 16 microns.

2. 3. 3 Pipelines and hoses

Pipelines made of different metals depending on their use Pipelines pressure lines made of stainless steel 12Х18Н10Т. Pipelines low pressure lines are made of aluminum alloy АМг2М. Steel pipes are ending as the outer cone and the inner cone. Pipelines from АМг2М made only with ending on internal cone. Fixing pipes on the aircraft carried out mainly by means of at railway pads.

Pads are made from a mixture of rubber and cork crumbs. On the outside duralumin cover pads are installed. In some places, the installation pad on a flat base, the bottom cover is not installed.

In some parts, where the one or two pipelines, carried their mounting clamps.

Metallization pipeline caught a shoe or clamps, with design made flexible belt. Steel piping pressure lines are not painted. Pipelines low pressure lines painted enamel dark gray. In hydraulic piping is applied labeling.

Additional marking

Sign and text main marking

Hydrolig

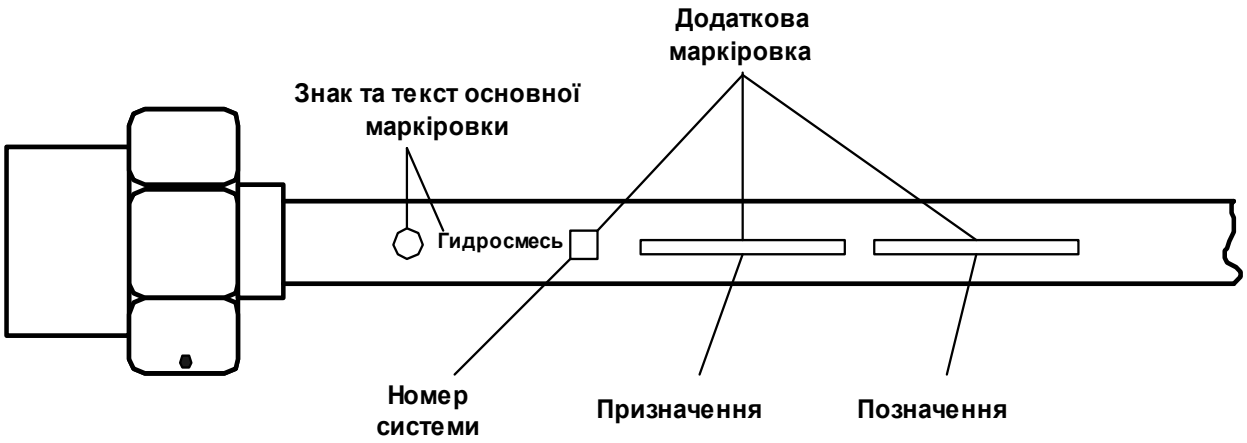

Figure 2.3 - Marking pipeline

In areas "additional marking" applied:

- on the site "number of system" - "1" or "2";

- on the section "Purpose" - the word "shower", "Pressure", "In a start", "Picking", etc .;

- at the site of "Marking" - drawing the number of pipeline.

2.3.4 Hydro tank

Hydro tank provides power to the working fluid PS-140. Hydro tank internal cavity is divided into two compartments. In those sections of the working fluid returns all of the lines with shower.

The fluid level in Hydro tank controlled by level. On the scale gauges marked green and white risks, which are determined by control fluid levels in hydro tank.

Full capacity Hydro tank - (15,9 ± 0,2) l.

Housing Hydro tank - cylindrical, made of aluminum alloy sheets “АМг6” thickness 1.2 mm welded argon arc welding. In boiled union body, the neck, which is the building block of the tank. Cover structurally executed in a way that is both antigravity partition for both compartments of the tank.

Hydro tank equipped with devices that ensure the power of the PS working fluid in the case of negative overload, separation of air from the fluid enters the tank, and protection from excessive increases in pressure boost hydro tank and devices for measuring the amount of fluid and issuing signals at lower level Hydro tank in liquid, but no input in the design of the tank.

Hydro tank internal cavity is divided into two compartments, one of which is designed to supply pumping station HS 1, another - for pump station 2. HS cavity inner tank communicates with the main cavity hydro tank through the holes in the lid of the case. Cover structurally executed in a way that is both antigravity membrane compartments for both hydro tanks.

*Work.*The working fluid returns from the hydraulic system in the compartments of tanks via adapter, check valves, caps and cavity rods and then through the holes in the eddy enters the cavity air separator. When rotating fluid air bubbles detached from the grid, and emerge through the holes at the top of air separator go into the air cavity hydro tank.

Collection of fluid from the cavity through the compartments of shells and sinker, servicing - through the drain line hydro tank main compartment (compartment HS 1). Drain liquid from each compartment provided separately through the squares.

At full refueling hydro tank fluid level is above antigravity membrane through which the two compartments cavity communicated with each other. In the case of a depressurization of the hydraulic fluid level decreases and when the total amount of liquid 11,3l (6,9l - in bay 1 and 4,4l HS - HS in bay 2) cavity compartments disconnected. In the complete loss of fluid in one of the sections - otherwise it is sufficient to complete the flight.

2.3.5 Network pressurization hydro tank

The network is designed to boost the creation of excess pressure in hydro tank. The air in the network shown pressurization of air conditioning system (ACS)

aircraft.Air purification from impurities carried in the filter drier and separation from moisture in the drainage tank and filter-driers. In the gearbox there is a decrease in air pressure to 1,7-2,6 kg / cm^2.

The presence of the drainage tank pressurization network dramatically reduces the amount of air that passes through the network boost, and hence the amount of moisture that can get into hydro tank. To prevent excessive pressure boost network has two safety valves, one of which is installed in the drainage tank to another hydro tank. Valves open in achieving air pressure (0.3) kg / cm^2.Control presence boost pressure in the network is carried out on a board "НЕТ НАДДУВА" on the name plate of the hydraulic system.To improve the pumping station on the ground when the engines and APU does not work, the air pressure in the network must be submitted boost from the airfield source through the union board boost set in the right fairing to chassis frames №23. Announced air pressure must be within 5.7 kg / cm^2.Incitement of boost pressure hydro tank made through a drain valve, installed in the drainage tank. Arrangement units to boost network hydro tank on the plane shown in table 2.2.

List of shortcomings:- alarm "ГС-ПРОВЕРЬ" in flight when hydraulic system is alright- occasional fire boards "МАЛО ЖИДКОСТИ" in flight at a normal level of liquid in hydro tank. - collecting water on the lower lid compartment sources pressure of hydro system in the right chassis fairings.- not provided operational control of the servicing hydro tank and spacecraft because of the large number of manhole covers and screw the lack of illumination.- not provided operational control of the servicing correctness hydro tank network supervisor emergency exit crew in preparation for the flight.- not possible to hydro tank hydraulic refueling tanker in the absence of FSL.- big noise in the passenger cabin when working pumping station.

Table 2.2. Arrangement units

Number n \ n	Aggregates	Quantity	Location	Operational approaches
1	Trip boost choke	1	In the rightpartfairing chassis between frames №22-24	Side door 740-4K in the right chassis fairings
2	Drain tank	1	In the right chassis fairings between frames №22-24 On the drainage tank	Side door 740-4K in the right chassis fairings Since when removing passenger cabin floor panels 225-3HTS
3	Alarm pressure SDH- 1.25	1		
4	Drain valve	1		
5	Safety valve	2	One on drainage tank to anotherhydro tank	
6	Filter dryer	1	Under the floor in the cabin frames №22 on the right side board	
7	Reducing valve	1	Under the floor in the cabin frames №22 on the right side board In front fairing junction with the fuselage center section to the right of the plane of symmetry of the aircraft	Since when removing passenger cabin floor panels 225-3HTSThe top hatch on the front 243-1B fairing junction center sect of fuselage
8	Check Valve	2		
9	Check Valve	2		

2.4 Shortcomings hydraulic system, you revealed in the tests of theplane

The level of oil АМГ-10 in the tank when charged and discharged hydro and accumulator changes significantly. When refueling АМГ-10 for maximum level at defuse hydroaccumulators level АМГ-10 can go beyond the scale tank.

Analyzing the above listed deficiencies identified in the performance of maintenance of the hydraulic system in actual operating conditions, to ensure

operational control accuracy of a referral hydro tank network emergency exit crew in preparation for the flight during the day in the project proposed to install additional filling neck and log scale on the body hydro tank.

Conclusion to part 2

The hydraulic system is an important component for the supply of all liquid components and assemblies associated with the control plane. In this section are listed components and assemblies that are directly connected to the hydraulic system. A brief description of each unit and work and table that let sees it all more clearly.

Picture reproduced on the identification markings on the pipeline. This will get more information about the show pipeline.

Also given short list of hydraulic deficiencies that were identified during testing of the hydraulic system of the aircraft, to help you better focus on certain things.

PART 3. FOUNDATION OF THE MAIN COEFFICIENTS

3.1 Calculation and analysis of factors accessibility easy removal and hydraulic units

To determine the coefficients accessibility Кд *and* Кл easy removal used formula:

$$K_д = 1 - \frac{Tдоп}{Tосн + Tдоп}, (3.1)$$

where:

$T_{доп}$ - the complexity ofadditional work man-hours.

$T_{осн}$– complexitymain, targeted work man-hours.

$$K_л = 1 - \frac{\Delta Tдм}{Tдм}, \quad (3.2)$$

Where:

$\Delta T_{дм}$ - excess complexity dismantling and assembly work on this unit compared to the reference value, man-hours

$T_{дм}$ - the complexity of dismantling and assembly work on this unit man-hours

Calculation of made in tabular form (table 3.1.). Only for the main hydraulic units, requiring its replacement during operation.

Data on labor used in the calculation were obtained by “ЛИиДБ” and database normalization operations to replace hydraulic units An-140.

For reference values dismantling labor and installation work during replacement units. Adopted indicators easy removal raised operational requirements to ensure manufacturability civil aviation.

Evaluation of operational adaptability hydraulic units manufactured by the coefficient easy removal and comparative values (evaluative) accessibility factor:

$$K^{оц}_{д} = \frac{K^{р}_{д}}{K^{эт}_{д}}, \quad (3.3)$$

where: $K^{р}_{д}$ - coefficient accessibility aggregate consideration plane.

$K^{эт}_{д}$ - coefficient accessibility reference plane.

In this case, the more important evaluative factor, the better the performance accessibility considered in aggregate.

Of estimated coefficients and standard accessibility and easy removal for basic hydraulic units are shown in table 3.1.

3.2 Calculation and control suitability analysis units and functional areas in the hydraulic system of the aircraft An-140

Due to the fact that the hydraulic units under the control of their disability is not removed from the aircraft and checked directly in the operation of the system, it is advisable suitability of control estimated using the formula:

$$K_K = \frac{n_{зам}}{n_{потр}} \quad (3.4)$$

where:

$n_{зам}$ - the number of parameters measured the existing control system and used to determine the technical condition of units and functional areas of the hydraulic system.

$n_{потр}$ - required parameters necessary for determining the technical condition and troubleshooting of aircraft hydraulic system.

3.3 Indicators of operational and technological Кл Кд for fixed hydraulic units

Table 3.1. Coefficients of hydro system

Name, type of unit	The complexity, man-hours.					Кл	$К_{д}^{р}$	$К_{д}^{эт}$	$К_{д}^{оц}$
	Т*дол*	Т*dm*	Т*dm*+*Тдол*	$Т_{дм}^{эт}$	ДТ*дм*				
Pumping station PS-140	0.23	0.5	0.73	1.0	-0.5	2.0	0.68	0.9	0.755
Filter 8D2 966,504	0.07	0.5	0.57	0.33	0.17	0.66	0.88	1.0	0.88
Accumulator 140.00.5601.100.000	0	0.7	0.7	0.5	0.2	0.72	1.0	1.0	1.0
The switching unit Q A08077	0.2	0.85	1.05	0.6	0.25	0.71	0.81	1.0	0.81
Hydro tank	0.4	1.5	1.9	0.83	0.67	0.55	0.79	0.9	0.877
Aggregate braking ATK-02	0.5	1.2	1.7	1.0	0.2	0.83	0.71	0.8	0.877
Cylinder cleaning and release the front support	0	0.7	0.7	0.5	0.2	0.72	1.0	1.0	1.0
The cylinder cleaning and production of basic support	1.5	1.0	2.5	0.66	0.34	0.66	0.4	1.0	0.4
Safety valve RD58-2	0.1	0.5	0.6	0.5	0	1.0	0.84	1.0	0.84

Table 3.2. Calculation of $К_к$

Functional area	***Кк***
Plot power I discharge line	0.55
Plot II power discharge line	0.38
The site collection and production of chassis	0.6
The area of production and assembly of flaps	0.62
Plot braking wheels	0.66
Plot turn the front wheels	0.6
Land management intertceptor	0.7
Plot control door-ladder	0.6

Higher $К_к$ better suitability of control areas

Analysis of table 3.2, allows to establish that suitability of control functional areas within 0.6.

For the final conclusion about the suitability of the existing control system to determine the technical condition of the functional areas and finding faulty hydraulic units, the analysis time of search and removal of whack. In the raw materials being used for “ЛИиДБ”

Analysis is performed on the main faulty conditions encountered in operation of An-140. The calculation results are summarized in table 3.3.

Table 3.3. Main failures

Defective status functional areas	The unit, which led to failure	T *Search* man-hours.	T *Device* man-hours.
Internal hydraulic leakage sites	Electrohydraulic power distributorQ A08077	4.6	0.5
	Distributor КЭ 74-2	3.8	1.0
	Crane inclusion КВ-38	4.1	1.5
	Crane turning КП-38	4.2	1.5
	The safety valve РД58-2	1.5	0.6
	Braking unit АТК-02	1.5	0.6
	Modulator УГ-148-2	2.6	1.8
The rapid drop the pressure in the systems	Accumulator	2.8	0.7
	Failure of other units	4.6	0.5
External leaks	Hoses, pipelines	1.2	0.3
	Other units	0.5-0.8	0.1-0.7
No pressure increase in the system	PS-140	2.1	0.78
	Other units	3.5	0.6
Loss of efficiency some units	Individual units	0.1-0.6	0.2-0.8

3.4 Operating hydraulic assessment of An-140

Assessment of the operation of the hydraulic system being made in actual weather conditions during operational service and periodic service after 500 hours of flight.

Embodiment hydraulic system provides access to:

- threaded connections;

-unit filters;

- panel mount hydraulic units;
- pipelines of brake system;
- hydroaccumulators charger;
- any desired point while survey work areas.

Thus, access through the performance hatches to all nodes, connections and components that require in control of the operation, adjustment and maintenance, lubrication, mounting and dismounting components and pipelines, both in summer and in winter provided.

Ease and speed of servicing hydro tank working fluid, charging nitrogen gas cavities hydroaccumulators, completeness hydro tank drain from the tank and drainage system boost provided without redraining and spraying the working fluid.

Incompatibility working fluid of construction materials and coverings in is not found. Chargers valves hydroaccumulators board valve hydraulic system board and the union-government over-compatible as airport facilities maintenance.

Controls, signaling and control hydraulic are situated in cockpit provides easy and convenience checks the status and readiness for flight, allowing crew and technical staff objectified cheats serviceability and performance, and time to find rejection.

All units and hydraulic pipelines are of type and design according to their functional purpose, equipped with the appropriate marking and inscriptions that indicate their function and operational constraints.

External tightness ensured during exams. Individual cases of leakage of working fluid eliminated retorque respective sockets. No cases of destruction or units hydraulic pipelines under the influence of internal and external influences were not.

During the examination of destruction or construction elements of the hydraulic system efficiency through weathering, corrosion, erosion and abrasion was not. All compartments, which are the aggregates and hydraulic piping provided with adequate means of ventilation drainage, unacceptable accumulation of

moisture, dust and dirt are not observed. In proven operating conditions, the system adopted technical service provided reliable operation of both the hydraulic system and its individual units. The analysis of indicators and easy access easy remove hydraulic units An-140 showed that some units, particularly hydro tank, cylinder-release gathering bases-foot chassis have very little value.

Analysis of labor search and removal of whack shows that the current system has insufficient access to control and allows only certain areas of a failure of the hydraulic system and makes it impossible to quickly and accurately find the faulty unit area.

3.5 Hydraulic system design improvements An-140

Before we talk about improving hydraulic system, would like to spend a short description and principle of the alarm system water in fuel SAW1-1.

3.5.1 Description of the system

The system is designed for the detection of sludge in fuel free water and the alarm on the remote polling and alarm at the parking lot on the ground one by one in each tank left and right half wings.

The system works for positive values of the temperature of water sludge to +60 ° C ambient temperature range from -60 to +60 ° C.

The system provides an alarm when the level of free water from the reference plane of the sensor is not less than 8 mm.

The system includes:

- sixteen sensor alarms water sludge installed inside

fuel tanks at their lowest points near the sludge drain valve fuel;

- generating unit signals БФС7-1 mounted on the frame РМ16-I;

- survey and remote alarm П1-1 set right next to the chassis cowl flap control centralized refueling.

The operating principle of the system is based on the difference in conductivity of the free water and fuel.

Power system is a direct current voltage of 27 V and AC 115 V 400 Hz.

The switch system "СИГН. ВОДЫ И СЛИВ ОТСТОЯ " is set on the control panel of centralized refueling.

Structurally probe (see fig. 3.1.)consists of three stainless steel electrodes: the measuring, protection and earthing. The measuring electrode is provided in the form of plates with serrated edges. Earthing is a plate, which is bent edge of the reference plane of the sensor node is I mount the sensor to the elements of design. Rivets attached to the earth electrode pressed insulating base on which the reception of the pressure material into the measuring electrode. Base and column are separated by guard electrode.

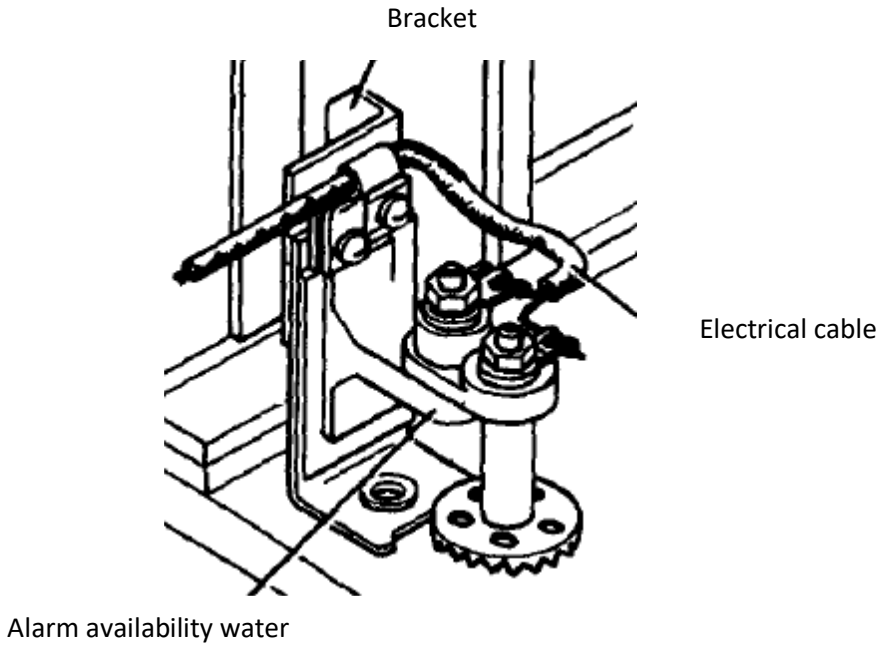

Figure 3.1 - The sensor alarm water sludge

Connecting the sensor is a shielded cable. The measuring electrode is connected to the residential cable protection - with the screen using a tip attached to

the transmitter terminals. Connection to the earthing elements of the construction is carried out connecting wire.

On the front of the remote polling and alarm set П1-1:

- ganged switch for switching pairs of controlled sensors
- two green flasher "ТОПЛ.", signaling the absence of free water in the fuel;
- two red flasher "ВОДА", indicates the presence of free water in the fuel;
- two buttons "КОНТР." ("ТОПЛ." And "ВОДА"), built-in control;
- stencils with information on the various positions of the switch. Inscriptions define how the poll sensors and contain sequence number generation, which set the respondent sensor and the number of engines, to which fuel is supplied from the tanks of the line.

Control of the availability of free water in the tanks of the second stage, supplying engines number 1 and 4, it is necessary to carry out two pairs of transducers "А" and "Б". This is due to the structural feature of these tanks. Therefore, in the screen there are two position switch to control the tanks of the second stage engines "1,4" - the point "А" and "Б".

3.5.2 System operation

Control of the availability of water in the fuel tank, by setting the 2I6-A2 remote polling and alarm in the position corresponding to the sensor-controlled 2I6-BI ... 2I6-BI6. The sensor sends a signal to the block 2I6-AI signal generation, the red flasher "ВОДА" in the presence of free water in the sludge fuel or green flasher "ТОПЛ." in the absence of water in the fuel.

Operating check system by pressing the "КОНТР." with the inscription, the corresponding button on the burning Flasher 2I6-A2 survey and signaling.

The system is effective item, if the button is pressed, a "КОНТР." a change in signal, that is, one goes flasher lights and other. After releasing the "КОНТР." flashers should return to its original position.

A detailed description of the system and the rules for its operation are given in the Guide for the technical operation of the alarm system of an aqueous sludge CCBI-I 6TI.463.000 РЭ.

Given the above description and job offer SAW1-1 in hydro tank. This will ensure timely detect the presence of water in hydro tank continue its service life, reduce costs downpour hydro liquid, since it was possible to control water without its drain and refresh much of the technical staff at service hydro tank and hydraulic system as a whole.

Conclusion to part 3

To select the optimal strategy for maintenance of the hydraulic system of the aircraft An-140 commonly used ratios accessibility -operational adaptability, and control suitability easy removal system.

Through various methods for determining the factors accessibility, easy removal, on the one hand, and the other factors control suitability, their calculation and analysis is done separately.

There is a table where the pooled control suitability for different functional areas. The higher the ratio, the better suitability of area.

For the final conclusion about the suitability of the existing control system to determine the technical condition of the functional areas and finding faulty hydraulic units, the analysis time of search and removal of whack

PART 4. LABOUR PRECAUTION

4.1 Introduction

Choose as a specialist equipment servicing the hydraulic system, which is directly linked to servicing the hydraulic system of the aircraft, based on the theme of the degree project "Structural and technological measures to maintain operational reliability of hydraulic passenger aircraft take-off weight of 20-25tons."

When completing the desired procedures, the technician in charge encounters several challenges. Continued work on hydraulic fluid-containing components andassemblies, or direct usage of it, necessitates cautioning machinery against detrimental effects on the body, such as the use of protective gloves.

However, not all problems can be resolved quickly.

4.2 Workplace analysis

4.2.1 Workplace Organization

Each employee is assigned to a task that he or she can complete. Hydraulic workplace equipment allows for the storage of keys, spare parts, storage units and units, as well as liquids.

Depending on the tasks that require the use of a particular tool, the workplace can be equipped with hydraulic, pneumatic, or power tools. Using a particular tool facilitates a lot of work and reduces the time it takes to implement it, which leads to increased productivity.

However, these, as well as other equipment and facilities, can be sources of dangerous and hazardous industrial variables that have an impact on workers.

In addition, the professions allotted unique supplementary lighting, allowing you to perform at your best.

4.2.2.A list of the most dangerous and harmful production factors- insufficient lighting in the work area;

- a working environment with a high or low temperature air;

- a high level of vibration;

These elements have an impact on the entity, and their source is a direct factor in this production room, as are the names of the factors involved.

4.2.3 Workplace analysis of harmful and dangerous industrial factors

4.2.3.1 Natural light

Direct sunlight or diffuse skylights are used to provide natural illumination. All production, storage, sanitary, and administrative facilities should be included.

The range of natural light that is most pleasing to the human eye. It's a part of the solar spectrum. UV radiation is necessary for human health, but it is nearly completely delayed when passing through regular glass, therefore it does not permeate the premises.

Because natural light varies greatly depending on the time of day, season, and weather conditions, it cannot be used exclusively for much of the job. With this in mind as the primary consideration,

e = 100Er / Yen, %

The premise of the foundation of the classification of work as per the level of exactness put the littlest size of an object of separation, the base worth of the item that is to recognize the eyes at a given work, for example, the distance between two contiguous strokes when utilizing an estimating apparatus, the width of the point (an accentuation characteristic) of the littlest text dimension for perusing and composing, etc. Notwithstanding the force of regular light standardized its consistency, which in modern premises for work I, II, III and IV pieces and joined with the upper lighting ought to be basically 0.3. The consistency is portrayed by the proportion of the base worth etip to greatest etax on the functioning plane inside a common part of the room.

A commonplace cross-segment of the center track down the room, which is opposite to the plane of the glass lookout windows (with side light) or longitudinal

hub traverses the room (at the top light). If the premises for the work I and II releases can lessen the distance between the lights and increment their numbers.

4.2.3.2 The microclimate of working zone

Clean principles in the boundaries of the microclimate in the functioning region are surrendered Гост 12.1.005 - 76 Working region think space up to 2 m over the floor or ground, n which there are occupations. Extremely durable positions is thought of, where she worked the greater part of his functioning time, or over 2 hours persistently. Assuming individuals work in better places of the functioning region, it's all consider super durable positions.

The microclimate in the functioning region characterized by the current on the human body blends of temperature, dampness and air speed and temperature of the encompassing surfaces. Inordinate dampness obstructs heat move from the body by dissipation under high temperature and adds to overheating at a low temperature and, on the other hand, improves heat move, serving to supercooling. Ideal environment boundaries to such an extent that during drawn out and methodical human openness guarantee the safeguarding of ordinary capacity and the warm condition of the body without pressure responses thermoregulation, which makes a sensation of warm solace, and is an essential for elite execution.

Cleanliness principles shift by the level of actual responsibility, just as the warm or the virus season and the overabundance reasonable hotness from entering the hardware space, the warmed materials, warming machines, individuals, and daylight, for example the contrast between reasonable hotness and hotness misfortune in the computation of the boundaries of outside air into account all actions to decrease heat misfortune. For instance, for light work during the warm time of the year the ideal temperature is 22 ... 25 ° C, and permitted (at significant overabundance reasonable hotness) at 5 ° C higher than the normal temperature of the external air 13 hours of the most sweltering month, yet not more than 28 °. Relative moistness with up to 55%. Velocity 0.2 ... 0.5 m/sec (ideal speed of 0.2

m/s). In the virus season on a similar work ideal temperature is 20 ... 23 ° C, max - 19 ... 25 ° C. At times, permit some deviation from the standard. Recording Devices thermography estimates the air temperature and psychrometer - dampness.

4.2.3.3 Vibration

Vibration is the back-and-forth movement of a rigid body. This phenomenon is widespread in the work of various mechanisms and machines. Vibration sources: Bulk goods transport aircraft, drills, gears, pneumatics, internal combustion engines, electric motors, etc. D. Main vibration parameters: frequency (Hz), vibration amplitude (m), vibration duration (s), speed (m / s), vibration acceleration (m / s2).

Exposure to vibration is a more than a century-old risk factor that is still present in various sectors . Depending on its direction and the body part affected vibration has various health effects that affect the worker's ability to work. In the final stage the majority of the diseases are incurable, thus prevention is essential . European legislation regulates vibration at work in Council Directive 2002/44/EC. Exposure measurements and medical tests are guided by standards.Physical characteristics of vibration, risk assessment and measurements methods, objective and subjective classification of health effects, common vibration induced diseases and prevention thereof are detailed below.Health effects of vibration

Above a certain level the vibration transferred can harm the human body in different ways. Short term exposure to intense vibration can lead to discomfort and, thus, decreased productivity . Chronic exposure can initially lead to functional and afterwards organic aberrations: changes in the body functions or even the structure of the tissues that cause impairment. "Coarse" vibrations, which are of mostly low frequency and high amplitude, harm predominantly the bones and joints. High frequency and low amplitude "smooth" vibrations are damaging mainly the soft tissues. In general, impact devices are more dangerous then those with rotating mechanism. Besides the physical characteristics of vibration, the severity of damage is dependent on other factors, such as: noise, wet, cold, ergonomics, and work

methods.Based on the place of entry of vibration into the human body, local (segmental) and whole-body vibration can be distinguished. Local vibration occurs predominantly in the hands and arms, as the worker mainly operates tools/machines with his/her hands. This is termed hand-arm vibration (HAV). The source can be the vibrating hand tool, or the object of work that is processed by a vibrating machine (e.g., use of pedestal grinder) . The source of whole-body vibration (WBV) is the platform on which the worker is positioned and transmits the vibration of a nearby vibrating machine. It enters the human body via the lower extremities or the gluteal region. Combined exposure is the simultaneous presence of HAV and WBV. An example of combined exposure is a tractor driving or the operation of heavy equipment; whereby, the driver is seated in the vibrating machine (WBV), while steering and manipulating the handles that are vibrating too (HAV).Health effects of local vibration (mainly HAV)

Vibration is not a physiological stimulus to the human body (it is uncommon in the natural environment) and it mainly acts as repeated minute injuries (microtrauma) via the energy dissipated in the organ(s) .The pathophysiology is still not completely understood. Vibration injuries are characteristic but not specific: there is no such disorder that can be seen only in vibration and not because of other cause. Thus diagnosis cannot be based solely on the clinical picture. The most typical, but still not specific symptoms of HAV syndrome are Raynaud-phenomenon and the avascular necroses of the bones. The final combined pain and disability in the upper limb can be significant and correlated to the severity of the sensory component or the frequency of blanching attacks .In the verification of an occupational disease it is essential to prove appropriate exposure and to rule out other diseases with similar symptoms (e.g., diabetes, frostbite, autoimmune diseases). Health standards set the maximum allowable vibration in industrial premises of undertakings.

Table 4.1. Permissible values of vibration in industrial premises of undertakings

The oscillation amplitude of vibration, mm	Vibration frequency, Hz	Speed oscillating movements, cm / s	Acceleration of vibrational motions, cm /s2
0.6-0.4	To 3	1.12-0.76	22-14
0.4-0.15	3-5	0.76-0.46	14-15
0.15-0.05	5-8	0.46-0.25	15-13
0.05-0.03	8-15	0.25-0.28	13-27
0.03-0.009	15-30	0.28-0.17	27-32
0.009-0.007	30-50	0.17-0.22	32-70
0.007-0.005	50-75	0.22-0.23	70-112
0.005-0.003	75-100	0.23-0.19	112-120
1.5-2	45-55	1.5-2.5	25-40

4.3 Advancement of work security measures

4.3.1 The normalization of the microclimate

The article conducted a study of the working conditions of the combine operator, as a result of which it was revealed that the occupational hazards of an employee are unfavorable microclimate parameters. Based on the analysis of the thermal state of the combine cab during the summer and winter operation, a microclimate normalization system has been proposed, for which the main functional characteristics (cooling and heating capacity) have been determined. According to the results of the calculation, the relationship between these characteristics and the working speed of the combine is established. So, with the increase in the speed of the combine up to 20 km/h, the cooling capacity of the climate system increases by 36%, and the heat output – by 22%. The surface areas of the main elements of the microclimate normalization system (condenser and evaporator), providing the necessary performance, are also determined.

4.3.2 Vibration resistance

To decrease the impacts of vibrating apparatus and hardware on the human body, the accompanying measures and means:

- substitution of an apparatus or gear with vibrating working bodies on a vibration free in processes where feasible (for instance, the substitution of electro-mechanical to electronic sales registers);

- use vibration confinement vibrating apparatus comparative with the base (ex, the utilization of springs, elastic seals, springs, safeguards);

- utilize the controller underway cycles, (for example, the utilization of media communications to control vibrating from adjoining regions);

- the utilization of mechanization in modern cycles, utilizing vibrating machines (for instance, the board of a given program);

- use hand apparatuses with vibration-verification handles, shoes and gloves.

4.4 Fire safety

Those responsible for workplaces and other buildings to which the public have access can avoid them by taking responsibility for and adopting the right behaviours and procedures.

This section covers general advice on fire safety and also provides guidance on substances that cause fire and explosion.As per the premises at 24-86 ONTP blast and fire danger are isolated into five classifications (A, B, C, D, E).

Class A. Ignitable gases, combustible fluid with a flashpoint not surpassing 28 ° C in an amount that can frame unstable combinations fume gas air, which creates streak at appraised overpressure impact in the room, which surpasses

5 kPa. Materials and substances that can detonate and consume in touch with water, oxygen, or with one another so much that appraised overpressure impact in the room in excess of 5 kPa.

Class B. ignitable residue or strands, combustible fluid with a flashpoint more than 28 ° C, and combustible fluids in an amount that can shape unstable combinations Steamair dusty or then again, if streak which creates appraised overpressure impact in the room, which surpasses 5 kPa.

Classification B. Ignitable and weighty consume fluid, strong and substantial consume burnable substances and materials and substances able in touch with water, oxygen, or with one another lit uniquely on condition that the premises wherein they are, or utilized, do exclude classifications An and B.

Classification C. Non-burnable substances and materials in the hot, hot or liquid express, the handling of which is joined by brilliant hotness, sparkles, flares; combustible gases, fluids, solids are burned or reused as fuel.

Class D. Non-flammable substances and materials vulnerable.

Select the sort and meaning of the necessary number of fire quenchers as per Table 1 or 2 relying upon their dousing limit, minor regions, class fire combustible substances and materials in the room or on the secured object (standard ISO 3941-77):

Class A - fire solids, ideally natural beginning, which is joined by consuming rot (wood, materials, paper);

Class B - flames of combustible fluids or solids which dissolves;

Class C - fire gases;

Class D - fire metals and their compounds;

Class (E) - the fire because of consuming electrical establishments.

Automatic fire detectors, the principle of action divided into thermal, light, smoke, combined optical, ultrasonic.

Heat detector (fire alarm detector) sensor controlled every area - 30m2 installed on the ceiling.

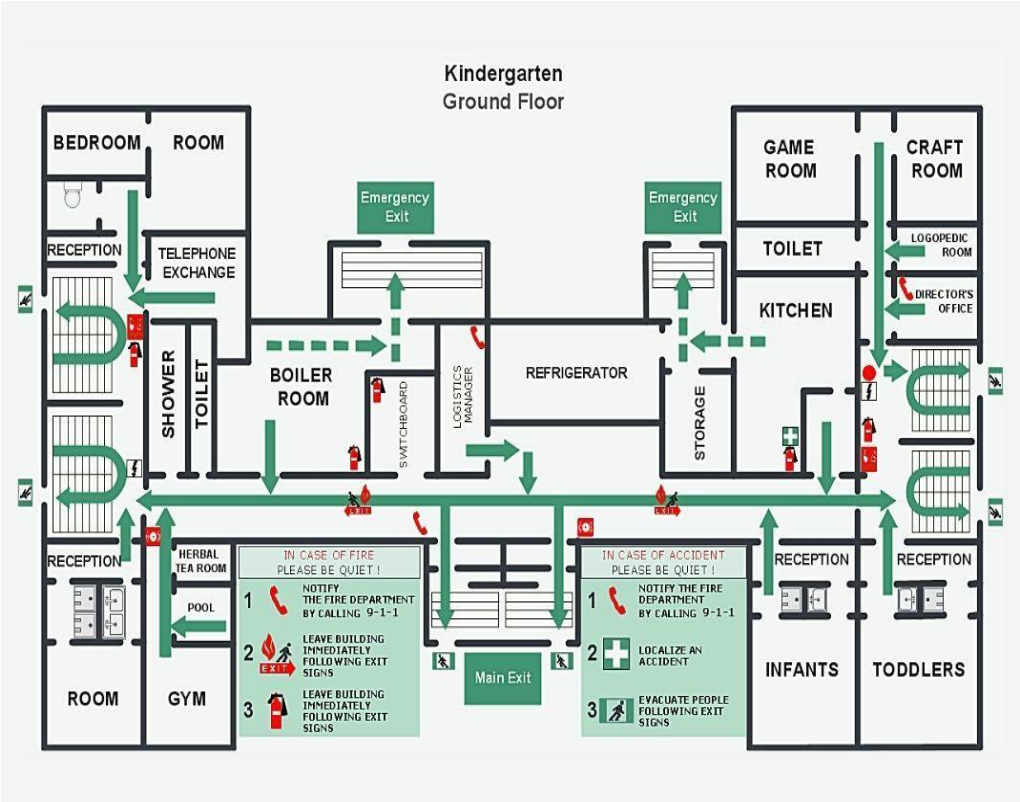

Figure 4.1 - Evacuation plan in case of fire

4.5 Calculation part

Example calculation the method coefficient using of light flux.

Determine the electric power of the lighting system W, the number of lamps N, the height of the suspension lamps Hp scheme placing fixtures on the ceiling to create a common uniform lighting equipment room power.

Input data:

The length of the equipment room A = 20 m, breadth B = 10 m, the height h = 5 m.

Whitewashed ceiling, the walls are painted blue paint.

Decision.

Select the mains voltage U = 220 V, lamp incandescent Wl = 300 W and fixtures such NSP03.

The calculations were performed by the method of utilization.The required amount of light to create a desired normalize

$$Nл = \frac{E \cdot S \cdot K_з \cdot Z}{\Phi_л \cdot \eta} \qquad (4.1)$$

where Ks - the safety factor.

For areas where there is no dust emissions Ks = 1.5

S = A * B = 20 * 10 = 200 m 2;

E_{min} = 200 lux for incandescent lamps.

F_l - the luminous flux generated by one lamp lumens is determined from Table. For incandescent lamps Wl = 300 W light output is F_n = 4100 lm.

Z - factor accept uneven lighting 1.15.

η - coefficient of luminous flux is determined by the Table.

The value depends on the utilization rate of the index space **i**, coefficient ρst, wall and ceiling ρ_n the room, as well as the height of the suspension lamps Hr. The reflection coefficients of the walls and ceiling are determined from the table. $\rho_v = 0.5$ and $\rho_n = 0.7$. Height Suspensionlamps is defined as the distance between the level of laborhorizontal surface and a lamp.

In this case: $Hw = h - (h_w + Hl)$

where, h - height of the room, h = 5 m;

h_w- the level (height) of the working surface, hw = 1.5 m;

hl - distance between the lamp and the ceiling, hl = 0.5 m.

Then: Hp = 5 - (1.5 + 0.5) = 3 m.

The index of the room ***i,*** is given by:

$$i = \frac{A \cdot B}{H_p \cdot (A+B)} = \frac{20 \cdot 10}{20+1\rho} = 1{,}9 \qquad (4.2)$$

From table we find η = 0,56.

Thus, the number of lamps is:

$$N = \frac{200 \cdot 200 \cdot 1{,}5 \cdot 1{,}15}{100 \cdot 0{,}56} = 30 \text{ pcs} \qquad (4.3)$$

Post ceiling lamps symmetrically equipment room, three rows of ten fixtures in a row.

Electrical power lighting system for general lighting is:

$$W = W_L \cdot n = 300 \cdot 30 = 9\text{kW} \qquad (4.4)$$

Conclusion to part 4

Based on the theme of the degree project, entitled "Constructive-technological measures to maintain operational reliability of hydraulic passenger aircraft take-off weight of 20-25 tons,"was picked hardware upkeep water driven framework, as a subject.

In this paper, on wellbeing and security in the field were given various elements which method as care staff need to look in completing the undertakings allocated to him. Knowing these variables we can lessen their effect on staff and make great conditions for work.

Perform support laborer has the chance through working environment association with adequate lighting, air flow, temperature typical, satisfactory degrees of commotion and vibration, etc.

In fostering the actions were wellbeing measures are to standardize microclimate and assurance from vibration.

As to security, for the blast and fire risk was picked classifications A, B, and C. Likewise, thinking about the picked class (B, C), chose number of compact fire quenchers, in particular, froth and water dousers with a limit of 10 liters. - 4 computers. Powder fire quenchers with the charge 5kg - 4 laptops., 3 l refrigerant. - 8 computers. The proposed heat locator STS-038, which is introduced on the roof.

PART 5. ENVIRONMENTAL PROTECTION

5.1 Exhaust of the aircraft

The fundamental elements of destructive impact of the airplane on the climate are fumes of hurtful substances by the motors, contamination of the ground by various fuel-oil materials, and furthermore aeronautics commotion. Extraordinary harm is brought to climate during handling of hostile to icing of the airplane and during its washing.

Commitment of air transport of the entire world in tainting of the air can be assessed by correlation with volume of all pre-owned oil items.

Anticipated development of air transport on the planet caused need of impediment of unsafe debilitates bit he motors. Global Civil Aviation Organization (ICAO) worked out regarding said above more severe standards on flying motors discharge.

Exhaust gases from gas-turbine engines include the following components that pollute the air: carbon monoxide CO, carbons (methane CH4, acetylene C2H2, ethane C2H6, ethylene C2H4, propane C3H8, benzyl C6H6, toluene C3H5CH3 etc.), nitrogen oxides (NOx), aldehydes (formaldehyde HCHO, acrolein CH2=CH=CHO, vinegar aldehyde CH3CHO), sulfurous oxides SO2, soot (visible smoke strip after the engine nozzle), benzapiren. During operation of turbojet and turboprop engines for 1 min into the air there are exhausted 2…4 mg of cancerogenic substances, mostly benzapiren.

Fumes of petroleum product into the climate by aeronautics motors isn't permitted by the standards of ICAO and ought to be disposed of during the time spent planning of new avionics motors and airplane. Regardless of this impediment in post soviet nations there are worked flying motors, from which fuel totals and ignition chamber (after each stop of the motor or during fruitless beginning) fuel is accumulated into waste tanks, and from them is streaming to the motor spout. Not

really set in stone that negligible part of contamination of the air via carbons through the debilitates of non-renewable energy source is close 20%.

Quantitative attribute of debilitates of unsafe substances of aeronautics motor is list of outflow EIi, which shows how much grams of the substance are depleted noticeable all around during terminating of 1 kg of the fuel. Hurtfulness of the motor is described by the control boundary of the emanation Mi/R0, where Mi is mass of the depleted I-th destructive substance (fixing) in the grams for quite a while of motor activity, R0 is drop weight of the motor. Assessment of biological and clean sterile prerequisites to the air terminal shows that it impacts the climate.

To them there are incorporated:

avionics commotion, which is spread on significant stretches from the aerodrome, has terrible effect on impressive piece of the populace and on fauna of firmly positioned districts under flight ways. Commotion is muddled blend of unfortunate sounds for human, which upset working action and rest. Effect on living creature of the commotions, which show up during the time spent airplane working, relies extensively upon their power and character. Steady clamor effects on climate not exactly non-customary seeming ones, and commotions of lower frequencies than high recurrence clamors. Non-uniform commotions, for instance during non-synchronic activity of propellers on the airplane with a few motors, power awful impact on the climate.

Following up on ears, focal and vegetative sensory systems, and through them on inside organs, clamor is the explanation of improvement of boisterous sickness. Diminishing general opposition of the organic entity to outer impacts, it advances improvement of contamination sicknesses.

The primary measures, which observed wide application in current act of diminishing of crabby impact of flying commotion on the domain and close to the air terminal, are:

- production of less uproarious power plants on the airplane;

- teaching of proficient functional systems and authoritative implies that permit to dispose of or decline impact of the commotion;

- utilization of building-arranging measures.

These days in the air terminals and on the airplane of common flying wide utilization for correspondence, radio-route, TV control, TV signalization and radiolocation is found by radio-mechanical assembly, which works in the diapason of high (HF), ultrahigh (UHF) and super-high frequencies (SHF). The most wide-spreading in the common flying there is found by radio-contraption and radio-frameworks that work in the diapason of UHF and SHF. They include: frameworks of instrumental setting down of the airplane – course and glissade bacons; frameworks of adjoining route; radio-locative stations – far off and adjoining uncovering, landing, assessment of flight field (diapason of millimetric frequencies), assessment of the airplane, communicating stations of short and ultrashort wave diapason – frameworks of programmed and self-loader control of the traffic; radio broadcasts of the aircraft etc.

Electromagnetic energy is radiated in the environment, at first, by antenna devices. Besides, the sources of electromagnetic fields in the working rooms of radio-locative stations, radio-technical workshops, laboratories and radio-centers can be separate units of SHF generators (magnetrons, klystrons), connective elements of modulators with generators, transmitting lines from generators to the antenna, cathode outputs of the magnetrons, ventilation slots, slots in wave-type tracts and coaxial lines etc.

Electromagnetic energy is emanated in the climate, right away, by radio wire gadgets. Additionally, the wellsprings of electromagnetic fields in the functioning rooms of radio-locative stations, radio-specialized studios, research facilities and radio-focuses can be isolated units of SHF generators (magnetrons, klystrons), connective components of modulators with generators, sending lines from

generators to the recieving wire, cathode yields of the magnetrons, ventilation openings, spaces in wave-type lots and coaxial lines and so forth

High recurrence radiation causes in living beings change of reflex movement (breaking of traditional and outright reflexes), dropping of circulatory strain, diminishing of the beat. Steady impact of radiation can prompt stable useful changes in focal and cardiovascular frameworks.

The primary ways during working out of proportions of assurance from impact of HF and SHF fields are: diminishing of thickness of radiation stream by the wellspring of radiation, screening of radiation source.

The proportions of insurance ought to fulfill the accompanying necessities: not make impressive electromagnetic field; not decline amount of activity and fix – one of the main elements of arrangement of flight wellbeing.

Contamination of air climate by the objects of the air terminal and airplane has, by and large, nearby incentive for administration specialized region of the air terminal, that in ominous conditions can arrives at levels that are balanced to edge of passable standards for populated locales;

Assembling sewages and surface sewages from the domain of the air terminal can dirty many water and ground protests, that is the reason require production of neighborhood cleaning structures.

The toxins of air incorporate power plants of the airplane, motors of extraordinary vehicles and heater houses, mechanical debilitates from the air terminal structures (studios, fix plants etc) Environment is likewise debased by fuel evapouration through waste openings on the storage facilities of fuel-oil materials, through spillages and spills of fuel and oil, extraordinary fluids during handling of the runways.

Among surface wellsprings of air contamination there are point (pipes, upcasts,etc) and direct (air circulation lights, open window openings etc) that are the explanation of between building spaces of aeronautics endeavor.

The primary estimates that are coordinated on diminishing of defilement of air climate on the domain of the air terminal are:

- cleaning of ventilation and innovative debilitates in the air;
- improvement of innovative cycle and completing it to wasteless industry;
- compression of hardware and lines;
- following the arranging prerequisites of security of airshed during putting of the air terminal articles.

During arranging and acknowledgment of ecological insurance measures in the air terminal extensive significance has the detail stock of coordinated and non-coordinated depletes of unsafe substances into air.

Current course of natural insurance from the contamination by modern debilitates predicts arrangement of the issue not just in the method of mechanical and sterile specialized measures, yet additionally by right useful utilization, building and well plan of air a terminal area with considering consistencies of spreading of hurtful substances in climate and points of view of improvement of assembling base.

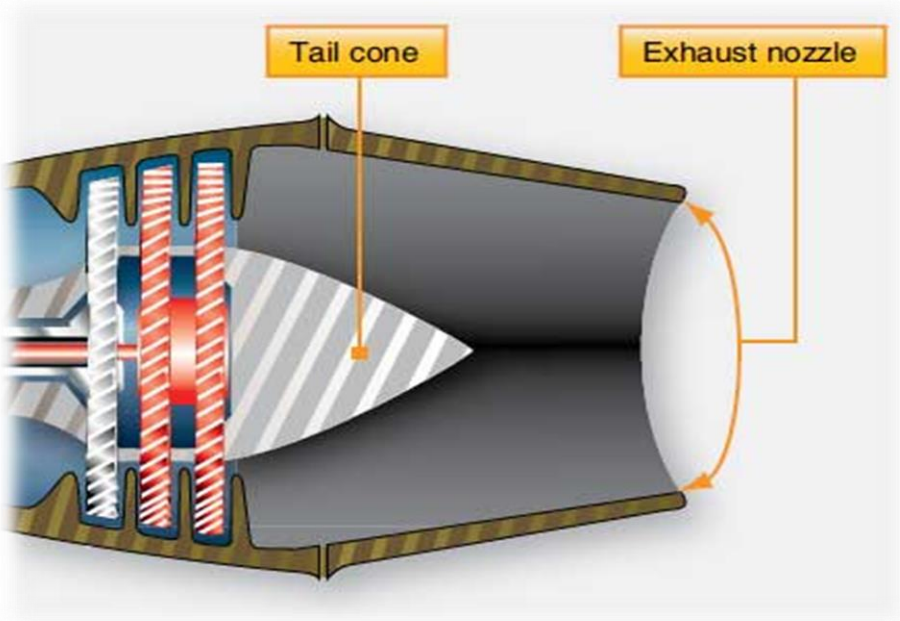

Figure 5.1 - Exhaust systems in the aircraft

5.2 Controlling emission from aviation engines

In 1981 Committee of aviation engines emission (ICAO) worked out and agreed project of the norms on the emission and gathered them in the Appendix 16 “Environmental protection”. Appendix was worked out on the base of the circular 134-A N/94 “Normalizing of emission of aviation engines” inn which there were added corrections by the states-members of ICAO.

Standards on the outflow set up restrictions of vaporous emanation of carbon oxide (CO), carbons (CxHy) and nitrogen oxides (NOx), and furthermore smoking of flight motors and disposal of the depletes into the environment. Standards limit outflow independently for turbojet and turbofan motors, which are situated on the subsonic airplane, and for aeronautics motors, which are situated on the supersonic airplane. Standards of the emanation are set up just for turbojet and turbofan motors of long reach subsonic airplane with push more noteworthy than 26.7 kN. Discharge of the cylinder flight motors and motors that are situated on the little airplane isn't standardized in light of the fact that amount of the fuel, which is copied by them, is little in examination with the motors of long reach airplane.

Standards on the turboprop aeronautics motors (TPE) isn't set up in light of the fact that airplane, on which they are found, perform little volume of the transportations. Emanation of hurtful substances of assistant power units (APU) of the airplane are not standardized on the grounds that the costs on their improvement would be a lot more noteworthy in correlation with effectiveness of got diminishing of discharge. The objective of outflow is to diminish tainting of the close to surface space of the Earth.

For assurance if outflow of aeronautics motor relates to the set up standards, there are anticipated seat affirmation tests. States of the tests are set up for overall a similar kind motors comparative. Tests are done in the conditions, which relate to the states of flight motor activity in the zone of the air terminal. After the trial of the motor reporter association gives the archive – authentication that affirms correspondence of its emanation attributes to the standards, set by ICAO.

For such certificate tests there is worked out the plan that anticipates keeping to genuine states of activity. The plan incorporates affirmation pattern of discharge, which compares to functional method of flying motor work during take-off and moving to 1000 m and landing come closer from the stature 1000 m.

Comparison of two aviation engines by integral value of emission on the unit cycle “take-off – landing” for all engines allows objectively and simply to evaluate level of pollution of atmosphere air by them. Certification tests are made on the fuel with certain characteristics and on the certain benches for testing of given types of the engines.

Engine smoking during bench tests are determined by reducing of reflective ability of paper filter in the values of smoking.

The norms of ICAO on control parameter of emission on modern day are:

$M_{CO}/R_0 = 118$ g/kN;

$M_{CxHy}/R_0 = 19.6$ g/kN;

$M_{NOx}/R_0=(40…80)$ g/kN;

$M_{Sox}/R_0 = 15$ g/kN;

$M_{S.P}/R_0 = 11$ g/kN.

ICAO norms on the exhaust of the fuel ingot atmosphere suggest to the designers of the engines on the aircraft to turn on intended fuel exhaust into atmosphere from the nozzles in the case of engine stop after finishing of normal flight and operations of start and stop on the ground.

During certification tests of the engines for measurement of concentration of harmful substances there are used the following analyzers: measurement of the totality of carbons (C_xH_y) is performed by fire-ionizing detector; carbon oxide and dioxide (CO and CO_2) is measured by infrared analyzer that is not disperse, with differential absorption of the energy in parallel elements; nitrogen oxides (NO_x) is measured by chemiluminescent method.

5.3 Ways for reduction exhaust of engines

Radical direction that leads to exhausts reducing by aircraft is limitation of aviation engine emission of harmful substances, and in future creation of so called “clean” engines. Realization of this direction is connected with multifunctional scientific investigations, which require presence of modern high-accuracy apparatus and considerable financial expenses during working out and tests of complex and expensive structural solutions on the aviation engines. Provided that performance of all adaptations and developments of aviation engines shouldn’t influence on achieved levels of flight safety and reliability of the aircraft, besides, be acceptable by economic reasons.

Let’s consider some directions of engines improvement, including structural ones.

For decreasing of the products of incomplete burning of the fuel (C_xH_y and CO) during designing it is necessary to increase fuel combustion efficiency, on which indexes El_{CO} and El_{CH} depend, can be achieved with the help of usage of the systems of preliminary fuel evapouration, enriching of fuel-air mixtures in the zone of burning and increasing of number of zones in the combustion chamber, that allows regulating engine operation by turning on or turning off the part of the nozzles.

It is not difficult to notice that structural changes lead to decreasing of specific fuel consumption, that is improvement of aviation engine efficiency, and so to decreasing of emission indexes of CO and C_xH_y. In such a way solution of the task of increasing of efficiency of aviation engines of long range aircraft, which stands before the designers, automatically leads to solution of the task of emission reducing of CO and CH of these engines.

The task of reducing of NO_2 emission is more complicated during working out of perspective engines for long range aircraft. The problem is in that the task of increasing of efficiency of perspective aircraft is connected with growth of the

pressure ration in the combustion chamber and growth of air temperature behind the compressor on the outlet in the combustion chamber T_c. Growth of T_c in its turn leads to increasing of emission of NO_x.

For emission decreasing of nitrogen oxides NO_x aviation engines can have the following designing solutions: injection of the water in the burning zone; application of double or multi-zone combustion chambers; application in the combustion chambers of catalytic burning in which gas temperature in the burning zone decreases; leaning of fuel-air mixture. The last measure lead, however, leads to increasing of emission of products of incomplete fuel burning on the idle mode. In double-zone chambers fuel burns in two stages in different parts of the chamber, and in the first zone it is provided optimal fuel combustion in the idle mode, for example, during taxiing on the aerodrome, and in the second zone of combustion chamber fuel is not supplied.

On the take-off mode, climbing and cruise flight the second zone of combustion chamber is added to the operation, providing optimal process of combustion and necessary thrust. Process of combustion in the second zone passes in lower temperatures than in single zone combustion chambers, and this leads to decreasing of emission of nitrogen oxides.

Considerably emission reducing for past time is achieved on the series of the last models of aviation engines, such as Д-36, 1Т9В, СГ6, КВ211, and evidently in the nearest future in the structural view there will not be complicated difficulties.

Operational methods of reducing of emission of harmful substances from aviation engines are based on decreasing of duration and change of modes of engine operation in the zone of the airport on the stage “start – taxiing – take-off –taxiing after landing to parking place”. Decreasing of harmful substances emission from aviation engines in the zone of the airport can be achieved by:

- towing of the aircraft from the parking place to the runway;
- taxiing of the aircraft on the part of working engines;

- the most favourable distribution of the aircraft on the runways (in runways are more than one) in take-offs and landings.

Introduction of the aircraft towing can decrease harmful substances emission of incomplete fuel combustion on the stage “start – taxiing” to take-off on 50%, nitrogen oxides – on 5%, and fuel economy – on 25%. Application of this method is justified if tower’s exhausts are inconsiderable or it works, for example, on electrical thrust.

New kinds of fuels for the aircraft. Problem of economy of fuel-energetic resources called interest of development of alternate synthetic fuels and application of liquid hydrogen as the fuel, including for the aircraft. It is natural that kind if the fuel determines considerably discount and flight performances of the aircraft, including level of contamination of the environment.

Parametric investigations, performed for the aircraft on 400 passengers with the flight range 10000 km and cruise speed that corresponds to M = 0.85, which operates on synthetic aviation gas, liquid methane and liquid hydrogen, showed the advantages of liquid hydrogen as economically reasonable and less polluting the environment.

Calorific power of the hydrogen is on 28%, and of the methane on 16 % higher than aviation gas T-1. But by volumetric calorific power hydrogen and methane concede to gas because of their lowered density.

That’s why for placing equivalent fuel store on the aircraft it is necessary except 1 m^3 of the gas 4.25 m^3 of the hydrogen or 1.66 m^3 of liquid methane. During designing of the gas-turbine engine on liquid hydrogen the main difficulties brings the development of the system of regulation and supply of liquid hydrogen from the tank to the fuel nozzles, working out of the materials and provision of efficient combustion of the hydrogen in the combustion chamber. Problems hat appear during application of liquid hydrogen in aviation engines are in development of cheep methods of obtaining, conservation and loading of the fuel tanks. Cost of hydrogen thermal unit is in 3…4 times in our days higher than in gas, but in future, as the

forecasts show, it will be equivalent. It is necessary to create complex, which provides safety of the application, conservation and usage of liquid hydrogen. Costs of these works will be near 40% of the cost of whole program for application of liquid hydrogen in the whole aviation.

In such a way for reducing of environmental pollution by the aircraft of civil aviation it is necessary to create the complex of measures, which should include: improvement of aviation engines and aircraft; application of more developed methods of operation; ecologically reasonable traffic of the aircraft in the airports and on its approaches.

5.4 Calculation exhausts of aviation engine

Aircraft is transient organized sources of exhausts of harmful substances (HS) into atmosphere air. In accordance to the norms of ICAO there are regulated exhausts by aviation engines of the following harmful substances:

- carbon monoxide (CO);
- carbon compounds, which didn't born (C_xH_y);
- nitrogen oxides (NO_x);
- smoke in the form of carbon solid particles, which didn't burn (SN).

The aim of the part is calculation of the weight of HS, which get into the atmosphere during engine operation in the zone of the airport.

Emission of HS with exhaust gases depend on emission characteristics of the engine, modes of its operation on different stages. Weight of HS exhausts in the zone of the airport is calculated in one take-off-landing cycle (TLC), which parameters are determined by ICAO.

Aircraft take-off-landing cycle that is made in the zone of the airport consists of the following stages:

- start and warming up of the engines;
- taxiing on the start;
- take-off;

- climbing to the height of 1000 m;

- landing;

- taxiing to the stop of the engines.

But aircraft engines on these stages work on different modes. That's why for convenience of calculation take-off-landing cycle of the aircraft is divided into two kinds of the operations:

- ground operations;

- operations take-off – landing.

$M_i=M_{ig}+M_{it\text{-}l}$. (5.1)

Ground operations are engines start, their warming up, taxiing of the aircraft before take-off and after landing.

This circumstance simplifies calculation.

Determination of M_{ig} is made by the formula:

$M_{ig}=K_{ig}\cdot G_{fg}$, (5.2)

where K_{ig} – coefficient of exhaust of *i-th* ingredient during ground operations (kg_{ingr}/kg_f).

It is evident that $K_{ig} = 10^{-3}\cdot EI_{ig}$ (by definition, it is the same index of emission). Like EI_i, K_i is determinedduring certification tests of the engines.

G_{fg} – fuel weight, which is spent by the engine during ground operations of take-off-landing cycle:

$G_{fg}=C_{spidle}\cdot R_{idle}\cdot t_{idle}$. (5.3)

There $C_{sp\ idle}\left[\frac{kg}{N\cdot h}\right]$ – specific fuel consumption during the engine operation on the idle mode (it is given in the log book of the engine as its one of the most important technical characteristics),

R_{idle} – engine thrust on the idle mode (it is given in the log book of the engine as its one of technical characteristics),

t_{idle} – time of operation on the idle mode.

Operations take-off – landing are take-off, climbing to the height of 1000 m and landing. In this case of calculation of aircraft engine emission, which is in the air, emission characteristic is weight speed of the emission $W_i\left[\frac{kg_{ingr}}{h}\right]$, (not index of emission), which shows how much harmful substance is exhausted on the given operational mode during time unit. W_i is determined during certification tests of the engine.

Then determination of M_{it-l} is performed by the formula:

$$M_{it-l}=W_{i1}\cdot T_{1t-l}+W_{i2}\cdot T_{2t-l}+W_{i3}\cdot T_{3t-l}, \quad (5.4)$$

where $W_{i1,2,3}\left[\frac{kg}{h}\right]$ – weight speed of ingredient emission in correspondent engine operational modes: take-off, climbing to the height of 1000 m and descend from the height of 1000 m;

$T_{1,2,3}$ [h] – mode time of the engine correspondently on take-off, climbing to the height of 1000 m and descend from the height of 1000 m.Values t_{idle} are got from the table of the modes of engine operation in the zone of the airport.

After calculation of $M_i = M_{ig} + M_{it-l}$ it is necessary to calculate control parameter of the engine emission $\frac{M_i}{R_0}$ (R_0 –take-off thrust in kilo Newton's) and it is compared with ICAO norms, then it is made conclusion about correspondence of given engine to modern requirements of emission in relation of given ingredient.Initial data for calculation:

R_0 = 308.72 kN;

R_{idle} = 21.61 kN;

Specific fuel consumption on idle mode $C_{sp\ idle} = 0.072\left[\frac{kg}{N\cdot h}\right]$.

1. Define values of coefficient K_{ig} of harmful substances exhaust during ground operations of the engine and weight speed of ingredient emission W_i:

K_{CO} = 0.0193 kg_{ingr}/kg_f;

K_{CxHy} = 0.0034 kg_{ingr}/kg_f;

K_{NOx} = 0.0084 kg_{ingr}/kg_f.

2. Determination of fuel weight, spent by the engine during ground operations of take-off – landing cycle according to the formula 5.3:

G_{fg} = 21610·0.072·0.4 = 622.368 kg.

3. Determination of harmful substances weight, thrown by the engine during ground operations according to formula 5.2:

$M_{CO\ g}$ = 0.0193·622.368 = 12.01 kg;

$M_{CxHy\ g}$ = 0.0034·622.368 = 2.12 kg;

$M_{NO\ g}$ = 0.0084·622.368 = 5.23 kg.

4. Determination of harmful substances weight, thrown by the engine during take-off – landing operations according to formula 5.4:

$M_{CO\ t\text{-}l}$ = 0.2·0.013 +1.3·0.0417 + 7·0.067 = 0.526kg

$M_{CxNy\ з\text{-}п}$ = 0.5·0.013 + 0.7·0417 + 1.2·0.067 = 0.116kg

$M_{NO\ з\text{-}п}$ = 98·0.013 + 10.5·0.0417 + 1.2·0.067 = 1.612 kg

5. Determination of harmful substances weight, thrown by the engine during take-off – landing cycle according to formula 5.1:

M_{CO} = 0.526 + 12.01 = 12.536 kg;

M_{CxHy} = 0.116 + 2.12 = 2.236 kg;

M_{NOx} = 1.612 + 5.23 = 6.842 kg.

6. Definition of control parameter of emission and comparison it with ICAO norms:

M_{CO}/R_0 = 12536/308.72 = 40.61g/kN< 118 g/kN;

M_{CxNy}/R_0 = 2236/308.72 = 7.24 g/kN< 19.6 g/kN;

M_{NO}/R_0 = 6842/308.72 = 22.16g/kN< 80 g/kN.

Conclusion to part 5

So, engines which are set up at the designed plane correspond to ICAO norms in all parameters. In reference to the ever-growing have an effect on at the man-made surroundings, the hassle of its safety is one of the maximum acute and consists of many aspects. In latest years, the difficulty of environmental safety came about increasingly. Gradually it has emerge as a worldwide hassle, and with every passing day it turns into increasingly urgent.

The cause for this example are the diverse anthropogenic factors. This populace explosion, and the speedy boom of urbanization and more. On the surroundings a first-rate effect additionally has a human factor: waste disposal, pollutants of water our bodies and forests, growing the weight on arable land - all that is the paintings of man. Reducing gasoline intake and CO2 emissions is turning into a concern for the improvement of aviation era, in step with a massive variety of improvements and traits on this region in latest years. At gift records at the effectiveness and price of middle era engine, transmission and the plane as a whole, commercial improvement withinside the coming 10-15 years will cause a 15-30% discount in gasoline intake and C02 emissions.

GENERAL CONCLUSION

The hydraulic system provides aircraft management systems and mechanisms that determine the safety of the flight.Reliability, survivability and sturdiness completed perfection hydraulic layout units, more than one redundancy, as a supply of power and hydraulic drives, automation manage, tracking and operation records of the crew. The use of hydraulic actuators at the plane because of the especially small weight and size, awesome velocity and coffee inertia of the actuator (in contrast to electric powered motors).

Each manage floor is managed with the aid of using the most quantity of hydraulic structures to be had at the plane and accountable purchasers as a minimum hydraulic structures. Less accountable purchasers and purchasers who paintings best on land managed with the aid of using a hydraulic machine. Each addition to the principle hydraulic pumps to be had with redundant electricity supplies. As such torque converters are used, organized among the hydraulic machine, in addition to set up and electrically pushed rapid pump pumping station.

After studying statistical facts on disasters and faults had been observed weaknesses that want to accept unique interest at servicing and figuring out the technical situation of the machine.

Given quick listing of hydraulic deficiencies that had been diagnosed at some point of trying out of the hydraulic machine of the plane, that will help you higher attention on positive things.

REFERENCES

1. Дмитрієв С.О., Тугарінов О.С. та ін. Технічне обслуговування планера і функціональних систем повітряних суден та авіадвигунів. Навч. посіб./ За ред. С.О. Дмитрієва. – К.: НАУ, 2004. – 244 с.

2. Dmitriev S.O. Technical operation of aircraft / S. Dmitriev, O. Tuharinov, A. Rugain, Yu. Kazarinov // Manual. – К: НАУ, 2014. – 192 с.

3. Dmitriev S.O. Continuing Aircraft Airworthiness / S. Dmitriev, O. Tuharinov, A. Rugain, Yu. Kazarinov // Manual. – К: НАУ, 2015. – 104 с.

4. Aircraft Technical operation: Laboratory work / Compilers: T 382 M. F. Molodtsov, O. V. Rugain, I. S. Kozeletska, D. V. Popov. – K. : NAU, 2019. – 72 p.

5. Zhuravlova L.A. Aviation Maintenance Technician Handtools / L.A. Zhuravlova, A.S. Kryzhanovsky, O.V. Rugayn, P. Chamegh, A. Eyo // Theory Guide. – К.: Osvita Ukrainy, 2013. – 90 p.

6. Технічна експлуатація повітряних суден: Методичні вказівки по виконанню розрахунково-графічної роботи / Укладачі: М.Ф. Молодцов, Ю.П. Пучков. – К.: НАУ, 2015 – 17 с.

7. Дмитрієв С.О., Тугарінов О.С., Докучаєв В.Г., Молодцов М.Ф., Шевченко Я.Д. Інженерне забезпечення польотів у цивільної авіації. Курс лекцій. − К.: НАУ, 2006. − 80 с.

8. Авиационные правила. Часть 25. Нормы летной годности самолетов транспортной категории. – М.: МАК, 1994.

9. Смирнов Н.Н. и др. Техническая эксплуатация летательных аппаратов. - М.: Транспорт, 1990.

10. Самолет Ан-140. Руководство по технической эксплуатации. Часть 29. Гидравлическая система.

11. Башта Т.М. Самолетные гидравлические приводы и агрегаты (конструкция и расчет).-М.:Оборонгиз,1951. – 640с.

12. Башта Т.М. Расчеты и конструкции самолетных гидравлических устройств. – М.: Оборонгиз,1961. – 475с.

13. Черкашин А.С., Сафронов В.И. Авторское свидетельство СССР №1667344, кл.B64F 1/36, 1988. Аэродромная установка для обслуживания летательных аппаратов.

14. Сопротивление материалов. Под ред. Писаренко Г.С.- К.: Вища школа, 1979. – 696 с.

15. Гузенков Д.В. Детали машин. – М.:Высшая школа, 1982.

16. Бурiченко Л.А. Охрана труда в гражданской авиации: Учебник для вузов – М.: Транспорт, 1993. – 228 с.

17. Протоерейский А.С. Безопасность жизнедеятельности. Охрана труда: Учебно-методическое пособие. – К.: КМУГА, 1999. – 84 с.

18. Протоерейский А.С. Безопасность труда при применении горюче-смазочных материалов в гражданской авиации: Учебное пособие. М.: Транспорт, 1987. – 248 с.

19. Охрана окружающей среды в гражданской авиации: Учебник для студентов высших учебных заведений гражданской авиации /Л.А. Бурiченко, В.Г. Ененков, И.М. Науменко, А.С. Протоерейский; под ред. В.Г.Ененкова. – М.: Машиностроение, 1992. – 320 с.

20. Малахов Л.П. Основы экологических знаний: Тексты лекций. – К.:КИИГА, 1994. – 88 с.