

**INTERSTATE AVIATION COMMITTEE
AVIATION ACCIDENT INVESTIGATION COMMISSION**

**FINAL REPORT
BASED ON THE RESULTS OF THE INVESTIGATION OF THE AVIATION ACCIDENT**

Type of aviation accident	Catastrophe
Aircraft type	Tu-204-100V
State registration identification mark	RA – 64047
Owner	Ilyushin Finance OJSC
Operator	JSC Aviation Company "Red Wings"
Aviation Administration	Interregional territorial Air Transport Authority Central regions of the Federal Air Transport Agency
Scene of the incident	Russia, Vnukovo Airport, coordinates location of the aviation accident: 55° 35.040 N, 37°15.324 E
Date and time	29.12.2012, 12:32 UTC (16:32 Moscow time) time), day

In accordance with the Standards and Recommended Practices of the International Civil Aviation Organization, this report is issued for the sole purpose of preventing aviation accidents.

The investigation carried out within the framework of this report does not imply establishing the share of anyone either guilt or responsibility.

The criminal aspects of this incident are presented in a separate criminal case.

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List of abbreviations used in this report

TO THEM	- administration of civil airports (aerodromes)
a/c	- aviation company
AMIS	- aerodrome meteorological information and measuring system
AP	- aviation accident
A/P	- autopilot
a/p	- airport
ARM	- emergency radio beacon
ARP	- automatic radio direction finder
ASU	- automated control system
ASK	- emergency rescue team
ASR	- emergency rescue operations
ASH	- automatic steering wheel control system
IT	- automatic traction
ATIS	- automatic terminal information system
ATK	- Aviation Technical College
AT-EM	- electromechanical airfield trolley
Aireo	- aviation and radio-electronic equipment
SHOOTING	- Aviation Technical School
AUCC	- Aviation training and methodological center
AUC	- aviation training center
AFTN	- civil aviation information network
ACPU	- alphabetic digital printing device
ACTO	- authorized service center
BINS	- strapdown inertial navigation system
B/I	- flight engineer
BPRM	- near-homing radio beacon
VATU	- Military Aviation Technical School
VVL	- domestic air routes
VD	- east longitude
VKK	- Higher Qualification Commission
VLEK	- medical and flight expert commission
VNIIM	- All-Russian Research Institute of Meteorology

runway	- runway
VPR	- the height of decision-making
VS	- aircraft
VSDP	- auxiliary launch control center
VSL	- aircraft - laboratory
Supreme Court	- computer system for aircraft navigation
Armed Forces of Ukraine	- auxiliary power unit
VSUP	- flight control computer system
2P	- second pilot
Tue	- air transport
GA	- civil aviation
GGS	- speakerphone
City Clinical Hospital	- city clinical hospital
GOR-NAV	- horizontal navigation (autopilot mode)
hot water supply	- civil aircraft
State Research Institute	- State Research Institute
GPa	- hectopascal
GPMO	- the main list of minimum equipment
Timing belt	- glide path radio beacon
State Customs Committee	- state-owned transport company
GC BP	- Federal Autonomous Institution "State Center" "Air Transport Safety"
DV/SIGN	- name of frame on IM No. 1 (No. 2): main engine parameters
(SG OSN)	- signal information (without prompt)
d/n	- day/night
DPR	- taxi control tower
Zhli and DB	- Zhukovskaya flight test and development base
JSC	- closed joint-stock company
ZMK	- reverse lock alarm
ZPU	- specified course angle
IATA	- International Air Transport Association
IAC	- information and analytical center
COVID-19	- Runway with artificial surface with magnetic heading 194°
ICAO	- International Civil Aviation Organization
THEM	- KISS indicator

IZZ	– an artificial satellite of the Earth
frame of the UPR	- personnel information on the state of the elements of the runway mechanization, control surfaces and chassis supports
a letter.	– category
KV	- limit switch
KVD	– high pressure compressor
KBC	- aircraft commander
KDP	- command and control center
WHO	- command and instruction staff
KISS	– integrated information signaling system
CLO	- commander of the flight detachment
KLS	- command and flight personnel
KMV	– Caucasian Mineral Waters
CONTROLLER AP	– Commission for scientific and technical support of the investigation aviation accidents
KPI	- complex flight indicator
checkpoint	- checkout flight
PDA	- refresher courses
CARP	– Aviation Accident Investigation Commission
CRM	- localizer beacon
CSR PVD	– a set of automation tools for air traffic planning movements
CT	- brake wheel
KTS	- a comprehensive aircraft simulator
KUNG KRM	– universal body of zero (normal) dimensions KRM
LII	- flight research institute
PERSONS	- flight test center
LMO	- flight and methodological department
LO	- flight squad
LU GA	- civil aviation flight school
MADC	– Moscow Airport Control Center
HAVE	– Moscow Aviation Technological Institute
MAC	– Interstate Aviation Committee
MVL	- international air lines
Ministry of Internal Affairs	– minimum descent altitude

MG	- low throttle
MD	- maximum range
<small>Ministry of Health</small>	- Ministry of Health
IGA	- Ministry of Civil Aviation
MII GA	- Moscow Institute of Civil Aviation Engineers
MIIT	- Moscow Institute of Transport Engineers
MK	- magnetic rate
WE	- medical examination
MRL	- weather radar
MSRP	- magnetic system for recording parameters
IAS	- oil-chip-alarm
MSCH	- medical and sanitary unit
MT	- Ministry of Transport
MTU	- interregional territorial administration
MUB	- control and locking mechanism
MC AUVD	- Moscow Center for Automated Aircraft Control movement
NGEA-92	- standards for the operational suitability of airfields
NMO	- instructions for meteorological support
NPP "Aerosila"	- scientific and production enterprise "Aerosila"
NR	- fuel regulator pump
JSC	- public corporation
<small>Department of Internal Affairs</small>	- air traffic management
RAM	- autumn-winter period
HELLO!	- Order of Lenin Academy of Civil Aviation
OOO	- limited liability company
OPRS RMP	- a separate homing radio station, a homing radio beacon
PDP	- landing control point
PCBM	- Penza Design Bureau of Modeling
PMZ	- Perm Motor Plant
PO	- production association
POS	- anti-icing system
pores	- gusts of wind
PPLS	- flight crew training program
PPR	- after the last renovation

PRAPI	– Rules for the investigation of aviation accidents and incidents with civil aircraft in the Russian Federation
PRL	- landing radar
AKP	- search and rescue operations
PiD	- airframe and engine
PU	- simple conditions
PU	- control panel
PUI	- control and indication panel
RV	- radio altimeter
RG	- regional group
RD	- taxiway
RI	- speech informant
RK	- one-time command
RCC	- regional qualification commission
RLP RDC	- radar positions of the district control center
RLE	- flight manual
RMD-90	- rangefinder radio beacon
RMS	– radio beacon landing system
RO	- operational regulations
RPA	- airport flight director
RPP	- flight operations manual
RTOP	- radio technical support of flights
RTS	- radio engineering equipment
RU	- reversing device
RUD	– engine control lever
RUR	– reverse control lever
RE	- operating regulations
REGA	- manual for the operation of civil airfields
SAB	- aviation security service
SAS	- launching emergency rescue station
PAGE	– mean aerodynamic chord
SDP	- launch control center
SKV	- air conditioning system
SKRS	– voice communication switching system - difficult weather conditions

Contributor and Management Unit

SNEE	– from the beginning of operation
SAVE	- search and rescue flight support service
SRPBZ	- earth proximity early warning system
SSPI	– flight information collection system
SP-90	- instrument landing system
SPPPZ	– ground proximity warning system
SU	- power point
<small>Secondary school</small>	– northern latitude
SEV	– Council for Mutual Economic Assistance
SEI	- electronic indication system
TVG	– glide path entry point
<small>Togliatti State University</small>	– Togliatti State University
TC	- process map
TCAS	- a system for preventing collisions between aircraft in the air
TCC	- territorial qualification commission
THAT	- technical maintenance
TU	- technical conditions
<small>Shopping center "KaPO"</small>	- technical center of the Kazan production association
WOW HIM	– Ulyanovsk Higher Aviation School of Civil Aviation
<small>Internal Affairs Directorate</small>	- air traffic control
UNPLG	- Directorate of Supervision of Continuing Airworthiness
<small>Training Center</small>	- training center
DEATH	– Federal Air Transport Agency
FAP	- Federal Aviation Regulations
FAS	- Federal Aviation Service
<small>Federal State Educational Services for Vocational Education</small>	– Federal State Educational Institution of Higher professional education
<small>Federal State Budgetary Institution of the Federal Aviation Authority</small>	- Federal State Budgetary Institution special flight squad
<small>Federal State Unitary Enterprise</small>	– Federal State Unitary Aviation Enterprise
<small>Federal State Unitary Enterprise</small>	– Federal State Unitary Enterprise
PKU CUKS	- Federal State Institution Crisis Management Center situations
FSNST	– Federal Service for Supervision of Transport
CVM	- digital computer

Central Vlek	- Central Medical and Flight Expert Commission
GYPSY	- Central Directorate of State Aviation Supervision
CSO	- central signal light
CR	- central districts
SR	- plug connector
ERTOS	- operation of radio equipment and communications
CRM	- Crew Resource Management (crew resource management system)
E	- east longitude
EGPWS	- improved ground proximity warning system
FCOM	- Flight Crew Operations Manual (үүү)
BEARD	- on-board parameter monitoring system
THEY	- instrument landing system
New	- high pressure rotor speed
QFE	- pressure at the landing airfield
RDR	- a locator with a prediction function
RVSM	- reduced vertical separation minimum system
SAFA	- Safety Assessment of Foreign Aircraft (safety assessment program) foreign aircraft)
UTC	- Coordinated Universal Time

General information

29.12.2012, at 12:32 UTC¹ (16:32 Moscow time), while landing in Tu-204-100B RA-64047 ZAO crashed at Vnukovo Airport during the day. Red Wings Aviation Company² operating charter flight RVZ9267/RVZ9268 route Vnukovo-Pardubice-Vnukovo.

Interstate Aviation Accident Investigation Commission

The aviation committee was informed about the aviation accident that had occurred incident on December 29, 2012.

To investigate the aviation accident by order of the deputy Chairman of the Air Accident Investigation Commission Interstate Aviation Committee No. 49/614-R dated December 29, 2012 appointed commission.

The investigation involved specialists from the Federal Air Transport Agency, the State Research Institute of Civil Aviation, GC BP, JSC Tupolev, JSC Gromov Flight Research Institute, JSC Aviadvigatel, CJSC Motorservis-PM, JSC TC KAPO, LLC ATsTO Tupolev, JSC PMZ, and specialists from airlines operating Tu-204/214 aircraft.

The investigation began on December 29, 2012.

The investigation was completed on December 24, 2013.

The preliminary investigation was conducted by the Moscow Investigative Department air and water transport of the Moscow Interregional Investigative Committee Transport Directorate of the Investigative Committee of the Russian Federation.

¹ hereinafter referred to as Coordinated Universal Time

² hereinafter referred to as Red Wings Airlines

1. FACTUAL INFORMATION

1.1 Flight history

The crew of the Tu-204-100B RA-64047 aircraft of the Red Wings Airlines, consisting of The captain, co-pilot and flight engineer were on a passenger charter flight on December 29, 2012. RVZ9267/RVZ9268 on the route Vnukovo-Pardubice-Vnukovo. On board was There were no cabin crew (5 people), passengers or cargo.

At 12:32, while landing on runway 19 at Vnukovo Airport, the plane rolled off the runway, collided with the side of the Kyiv highway and collapsed. The fire that started was extinguished by the airport fire service. The flight crew and two cabin crew members were killed and three cabin crew members were injured of varying severity. The driver of the car was also injured, who was driving along the Kyiv highway towards the region at the time of the incident.

1.2 Bodily injury

Bodily injury	Crew	Passengers	Other persons
Fatal	5	0	0
Serious	3	0	1
Minor/absent	0 / 0	0 / 0	0 / 0

1.3 Damage to the aircraft

The plane was completely destroyed, the fire that started after the plane was destroyed was extinguished by the airport fire service.

1.4 Other damages

The KRM antenna was destroyed, the KRM KUNG was damaged, and the lights were damaged. approach and lighting equipment masts of the airfield with magnetic heading landing 014°. Fuel from the plane's destroyed fuel tanks spilled all over the area fuel. Damage was caused by separated structural elements of the aircraft a Volvo with license plate number K602UK199 driving along the Kyiv highway. The driver who was in it was injured.

1.5 Information on personnel

1.5.1 Flight crew member details

Job title	Aircraft commander
Floor	Male
Date and year of birth	21.11.1954
Class	1st class of civil aviation line pilot
Civil Aviation Pilot's License	I P No. 000788
Date of issue of the certificate	10.12.1996
Validity of the certificate	until 05.06.2013
Education	Higher, Krasnokutsk LU GA in 1977, OLA GA in 1989
Minimum weather	Approved for flights according to weather minimum: landing 30x350 m, takeoff 200 m, ICAO Category II
Total flight time	14975 time
Flight hours by aircraft type	An-2 aircraft – 3100 hours, captain – 2560 hours; Tu-154 aircraft – 8795 hours, KVS – 3680 hours.
Retraining on the Tu-204 aircraft	From 19.02.2008 to 28.03.2008 at the Federal State Unitary Enterprise AUTs St. Petersburg, certificate No. 658
Plaque on this type	On the Tu-204 aircraft – 3080 hours
Flight experience as captain	2800 hours
Raid over the last month	30 hours 10 minutes
Raid on the day of the incident	05 hours 20 minutes
Total working hours per day	7 hours 32 minutes
incidents	
Flight interruptions during last year	Planned vacation: January-February 2012, November-December 2012.
Last check date: - piloting techniques - aircraft navigation	05.09.2012, d/n, PU, grade "five", Captain of the Air Force - instructor-examiner 09/19/2012, rating "five", captain-instructor-examiner
Training on a simulator	08.09.2012
Clearance for flights in the OZP	Order of 04.10.2012 No. 92/LD
Preliminary preparation	28.12.2012, KLO

Pre-flight preparation	Before departure of flight RVZ9267/RVZ9268, on your own, at Vnukovo Airport
Making a decision to leave	According to the "briefing" system
Crew rest	18 hours at home (according to data airline management)
Medical check before departure	12/29/2012, at 04:50, the starting doctor medical center at Vnukovo airport.
Aviation accidents and incidents in the past	didn't have

After graduating from the Krasnokutsk Civil Aviation Flight School in 1977, the PIC worked in Brest JSC of the Belarusian Civil Aviation Administration in the position of second pilot of the An-2 aircraft.

In October 1979 he transferred to the Krasnokutsk Civil Aviation Flight School and was appointed to the position of pilot-instructor of the 4th class. During his work at the Krasnokutsk flight Civil Aviation School from October 1979 to November 1989. The captain worked as a pilot – the instructor, the unit commander.

In November 1989 he transferred to the Vnukovo Production Association and was assigned to the position of second pilot of the Tu-154 aircraft. In 1993, he was appointed to position of commander of the Tu-154 aircraft.

In October 1997, he was accepted to the position of second pilot of the Tu-154 aircraft at JSC Aeroflot. In July 2004, he was appointed to the position of commander of the Tu-154 aircraft at Aeroflot. Aeroflot.

In November 2007, he was hired by JSC Airlines 400 to the position of commander of the Tu-154 aircraft.

On February 18, 2008, he was transferred to the position of second pilot of the Tu-204 aircraft.

From 19.02.2008 to 28.03.2008 he underwent retraining for the Tu-204-100/100V aircraft in FSUE AUTs, St. Petersburg, certificate No. 658.

The commissioning of the Tu-204 aircraft by the second pilot took place from 03.04.2008 to 26.05.2008.

By order of 26.05.2008 No. 44/LD he was admitted to solo flights as second pilot of the Tu-204 with the right to take off and land according to the minimum of ICAO Category I (60x550, takeoff 200 m). No deviations in the pilot induction program were detected.

On July 25, 2008, by order No. 69/LD, he was approved for commissioning as a trainee captain.

The trainee PIC started flying (back 5, project 2) on 08/20/2008 (by this time Total flight time as a second pilot on a Tu-204 aircraft - 64 hours 56 minutes, 21 landings, of which 03 hours 59 min, 2 landings - at night).

The purpose of this task is to acquire management skills aircraft from the PIC's seat, as well as practicing piloting techniques and interactions within the crew.

03.09.2008 on the basis of state registration of changes made to constituent documents of a legal entity, Closed Joint-Stock Company Airlines 400 has been renamed a Closed Joint Stock Company. Red Wings Aviation Company.

Flights as a trainee captain were carried out from 20.08.2008 to 05.10.2008. Captain – The trainee flew 103 hours 23 minutes, completed 28 flights, including 45 hours 45 minutes at night, 17 flights (according to option II, at least 14 flights, 6 at night, time at least 100 hours). Flights performed with the captain - instructor, who was not included in the order for admission to entry into construction (Tu-204 PLS, general provisions, clause 6).

Note: Tu-204 fixed-wing aircraft of JSC Airlines 400 (Tu-204 fixed-wing aircraft).

*“...p.6 Flight training for independent work is carried out as
As a rule, by one captain-instructor. Appointment order
The captain-instructor or his replacement with an indication of the reason is issued in
flight department...”*

The training task does not indicate the landing approach systems used and type of approach (automatic, director), weather conditions are not specified.

The checkout flight for task 6 was carried out on 10/08/2008,
Inspector - Deputy Director General for Flight Safety.

On 13.10.2008, order No. 194 of the General Director of the airline was issued admission of the PIC to solo flights on the Tu-204 as part of the assigned crew minimum 60x550, takeoff 200 m. This order was issued on the basis of protocol No. 19 meeting of the RCC TsUGAN FSNST MT of Russia dated 10.10.2008.

Note: Tu-204 PPLS, Program 2, general provisions:

*“...p.1.7 Meteorological minimum for landing 60x550 m, takeoff 200 m
assigned to the commander of the Armed Forces after passing the control
test flights for task 6 under the following conditions:*

- a) the pilot had experience of flying as a commander of an aircraft in the previous type of aircraft, personal meteorological minimum 60x550 m, takeoff 200 m and below.*
- b) during the commissioning process for tasks 4, 5, 6, completed at least 3 approaches in real difficult weather conditions (DMC), corresponding to the minimum of Category I 60x550 m (permissible according to one parameter) or 6 approaches on a six-step simulator*

KTS 204, as well as at least 2 takeoffs with visibility of 400 m or less, in real construction and installation works or on the six-stage simulator KTS 204...”.

In violation of paragraph 1.7, subparagraph “b” of the general provisions of the Tu-204 PPLS, in During the commissioning process, the commander-in-training did not have 3 attempts in real weather conditions corresponding to a minimum of 60x550. Training on the KTS 204 simulator to complete 6 approaches, as well as 2 takeoffs with visibility of 400 m or less 09/20/2008 - 09/21/2008 before the performance of the checkout flight. Checkout test flights on KTS 204 in the volume of exercises 1-3 of task 9 were carried out without The captain is an instructor of an airline, which contradicts the requirements of the PPLS airline and the training and testing program at the KTS. However, he was assigned meteorological minimum 60x550, takeoff 200 m.

It follows from the above that the program for commissioning the aircraft commander was carried out with deviations from the Tu-204 PPLS, which was in operation at that time.

On June 18, 2009, by order No. 75/LD, the PIC was cleared for flights in an unassigned area. composition of the crew.

On March 29, 2010, a test to determine the level of language proficiency was taken at UTC-21. according to the ICAO scale, certificate No. 231. English proficiency level corresponded to level 4 on the ICAO scale.

In the period from 13.09.2012 to 04.10.2012 the PIC completed ground and simulator training training under the program for approval to fly at least Cat II of ICAO. The program minimum training for ICAO Cat II was conducted on the Tu-204 PPLS of the airline "Red Wings".

Training and verification for flights according to the minimum ICAO Cat II on a simulator KTS 204 FSUE UTs St. Petersburg was conducted by a simulator instructor who did not was a flight specialist at the time of the inspection and did not have authority from the TCC.

Note: RPP ZAO "Red Wings".PPLS Tu-204-100

Program 2, Section 1, Task 1. Training of the Armed Forces Commander and members crew for approaches and landings in Category II conditions (at decision height less than 200 ft (60 m) and/or runway visibility less than 550 m). General instructions for Task 1 of Section 1.

«...Exercise 3.

Flight training - 4 hours.

Objective: To gain practice in performing approaches and landings in conditions of minimum ICAO Category II.

Instructions: Training and testing are carried out on the KTS.

Exercise 4.

Test flights – 0:45 min.

Conducted in accordance with Program 3 “Periodic training and confirmation of qualifications.”

Test flights of at least 3 landing approaches.

Objective: To check the pilot's readiness to perform landing approaches and landings in ICAO Category II conditions.

*Instructions: The inspection is carried out by **the inspector (instructor-examiner)**, authorized by the VKK (TKK) for this type of inspection...”*

Note: RPP JSC Red Wings Part A, Chapter 11.

11.2.7 Instructor - examiner.

*“...The instructor-examiner is **a flight specialist or a person command and flight, inspector's composition, having instructor's qualification mark in the certificate a specialist** who has undergone appropriate training, testing and admitted to perform flights as an instructor-examiner by the authorized body in the field of civil engineering...”*

RPP ZAO "Red Wings", Part D, Chapter 2

2.2.3. Procedures for conducting training

All types of simulator training are conducted by an instructor training staff or instructor-examiner of CJSC "Red Wings".

Before training on the complex simulator, each crew member must pass a knowledge test on the elements of the upcoming exercises programs according to the simulator training methodology (Part D) Appendix D-1).

The circle of officials responsible for the implementation preparation and procedure for registration of documentation:

- *responsibility for the quality of training on the simulator -*

instructors-examiners who conducted the training.

After completing the required volume of training, qualification test of practical skills for the purpose of confirmation of qualifications in a specialty.

*The qualification test is carried out **by an instructor-examiner in the specialty.***

By order No. 212/pr of 05.10.2012, the PIC was allowed to perform flights according to ICAO Category II minimum (30x350, takeoff 200 m). Category II minimum was obtained by the PIC. in violation of the requirements and recommendations of the airline's PPLS.

Job title	Co-pilot
Floor	Male
Date and year of birth	20.01.1960
Class	1st class of civil aviation line pilot
Civil Aviation Pilot's License	I-P No. 008412
Date of issue of the certificate	09.01.1998
Validity of the certificate	until 26.07.2013
Education	Higher, Sasovskoe LU GA, in 1984. Komsomolsk-on-Amur Polytechnic Institute in 1994
Minimum weather	Approved for flights as part of an unassigned group crew on minimum weather: landing 60x550 m, takeoff 200 m
Total flight time	10222 time
Flight hours by aircraft type	VS L-410 – 3800 hours, KVS – 1500 hours; Tu-154 aircraft – 5800 hours, KVS – 1950 hours
Retraining on the Tu-204 aircraft	From 25.02 to 09.04.2011 "Retraining for Tu-204-100 aircraft at UVAU GA, certificate no. 169
Plaque on this type	On the Tu-204 aircraft – 579 hours
Raid over the last month	26 hours 57 minutes
Raid on the day of the incident	05 hours 20 minutes
Total working hours per day incidents	07 hours 32 minutes
Flight interruptions during last year	Vacation: November 2012
Last check date: - piloting techniques - aircraft navigation	December 22, 2013, rating "four", KLO Red Wings Airlines December 22, 2013, rating "four", KLO Red Wings Airlines

Training on a simulator	13.09.2012
Clearance for flights in the OZP	Order of 04.10.2012 No. 92/LD
Preliminary preparation	19.12.2013, ZKLO
Pre-flight preparation	Before departure of flight RVZ9267/RVZ9268, as part of the crew, at Vnukovo Airport
Crew rest	18 hours at home (according to data airline management)
Medical check before departure	12/29/2012, at 04:50, the starting doctor Vnukovo Airport medical center
Aviation accidents and incidents in the past	didn't have

The second pilot, after graduating from the Sasovo Civil Aviation Flight School in 1984, was assigned to the position of second pilot of the L-410 aircraft at the Kamchatka production unification of the Far Eastern Civil Aviation Directorate.

In August 1990, he was appointed to the position of commander of the L-410 aircraft.

In October 1994, following a transfer to Vnukovo Airlines, was assigned to the position of second pilot of the Tu-154 aircraft.

In July 2002, he was accepted to the position of second pilot of the Tu-154 aircraft in OJSC Siberia Airlines. In July 2006, he was appointed to the position

Commander of the Tu-154 Air Force.

In the period from October 2010 to May 2011, he changed two jobs: OJSC "Continent Airlines"; Aero Rent LLC, where he worked in the position

Commander of the Tu-154 Air Force.

From 25.02.2011 to 09.04.2011 he completed the course "Retraining for the Tu-204-100 aircraft" in Ulyanovsk Higher Aviation School of Civil Aviation, certificate No. 169.

On May 16, 2011, he was hired by Aviastar-Tu Airlines LLC for the position of second pilot of the Tu-204 aircraft, order No. 54-11/1.

The second pilot was commissioned from 01.06.2011 to 06.10.2011.

By the decision of the TCC MTU VT CR FAVT dated 14.10.2011, he was approved in the position of the second Tu-204 pilot.

The protocol and certificate of completion of the second were presented to the Commission. pilot test to determine the level of language proficiency according to the ICAO scale in Ulyanovsk Higher Aviation School of Civil Aviation.

At the Commission's request to the Ulyanovsk Higher Aviation School of Civil Aviation, Upon presentation of the audio recording of the test, a response was received from the rector of the Ulyanovsk Higher Aviation School of Civil Aviation.

Note: Response from the Rector of the Ulyanovsk Higher Aviation School

civil aviation:

In response to your letter dated March 28, 2013 No. 05-11-134, concerning submission to the Commission of an audio recording of the test to determine the level language proficiency according to the ICAO scale of the second pilot, who allegedly took the test on June 7, 2011 at the Ulyanovsk Higher Aviation School of Civil Aviation, I report following.

English language proficiency test

The second pilot did not pass the ICAO scale at the institute, audio recording The test was not created. Attached to your letter is certificate No. 076-11 and protocol No. 76 on the results of the qualification The tests were produced illegally.

Thus, the certificate and protocol presented by the second pilot The determination of the level of language proficiency according to the ICAO scale is falsified.

From 14.05.2012 to 26.05.2012 I completed the CPC course on "Annual periodic ground training for Tu-204-100 and Tu-204S aircraft pilots at UTC-21.

On July 11, 2012, he was dismissed at his own request from the Airline LLC. «Aviastar-Tu».

On July 12, 2012, he was hired by Red Wings JSC as a second pilot. Tu-204.

On September 20, 2012, he completed retraining for the Tu-204-100V aircraft from the Tu-204-100 aircraft. at UTC-21.

On October 16, 2012, he was dismissed from Red Wings CJSC at the employee's initiative.

On October 17, 2012, he was hired by AirUTS CJSC as a Tu-154 aircraft commander.

On November 20, 2012, he was dismissed from AirUTS JSC at the employee's initiative.

On December 17, 2012, he was hired by Red Wings JSC as a second pilot.

Tu-204.

From 12/17/2012 to 12/18/2012 he underwent ground training after a break in flight training. work from 45 to 90 days, on December 19, 2012, he underwent preliminary training.

On 22.12.2012, an extraordinary check of piloting techniques was carried out and Practical work. The inspection was conducted by the flight squadron commander, and the overall rating was "four."

Job title	Flight engineer
Floor	Male
Date and year of birth	28.03.1958
Class	1st class flight engineer
Civil Aviation Specialist Certificate	I-BI No. 002220
Date of issue of the certificate	25.06.1998
Validity of the certificate	until 20.12.2013
Education	Higher: MII GA in 1984.
Total flight time	10714 time
Plaque on this type	On the Tu-204 aircraft – 1597 hours
Raid over the last month	04 hours 40 minutes
Raid on the day of the incident	05 hours 20 minutes
Total working time on the day of the incident: 7 hours	32 minutes
Flight interruptions during the last years	vacation: January-February 2012; May-June 2012; from December 1, 2012 to December 21, 2012
Date of last practical check work	07/08/2012, rating "five", engineer - airline inspector
Training on a simulator	28.08.2012
Clearance for flights in the OZP	Order of 04.10.2012 No. 92/LD
Preliminary preparation	28.12.2012, KLO
Pre-flight preparation	Before departure of flight RVZ9267/RVZ9268, as part of the crew, at Vnukovo Airport
Crew rest	18 hours at home (according to data airline management)
Medical check before departure	29.12.2012, at 04:50, doctor Vnukovo Airport's starting medical center
Aviation accidents and incidents in the past	didn't have

Flight engineer graduated from the Moscow Institute of Civil Aviation Engineers in 1984 specialty operation of aircraft and engines with qualification mechanical engineer.

In 1989, he completed retraining on the Tu-154 aircraft at the Ulyanovsk Training Center. aviation personnel of the CMEA.

Since January 1989, he was admitted to flights as a flight engineer of the Tu-154 in Vnukovo Production Association.

At Vnukovo Production Association and later at JSC Vnukovo Airlines, flight engineer worked from 1989 to 2002.

From 15.04.2002 he was accepted to the position of flight engineer of the Tu-154 aircraft at JSC Airline "Siberia".

01.03.2006 transferred to the position of flight engineer of the Il-86 aircraft at JSC Airline "Siberia".

On November 17, 2008, he was dismissed due to staff reductions from OJSC Siberia Airlines. Initial retraining on the Tu-204 aircraft in the period 28.01.2010 - 04.03.2010 in Ulyanovsk Higher Aviation School of Civil Aviation, certificate of completion of retraining dated 04.03.2010 No. 127.

On April 24, 2010, he was hired by Red Wings CJSC as a flight engineer for the Tu-204 aircraft.

From 27.04.2010 by order No. 26/LD, after completion of retraining under the program KULP, was sent to the technical department of the Red Wings airline for Internships under Program 7 Section 1 Stage 1 PPLS Tu-204 of Red Wings Airlines.

By order of 14.05.2010 No. 31/LD assigned to the instructor for commissioning on Tu-204 aircraft.

The checkpoint was completed on July 15, 2010 with an overall rating of "four".

By order No. 171/1 of July 23, 2010, the flight engineer was allowed to perform solo flights as a flight engineer of the Tu-204 aircraft.

On July 13, 2011, by order No. 65/LD, he was approved for flights in an unassigned formation. crew.

05.03.2012 by order No. 38a/pr-2012 it was approved for flights at a minimum II ICAO categories as part of the Tu-204 aircraft crew.

From 12.03.2012 to 24.03.2012 the CPC "Annual Periodic Ground training of flight engineers for Tu-204-100 and Tu-204-100V aircraft at UTC-21.

On October 30, 2012, by order 268/pr-2012, the flight engineer was allowed to fly independently. implementation of procedures to ensure the departure of Tu-204-100/100V aircraft in off-base airports.

After returning from vacation, on December 28, 2012, the captain and flight engineer were undergoing preliminary training. The training was carried out without the participation of the second pilot. explanatory notes from the KLO, senior flight engineer and senior flight engineer, During preliminary training, the crew was informed about the aircraft rolling out Tu-204-100V at Novosibirsk airfield. Recommendations were given regarding the crew's actions.

It should be noted that this crew was performing a flight for the first time and, although all crew members were cleared to fly as unassigned crew members, the second The pilot was required to attend preliminary training.

Note: RPP JSC Red Wings Part A, Chapter 24

24.1. Preliminary and pre-flight training of flight crew members crews.

Each flight must be preceded by an appropriate Flight crew training. Flight training consists of preliminary and pre-flight preparations.

All members of the crew undergo flight training. flight crew, regardless of position held and experience flight work. Preliminary training is the main type preparation for the flight and is carried out under the guidance of the CIS, specialists LMO, flight detachment commander or deputy flight detachment commander detachment and is completed no later than one day before departure.

To carry out preliminary preparations, the following are involved: relevant specialists.

JSC Red Wings provides measures for crew training aircraft for flights using specific areas, routes and airfields no later than the day before departure in the following cases:

- *before the first flight as PIC;*
- *before the first flight as PIC on a new route, in new region;*
- *before a flight on a special mission;*
- *during a break in flight work;*
- *in case of expiration of the period specified in the note;*
- *in other cases, by decision of the LO commander of JSC Red Wings or his deputy.*

Organization of flight operations at Red Wings JSC

Checking flight records and flight logs of crew members in the flight service of JSC Red Wings" showed that the professional training of the crew pilots was carried out with deviations from the flight crew training program and the requirements of FAP-128.

Retraining, maintaining and improving professional skills in the Armed Forces

The crew members of the Tu-204-100/100V saw off the aircraft at the Training Center-21, JSC Vnukovo Airport (certificate No. 156 of 26.12.2012, valid until 25.12.2015).

On September 5, 2012, the PIC performed a qualification check on the Tu-204-100 aircraft, The flight was conducted by the captain-instructor. The flight was en route from Vnukovo to Hurghada - Vnukovo, in normal weather conditions. According to objective monitoring data, During landing at Vnukovo, the captain exceeded the glide path speed +20 30 km/h. Approach airspeed according to the flight manual: for flight weight of 74 t and flap position 37 °, recommended – 220 km/h (when approaching under conditions turbulence – 230 km/h), the actual speed on the glide path was 250..260 km/h. The plane landed at a speed of 230 km/h and a distance of 800...900 m from input end of runway 19. Engine power steering levers in the maximum reverse position. PIC moved to lower the front landing gear, bypassing the intermediate stop, which is violation of the flight manual and technology for using reverser during landing.

Note: RPP JSC Red Wings Part D, Appendix 1:

Evaluation of piloting technique.

No. s/n	Content checks	Grade		
		Five	Four	Three
1.6.2.4	endurance speed, km/h	+10	+15 -5	+20 -10
1.7	Landing			
1.7.1	calculation, m:	Within 150-600 m from start of the runway	Within 100-150 m and 600-800 m from start of the runway	Within 0-100 m and >800 m from start of the runway

According to the standards for assessing piloting techniques during qualification The PIC performed the approach and landing with a rating below "three", however, the PIC - The instructor rated the PIC's qualification check as a "five".

From the explanatory note of the captain-instructor:

"...since the PIC had extensive experience and responded correctly to comments, I gave an overall rating of 5 (five) with a recommendation to continue flights on Tu-204 as a line pilot as captain..."

Note: RPP JSC Red Wings Part D, Chapter 2.**2.7.1. Checking the flight crew's qualifications for flights.**

Qualification check of piloting techniques and practical work of flight crew members in flight is carried out once within 12 months.

Qualification checks members of aircraft crews, instructor and flight command personnel of JSC Red Wings on:

- *confirmation of qualifications;*
- *admission to instructor work;*
- *initial admission to independent work;*

are carried out by officials of Red Wings CJSC, assigned to conduct flight qualification checks territorial qualification commission of the Federal Air Transport Agency of the Ministry of Transport Russia (instructors-examiners).

Inspectors are personally responsible for quality of verification and the compliance of the conclusion with the level professional training of a flight specialist during its term actions until the next qualification confirmation test.

The aircraft's landing in the assessment zone is satisfactory. is being investigated by the command and management staff of the flight department JSC Red Wings using the SSPI to establish the causes. The results of the investigation are analyzed methodically and Necessary preventive measures are being taken.

The Commission, in order to analyze the professional training of the captain of the aircraft at the MTU VT CR The FAVT sent a request for submission to the Investigation Commission aviation accident data of objective control means, which should were presented to the MTU VT CR FAVT during the qualification checks of Red Wings Airlines pilots in accordance with paragraph 5.7. of FAP-128.

Response from the MTU VT CR to the FAVT: "...the MTU VT CR, on behalf of the FAVT, is conducting Renewal of aviation personnel certificates. Data by means of objective control, in accordance with regulatory documents, during pilot qualification checks and when renewing certificates, they are not presented by the operator."

A repeat request was sent to Rosaviatsia on 10.04.2013 No. 05-11-154 request to clarify what, in accordance with paragraph 5.7. FAP - 128, these funds the operator must submit objective control to the authorized body

civil aviation during qualification checks, as well as

the procedure for working with the mentioned materials established by the Federal Air Transport Agency.

By letter dated 16.07.2013 No. 4.02-141 Rosaviatsia informed that conducting qualification checks of the operator's pilots, in accordance with requirements of the flight data analysis program and the airline's RPP, carries out Integrated flight control. Data decoding of objective control equipment submitted to the authorized body (MTU VT CR) during the procedure extension of certificates for civil aviation personnel, after which returned to the airline for storage for two years.

It was established that during the qualification checks of the aircraft commander Red Wings Airlines did not send any objective control data to authorized body entrusted with the functions of issuing certificates (certificates) of civil aviation personnel, as well as in the established cases of their suspension, limitation of validity and cancellation. In turn,

The Ministry of Transport of the Russian Federation (MTU VT CR FAVT) did not request data on the means of objective verification from the airline control over the conduct of the qualification check of the aircraft commander.

Thus, the extension of the pilot's certificate on 01.06.2012 by the PIC was carried out MTU VT CR with violations of the requirements of paragraph 5.7. FAP - 128.

During the inspection of the organization of flight operations at Red Wings Airlines revealed:

- The airline's CLS did not always exercise quality and volume control preparation and training of flight personnel;
- control by means of the SOC was carried out superficially, there are no complete flight execution transcripts;
- during preliminary preparation for flights on 12/28/2012 as part of the crew was missing a second pilot;
- the crews underwent simulator training on the Ulyanovsk Higher Aviation School simulator GA and FSUE UTC, St. Petersburg. When passing qualification tests on simulator, in violation of the requirements of the Red Wings Airlines RPP, checks were performed by the simulator instructors.

Note: ***Red Wings Airlines RPP, Periodic Maintenance Program flight training and crew training on a simulator for confirmation of the right to perform takeoff and landing in weather conditions assigned minimum for Tu-204-100/100V aircraft, general provisions:***

"...p. 4. Crew training is carried out, as a rule,

instructors of Red Wings CJSC who have the appropriate permission and/or the simulator's instructor staff.

*If necessary, training **and testing of flight** personnel*

The simulator is permitted to be used by the command and flight personnel and instructor staff with the "instructor" clearance

"Examiner" on the Tu-204-100 aircraft...

Responsibility for the quality of training on the simulator -

are borne by the instructor-examiners who conducted the training.

After completing the required volume of training,

qualification test of practical skills for the purpose of

confirmation of qualifications in a specialty.

*The qualification test is carried out **by an instructor-***

examiner in the specialty...".

It should be noted that the admission to work as an "instructor-examiner" was introduced by the order of the Federal Agency for Air Transport dated 25.05.2009 No. GK-91r.

By order of the Federal Air Transport Agency dated 09.08.2010 No. 292 "On the recognition of acts as invalid Federal Air Transport Agency" this order has ceased to be in effect.

- there are no measures to eliminate deficiencies and comments to members crews identified during training on a simulator and according to objective data flight control.

The flight crew's professional training was insufficient for the conditions, that arose during the final flight. Effective preventive measures elimination of deviations in the implementation of crew work technology on the part of The Red Wings Airline's command and flight personnel were practically absent.

1.5.2 Cabin Crew Member Details

Job title	Senior flight attendant of the TU-204
Floor	Male
Date and year of birth	05.05.1980
Class	3
Flight attendant certificate of Civil Aviation, validity period actions	V BP No. 011769, issued on May 26, 2008 by the Civil Aviation Commission FSNST, until 24.01.2013
Retraining for the TU-204	27.03.2009, AUC LLC "Aviastar-Two", BP certificate No. 127/09-084

Total flight time	2589 time
Tu-204 crash	2449 time
Raid over the last month	70 hours 53 minutes
Raid on the day of the incident	5 hours 20 minutes
Date of last check	07.07.2012
Emergency rescue training	04/21/2012, Training Center - 21, Airport OJSC Vnukovo
Rest before the flight	18 hours at home (according to data airline management)
Time spent at the airfield before departure	2 hours
Medical check-up before departure on 29.12.2012, at	04:50, by the flight attendant Vnukovo Airport medical center
Job title	Tu-204 flight attendant
Floor	Female
Date and year of birth	10.04.1986
Class	3
Flight attendant certificate of Civil Aviation, validity period actions	IV BP No. 003663, issued on September 5, 2007 by the RG VKK at the Federal State Unitary Enterprise "KMV", until March 16, 2013
Retraining for the TU-204	05/28/2007, KavMinVody Autonomous Educational Center, certificate ý 1713
Total flight time	3035 time
Tu-204 Air Raid	2584 time
Raid over the last month	23 hours
Raid on the day of the incident	5 hours 20 minutes
Date of last check	11.01.2012
Emergency rescue training	April 21, 2012, Training Center - 21, Vnukovo Airport OJSC
Rest before the flight	18 hours (according to the airline management)
Time spent at the airfield before departure	2 hours

Medical check-up before departure on 29.12.2012, at 04:50, by the flight attendant	Vnukovo Airport medical center
Job title	Tu-204 flight attendant
Floor	Male
Date and year of birth	26.09.1988
Class	3
Flight attendant certificate of Civil Aviation, validity period actions	V BP No 015629, issued 08.07.2009 MTU VT CR, until 06.04.2013
Retraining for the TU-204	04/26/2012, Training Center - 21, Airport OJSC Vnukovo, certificate No. 1748
Total flight time	1180 time
Tu-204 Air Raid	493 time
Raid over the last month	68 time
Raid on the day of the incident	05 hours 20 minutes
Date of last check	14.12.2012
Emergency rescue training	April 26, 2012, Training Center - 21, Vnukovo Airport OJSC
Rest before the flight	18 hours (according to the airline management)
Time spent at the airfield before departure	2 hours
Medical check-up before departure on 29.12.2012, at 04:50, by the flight attendant	Vnukovo Airport medical center
Job title	Tu-204 flight attendant
Floor	Female
Date and year of birth	24.06.1987
Class	3
Flight attendant certificate of Civil Aviation, validity period actions	V BP No. 019261, issued on September 19, 2011, Far Eastern MTU VT FAVT, up to 17.05.2013
Initial training on TU-204 09/08/2011, Aviation Training Center of JSC Vladivostok Avia,	certificate No. 00390
Total flight time	466 time
Tu-204 Air Raid	466 time

Raid over the last month	61 hours
Raid on the day of the incident	05 hours 20 minutes
Date of last check	30.10.2012
Emergency rescue training	05.10.2012, Training Center - 21, Vnukovo Airport OJSC
Rest before the flight	24 hours
Time spent at the airfield before departure	2 hours
Medical check-up before departure on 29.12.2012, at	04:50, by the flight attendant Vnukovo Airport medical center
Job title	Tu-204 flight attendant
Floor	Female
Date and year of birth	08.07.1981
Class	3
Flight attendant certificate of Civil Aviation, validity period actions	V BP No 015980, issued 12.11.2009, MTU VT CR, until 06.03.2013
Retraining for the TU-204	04.10.2008, ATC "Aviastar Tu", certificate No. BP 127/08-319
Total flight time	2772 time
Tu-204 Air Raid	2670 time
Raid over the last month	23 hours
Raid on the day of the incident	05 hours 20 minutes
Date of last check	03.03.2012
Emergency rescue training	25.05.2012
Rest before the flight	18 hours
Time spent at the airfield before departure	2 hours
Medical check-up before departure on 29.12.2012, at	04:50, by the flight attendant Vnukovo Airport medical center

The level of professional training of cabin crew members and their qualifications, according to the documents submitted, corresponded to the established requirements of regulatory documents and air legislation of the Russian Federation.

1.6 Aircraft details



Fig. 1. External appearance of the Tu-204-100B RA-64047 aircraft before the accident.

Type of aircraft	Tu-204-100V aircraft
Aircraft serial number	1450744864047
State registration identification mark	RA-64047
Certificate of state registration	No. 6357 dated 15.12.2008, issued by the Directorate flight safety inspections Rostransnadzor
Date of manufacture	11.12.2008
Manufacturer of the aircraft	JSC Aviastar-SP (Ulyanovsk)
Airworthiness Certificate civil aircraft	No. 2082122922 dated 11.12.2012 issued by MTU VT CR FAVT of the Russian Federation, valid until December 10, 2014
Owner details	Ilyushin Finance OJSC
Information about the operator	CJSC "Red Wings"
Aircraft SNE operating time	8,676 hours 47 minutes, 2,484 landings
Resource and designated service life Design resource and service life of the aircraft-	25,000 flights, 45,000 flight hours during

	20 years; current stage of design life and service life is 4000 flights, 15000 flight hours over a service life of 15 years
The remainder of the assigned resource and service life	36323 hours 13 minutes, 20516 settlement, 15 years
Number of repairs	No
Last periodic maintenance	Periodic maintenance according to form F-1 on 11/23/2012 terms of JSC "TC "KaPO"
Last operational maintenance	Technical inspection according to the form ýý+ý+ýý on 29.12.2012 at the airport Pardubice

Engine information

Engine type	PS-90A
1st engine (left)	
Serial number	3949044822130ý1
Manufacturer	Perm Motor Plant OJSC
Date of manufacture	22.12.2008
Operating time of the power supply (hours, cycles)	8357 hours 38 minutes, 2135 cycles
Number of repairs	1
Date and place of last repair	December 23, 2011, PMZ OJSC
Operating time of scheduled maintenance	2460 hours 55 minutes, 692 cycles
Installed on the aircraft	06.03.2012 by the staff of the airline "Red" Wings»
2nd engine (right)	
Serial number	3949042602003ý2
Manufacturer	Perm Motor Plant OJSC
Manufacturer's date	09.09.1996
Operating time of the power supply system (hours, cycles)	13,729 hours 16 minutes, 3,175 cycles
Number of repairs	2
Date and place of the PPR	December 24, 2010, Perm Motor Plant OJSC
Operating time of scheduled maintenance	4745 hours 04 minutes, 1275 cycles
Installed on the aircraft	27.01.2011 by the staff of Tupolev Aviation Center LLC

Armed Forces of Ukraine	TA12-60
Serial number	4750664285
Manufacturer	JSC NPP Aerosila
Date of manufacture	17.07.2006
Operating time of the power supply system (hours, cycles)	2836 hours 44 minutes, 4625 launches
Number of repairs	2
Operating time of scheduled maintenance	706 hours 06 minutes, 1179 launches
Assigned resource	8700 launches
Remaining resource and service life	4075 launches

The Tu-204-100V RA-64047 aircraft, serial number 1450744864047, belonged to JSC Ilyushin Finance Co. and was operated by Red Wings Airlines. The aircraft issued by the aviation enterprise JSC Aviastar-SP (Ulyanovsk) on 11.12.2008.

At the time of the accident, the aircraft had its design life and service life service 25,000 flights, 45,000 flight hours over 20 years. Current stage the design resource and service life was 4,000 flights, 15,000 flight hours during service life of 15 years.

Since the start of operation, the aircraft has flown 8,676 hours and 47 minutes, producing 2,484 no landings or repairs.

The Tu-204-100B RA-64047 aircraft has a state registration certificate registration dated 15.12.2008 No. 6357, issued by the Safety Inspection Authority flights of Rostransnadzor.

Certificate of airworthiness dated 11.12.2012 No. 2082122922 issued Interregional Territorial Administration of Air Transport of the Central districts of the Federal Air Transport Agency with a validity period until 10.12.2014.

In accordance with the airworthiness certificate, the aircraft is approved for operation flights under ICAO Category II, as well as for performing flights in RVSM conditions.

Permit No. 00049 for on-board radio stations used in civil aviation aircraft RA-64047, issued on 20.04.2011 by the Flight Maintenance Directorate aircraft fitness of the Federal Air Transport Agency.

Certificate of fitness for civil aircraft for noise emissions

No. 6371 issued on August 1, 2011. The validity period of the certificate was extended until December 10, 2014 by the Ministry of Transport of the Russian Federation. Central regions of the Federal Air Transport Agency.

From 10.12.2008, under contract No. 155.04.2006, the aircraft was transferred from Aviastar-SP CJSC to OJSC Ilyushin Finance Co.

From 12.12.2008, under contract No. 31/048-2007, the aircraft was transferred from Ilyushin JSC Finance Co. to the Red Wings airline.

At the time of the accident, the aircraft was operated in the configuration 210 seats. The empty weight of the aircraft in this configuration is 59,722 kg, the center of gravity 27.05% PAGE.

Individual characteristics (according to the entries in the glider form), which could have influenced the development of the special situation in flight on 12/29/2012, but was not identified.

Engines and APU

According to the forms, the engines were repaired in accordance with current technical documentation 94-00-807UO, complied with the certificate type No. 16-D with supplement No. 16D/D31 edition 34 and were recognized as suitable for operation with resource management of the main engine components according to strategy No. 2.

In accordance with the provisions of paragraph 4.1.2 of the Data Card of Type Certificate No. 16-D aircraft cruise engine PS-90A, the application of strategy No. 2 provides for the possibility of operating the engine without mandatory removal for repair until it reaches assigned resource of any of the main parts.

Engine No. 1

Engine PS-90A No. 3949044822130r1, manufactured on 12/22/2008 by Perm OJSC Motor Plant". Operating time since the start of operation is 8357 hours 38 minutes, 2135 cycles, PPR – 2460 hours 55 minutes, 692 cycles.

The last engine overhaul was carried out at Perm Motor Plant OJSC.

12/23/2011 with the operating time of the power supply system being 5896 hours 43 minutes, 1443 cycles.

The engine had a number of individual features, including: emergency mode function (connected when installing the engine on the aircraft Tu-204-100V RA-64047) and ensured operation with the GEMU-122-5 aircraft unit (replacement vibration sensors MV-06-1 on SA-281).

From 22.12.2008 to 07.04.2011 the engine was used as part of the power installation No. 2 on the Tu-204-100V RA-64049 aircraft. The engine was removed due to a defect – damage to the 10th combustion chamber flame tube.

From 04/07/2011 it was mothballed and subsequently sent for repairs.

From 25.04.2011 to 23.12.2011 the engine was under repair.

From 29.12.2011 to 29.02.2012 the engine was used as part of the power Installation No. 1 on the Tu-204-100 RA-64019 aircraft.

The engine was installed on the Tu-204-100V RA-64047 aircraft on March 6, 2012 by personnel Red Wings Airlines with a service life of 5899 hours 43 minutes, 1445 cycles, outage 3 hours, 2 cycles (work order card No. 560 dated 01.03.2012).

The engine is equipped with a reversing device 93-20-800-01 No. RU-1140, manufactured on 28.11.2008. The service life before the next repair is set at 12 years. Had one medium repair on December 12, 2011 at Perm Motor Plant OJSC. Installed on engine 12/15/2011.

Reverse control valve KR-90 No. 4200721081437 manufactured on 21.11.2008. The service life before the next overhaul is set at 12 years. It has had one major overhaul. November 8, 2011, at Perm Motor Plant OJSC. Installed on a reversing device. No. RU-1140 12.12.2011.

The last periodic maintenance in the scope of form F-1 (RO-2008, 8400 hours) has been completed under the conditions of JSC TC KAPO (Vnukovo Airport) on 11/23/2012 during the development of the planned maintenance 2165 hours, 593 cycles (work order card No. 26 dated November 19, 2012). According to the defect list, No engine defects were found during maintenance.

The last operational maintenance according to form "B" (150 hours) was performed on 12/14/2012 under the conditions Red Wings Airlines with 2,345 hours, 652 cycles (work order card No. 5835).

Engine No. 2

Engine PS-90A No. 3949042602003r2 manufactured on 09.09.1996 by Perm OJSC Motor Plant". Operating time since the start of operation is 13,729 hours 16 minutes, 3,175 cycles, PPR – 4745 hours 04 minutes, 1275 cycles.

The engine had two major overhauls at Perm Engine Plant. Before The first engine repair was given a service life of 5000 hours, 1000 cycles.

The first repair was carried out on 14.12.2006 (due to deterioration of parameters) at

The operating time of the power supply is 4644 hours 41 minutes, 965 cycles.

The second repair was carried out on 24.12.2010 (due to the presence of chips on the MCC) high-pressure turbines) with an operating time of 8984 hours 12 minutes, 1900 cycles, PPR – 4339 hours 31 minutes, 935 cycles. After the second overhaul, the engine was given a service life of up to next repair 11000 hours

The engine has a number of individual features, including: emergency mode function (connected when installing the engine on the aircraft Tu-204-100V RA-64047) and ensured operation with the GEMU-122-5 aircraft unit (replacement vibration sensors MV-06-1 on SA-281).

From 08.08.2002 to 07.09.2005 the engine was used as part of the power Installation No. 1 on the Tu-214 RA-64505 aircraft.

On September 13, 2005, the engine underwent its first major overhaul.

After the repairs were completed, from 13.05.2007 to 17.04.2008 it was operated on aircraft Il-96-300 RA-96017 as part of the 1st power plant.

From May 1, 2008 to October 16, 2008, the engine was installed on the Tu-204-100 aircraft RA-64020 as part of the 1st power plant.

From 16.10.2008 to 25.04.2010, it was operated on the Tu-204-100 RA-64019 aircraft as part of the 2nd power plant, after which it was removed for the second major overhaul. The engine was under repair from May 4, 2010.

From 23.12.2010 it was mothballed for a period of 6 months.

The engine was installed on the Tu-204-100V RA-64047 aircraft on January 27, 2011 by personnel Tupolev Aviation Center LLC, with a service life of 8984 hours 12 minutes, 1900 cycles.

The engine is equipped with a reversing device 94-20-800 No. RU-7646, manufactured on November 5, 1993. The service life before the next repair is set at 12 years. Had 2 repairs, the last repair on 12.12.2010 at Perm Motor Plant OJSC. Installed on the engine on 12/14/2010.

Reverse control valve KR-90 No. 4200720571001 manufactured on July 17, 2007. The service life before the next overhaul is set at 12 years. It has had one major overhaul. December 9, 2010, at Perm Motor Plant OJSC. Installed on a reversing device. No. RU-7646 13.12.2010.

The last periodic maintenance in the scope of form F-1 (RO-2008, 8400 hours) completed under the conditions of JSC TC KaPO (Vnukovo Airport) on 11/23/2012 during the operation PPR 4449 hours, 1176 cycles (work order card No. 26 dated November 19, 2012). According to the statement defects (Appendix to work order card No. 26 dated 11/19/2012), when performing maintenance defects nothing was found on the engine.

The last operational maintenance according to form "B" (150 hours) was performed on 12/14/2012 in under the conditions of Red Wings CJSC with an operating time of 4629 hours, 1235 cycles (work order card No. 5835).

Auxiliary power unit

Auxiliary power unit TA12-60 No. 4750664285, manufactured July 17, 2006, Aerosila Research and Production Enterprise. Installed on the aircraft on March 30, 2012.

The engine was operated according to its technical condition (2 control strategy resources) until the established designated resource of any of the main details. In accordance with Appendix No. 2 of the form, the Armed Forces of Ukraine had an assigned resource 8700 cycles (starts), remaining assigned resource after the last repair amounted to 4075 cycles (starts).

The operational life of the power plant is 2836 hours, 4625 launches, scheduled maintenance is 706 hours 06 minutes, 1179 launches.

The Ukrainian Armed Forces had two repairs. The first (restorative) repair was carried out 05/25/2007 JSC NPP Aerosila. The second repair was carried out on 03/07/2012 under the conditions of JSC NPP Aerosila with a fuel consumption of 2131 hours 4 minutes, 3446 launches.

Preparing the aircraft for flight

The aircraft maintenance was carried out in accordance with the requirements Technical maintenance regulations RO-2008, put into effect by the Chief UNPLG GVS FSNST 07.07.2008.

Periodic maintenance is performed under contracts:

– with Tupolev Aviation Center LLC dated 21.12.2009 No. 1-09/TO with a validity period of up to December 31, 2013. Tupolev Aviation Center LLC received a Certificate of Conformity dated December 27, 2011. No. 2021110468, issued by the Federal Air Transport Agency, valid until 12/27/2013 for the right performance of periodic maintenance. Place of production activity – Zhukovsky, branch of ZhLiIDB of JSC Tupolev;

– with ZAO TC KaPO dated 01.03.2012 No. 5/2012 valid until 31.12.2013. JSC TC KaPO has a Certificate of Conformity dated March 13, 2012 No. 2021120074, issued by the Federal Air Transport Agency, valid until March 13, 2014, for the right to perform periodic maintenance according to forms F1, F2 according to RO-2000 (Tu-204-100) and RO-2008 (Tu-204-100V). Place of production activity: Moscow, Vnukovo Airport.

The last periodic maintenance according to form F-1 was carried out on 23.11.2012 under the conditions JSC TC KaPO, with 8411 hours of operational experience and 2386 landings, the aircraft had Work was carried out according to Form F-1 (frequency 600+60 hours). Based on the results of the work JSC TC KaPO was issued certificate No. 26 on the performance of technical services according to form F-1.

When departing from Vnukovo Airport, Red Wings Airlines personnel will The aircraft underwent operational maintenance work according to form A+OV. There were no comments No preparation for the flight was noted.

Before departure from Pardubice Airport, the aircraft underwent maintenance in accordance with the form VS+A+OV (work order card No. 6049 dated 12/29/2012). The work was carried out by engineering technical personnel of Red Wings Airlines who arrived at Pardubice Airport flight RVZ39268. Comments on the operation of aircraft systems during the flight Vnukovo – Pardubice not noted (according to the logbook entries).

Information about the personnel who carried out aircraft maintenance

Operational maintenance of the aircraft before departure on December 29, 2012 at the airports of Vnukovo and Pardubice was carried out by the following engineering and technical staff of the technical department of Red Wings Airlines:

1. Aircraft mechanic for PiD, born in 1970. Education – secondary technical, graduated from Yegoryevsky ATC in 1997. He has been working for the airline since April 2012, Employment order No. 131/k dated April 18, 2012. Has a specialist certificate of series R-1 No. 00115017 dated April 15, 1998. Approved for independent aircraft maintenance Tu-204-100(100B). The last advanced training on the Tu-204-100 aircraft, Tu-204-100V passed through Training Center No. 21 in December 2012.

2. Aircraft mechanic for A&REO, born in 1984. Higher education – St. Petersburg University in 2010. Has been working for the airline since June 2009, order No. 106/k dated June 17, 2009. Has a specialist certificate of series R-2 No. 0030052 dated 12/15/2011. Approved for independent maintenance Tu-204-100, Tu-204-100V aircraft. The latest advanced training on the aircraft Tu-204-100, Tu-204-100V passed through the AUMC of JSC Tupolev in March 2010.

3. Aircraft mechanic for PiD, born in 1952. Secondary technical education – Irkutsk VATU in 1973. Has been working for the airline since March 2010, order No. 47/k from 18.03.2010. Has a specialist certificate series R-1 No. 0031901 from 17.11.1998. Approved for independent maintenance of Tu-204-100 aircraft, Tu-204-100V. Final advanced training for the Tu-204-100, Tu-204-100V aircraft took place at Training Center No. 21 in November 2012.

4. P&D engineer, born in 1959. Higher education, graduated from Moscow Institute of Engineering Civil Aviation in 1989. Has been working for the airline since July 2008, order No. 252/k dated July 10, 2008, 4 years. Has a specialist certificate series R-1 No. 0049928 dated March 25, 2010. Admitted to independent technical maintenance of Tu-204-100, Tu-204-100V aircraft. The last advanced training course on the Tu-204-100, Tu-204-100V aircraft took place in Training Center No. 21 in February 2012.

5. Aircraft mechanic for AiREO, born in 1966. Secondary technical education – Kryvyi Rih ATU MGA. Employed by the airline since December 2009, Order No. 342/k from 22.12.2009. Has a specialist certificate series R-1 No. 0009459 from 17.12.1997. Approved for independent maintenance of Tu-204-100 aircraft, Tu-204-100V. Final advanced training for the Tu-204-100, Tu-204-100V aircraft took place at Training Center No. 21 in December 2012.

6. Engineer for Automation and Electronic Equipment, born in 1970. Higher education – MIT in 2003 year. Has been working for the airline since April 2011, order No. 141/k dated 04/17/2008. Has specialist certificate series R-1 No. 0009419 dated 11/20/1997. Admitted to independent technical maintenance of Tu-204-100, Tu-204-100V aircraft. The last advanced training course on the Tu-204-100, Tu-204-100V aircraft took place in Training Center No. 21 in April 2012.

7. Aircraft mechanic for PiD, born in 1973. Incomplete higher education – MATI. Employed by the airline since April 2010, Order No. 99-2/k dated April 22, 2010. Has a specialist certificate series R-1 No. 0051793 dated 10.08.2010. Admitted to independent technical maintenance of Tu-204-100, Tu-204-100V aircraft. The last advanced training course on the Tu-204-100, Tu-204-100V aircraft took place in Training Center No. 21 in November 2012.

8. P&D engineer, born in 1986. Higher education – Tomsk State University in 2008. Has been working for the airline since October 2010, order No. 291/k dated October 1, 2010. Has specialist certificate series R-1 No. 0045581 dated 04.09.2008. Admitted to independent technical maintenance of Tu-204-100, Tu-204-100V aircraft. The last advanced training course on the Tu-204-100, Tu-204-100V aircraft took place in Training Center No. 21 in November 2012.

9. Aircraft mechanic, Aerospace Engineering, born in 1959. Secondary technical education – Krivoy Rog ATU MGA in 1979. He has been working for the airline since April 2008, Order No. 131/k dated 04/07/2008. Has a specialist certificate of series R-1 No. 0028131 dated July 3, 2008. Approved for independent maintenance Tu-204-100, Tu-204-100V aircraft. The latest advanced training on the aircraft Tu-204-100, Tu-204-100V passed through Training Center No. 21 in December 2012.

10. Engineer for A&REO, born in 1971. Secondary technical education – Slavgorod ATU GA in 1991. Has been working for the airline since August 2011, order No. 332-1/k dated 10.08.2011. Has a specialist certificate series R-1 No. 0024075 dated September 29, 2006. Approved for independent aircraft maintenance Tu-204-100, Tu-204-100V. The latest advanced training on the Tu-204-100 aircraft, The Tu-204-100V passed through Training Center No. 21 in December 2012.

Technical maintenance according to form A+OV (order card No. 6114 dated 12/29/2012) of the Armed Forces Tu-204-100B RA-64047 on a flight from Vnukovo to Pardubice

The following specialists from Red Wings Airlines performed the work:

- engineer for aviation and electronic equipment (qualification grade – B2);
- P&D engineer (qualification grade – B1.1);

- engineer for aviation and electronic equipment (qualification grade – B2);
- aircraft mechanic for PiD (qualification mark – B1.1);
- aircraft mechanic for Aero-Electronic Equipment (qualification grade – B2);
- aircraft mechanic for PiD (qualification mark – B1.1).

Technical maintenance according to the form 99+99+99 (order card No. 6049 from 29.12.2012) Aircraft Tu-204-100B RA-64047 while performing a flight on the route Pardubice – Vnukovo – performed by the following specialists of Red Wings Airlines:

- aircraft mechanic for PiD (qualification mark – B1.1);
- aircraft mechanic for Aero-Electronic Equipment (qualification grade – B2);

The aircraft maintenance was carried out by personnel, who have completed the necessary training and have valid certificates of entitlement maintenance of this aircraft equipment.

Carrying out routine maintenance, modifications, replacement of units and elimination of crew comments during the operation of aircraft equipment.

Periodic maintenance according to form F-1.

11/23/2012 under the conditions of JSC TC KaPO (work order card dated 11/19/2012 No. 26), when 8411 hours of operational experience, 2386 landings, work on the aircraft was carried out according to the form F-1 (frequency 600+60 hours). Based on the results of the work of JSC TC KaPO, it was Certificate No. 26 on the performance of technical maintenance in accordance with Form F-1 was issued.

During the F-1 work, engines were installed on the aircraft.
No. 3949044822130r and 13949042602003r2.

Periodic maintenance according to form F-2.

05.10.2011 under the conditions of Tupolev Aviation Center LLC (work order card No. 59 dated 26.09.2011), when the SNE has operated for 6091 hours, 1674 landings, and work on the aircraft was carried out according to the form F-2 (execution frequency 6000+100 hours). Based on the results of work by ATsTO LLC Tupolev was issued certificate No. 36 on the completion of technical services according to form F-2+OZP.

During the F-2 work, engines were installed on the aircraft.
PS-90A:

- left No. 394904390100992 (at the time of the accident on the plane another engine was installed - No. 394904482213091);
- right No. 394904260200392, engine operating time at the time of form execution F-2 – SNE 2361 hours, 461 cycles; PPR 1842 hours, 461 cycles.

During the work, the following engine defects were recorded:

- the main fuel filter 1 of the power unit is not tight;
- the fuel filter F-2 of the HP-90 unit is leaking;
- filters 8D29667713 GP-26 1 and 2 of the power plant are not sealed;
- the rubber ring on the F-2 fuel filter of the HP-90 1 unit is not installed

power plant.

When performing work according to form F-2, it was envisaged to perform work according to paragraphs 72-00-00-12 "Inspection of the reversing device", 76-11-00-01 "Checking operability of the engine operating mode control system", 76-11-00-02 "Inspection of the engine operating mode control system", 76-11-00-03 "Checking adjustments to the engine operating mode control system." Technological maps for the performance of work, according to the specified points of the RO, is not provided the need to re-check (after replacing the engine) the adjustment mechanism blocking and reverse control.

Engine replacement work on an aircraft

Initially, work on adjusting the engine control system (mechanism blocking and control) are produced during the manufacture (repair) of the engine.

The technical maintenance regulations for the Tu-204-100V aircraft provide for performance of work on inspection of the engine operating mode control system (item 76-11-00-02 aircraft, frequency of 3000 hours (form F-2)) and adjustment check engine operating mode control systems (paragraph 76-11-00-03 of the aircraft, frequency of 3000 hours (form F-2). In process maps No. 202 (item 76-11-00-02) and No. 203 (paragraph 76-11-00-03) there are no references to the need performing work on checking and adjusting the engine control system in order, installed engine manual (technological maps "Inspection and testing of the system" control" (073.21.00, pp. 601...606) and "Checking and adjusting the control mechanism and blocking" (073.21.01, pp. 205...208)).

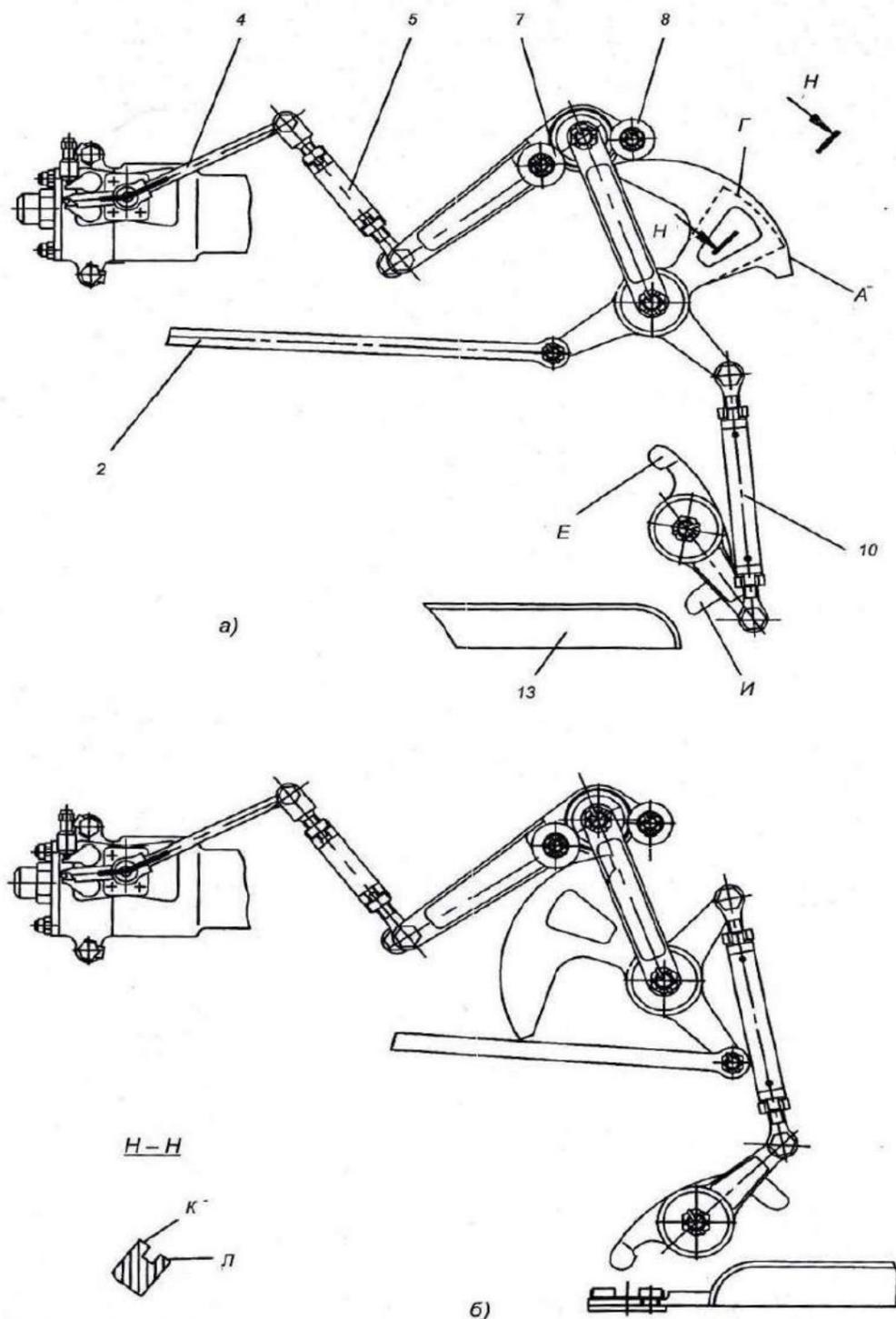


Fig. 2. Diagram of the blocking and control mechanism of the PS-90A engine.
 2, 5, 10 – rod; 4 – lever; 7, 8 – roller; 13 – guide; a – maximum position
 forward thrust; b – position of maximum reverse thrust.

Checking and, if necessary, adjusting the engine management system must be carried out during engine installation on an aircraft. List of process charts (in terms of checking the engine management system) performed when replacing the engine on the plane, is given in the table:

Aircraft manual	Engine manual
71-00-00-07, p. 413, «Disassembly and assembly the engine»	072.00.00, p. 619, "Works, performed when replacing the engine"
76-11-00, TC No. 204, p. 213, paragraph 4, check the roller starting force engine operating mode control	072.00.00.00, p. 407, «Installation engine», points 4 and 6 (installation in (in accordance with the aircraft's operating instructions)
71-00-00-07, p. 424, p. 5.10, connect compensation unit of the control system with a drive roller on the engine	072.00.00.00, p. 410, paragraph 8.8, connect the control system engine
76-11-00, TC No. 203, "Checking the adjustment operating mode control systems engines" 76-11-00, TC No. 204, "System Adjustment control of the engine operating mode" (when (if necessary) from paragraph 12 to paragraph 19.4	073.21.00, p. 601, "Inspection and testing engine management systems"
	072.80.00, p. 203, check inclusion reverse with the engine off
	072.80.00, p. 205, perform inspection reversing device.
71-00-00-07, pp. 425 - 426, testing by full schedule and check flight in in accordance with the engine operating instructions.	072.00.00d, p. 541, "Warm-up, check systems and engine testing full schedule"
	072.00.00, p. 603, "Works carried out after testing the newly installed the engine»
	073.21.00, p. 601, "Inspection and testing engine management systems"
	072.00.00, p. 585, "Check Flight aircraft with newly installed engine"

The engine replacement on the Tu-204-100V aircraft is carried out according to the process chart No. 403 (paragraph 71-00-00-07 of the aircraft's operating manual). When installing the engine, it is necessary to performing a number of works on checking and adjusting the engine management system (paragraphs 5.10 and 5.10.2 of process map No. 403).

Clause 5.10 of TC No. 403 provides for the connection of the compensation unit engine control systems ("aircraft part of the control system") with a leading roller on the engine. Adjustment work on the aircraft and engine according to this items are not produced.

Clause 5.10.2 provides for checking the adjustment of the mode control system operation of engines (section 76-11-00-03 of the aircraft operating manual, TC No. 203) and, if necessary, its adjustment (section 76-11-00-04 of the aircraft operating manual, TC No. 204).

Checking the engine control adjustment according to TC No. 203, section 76-11-00-03 RE the aircraft provides:

a) checking the RUR deviations with control by the NR-90 limb in the positions on the stop small and maximum reverse (clauses 1.4 and 1.5 of TC No. 203).

In accordance with paragraphs 1.4 and 1.5 of TC No. 203 of section 76-11-00-03 of the aircraft's RE:

- when moving the RUR upward until the lever is fixed on the small reverser pass stop, the lever indicators on the limbs of the HP-90 engines must be at an angle of $20^{\circ} \pm 2^{\circ}$;

- when setting the RUR to the maximum reverse stop, the levers on the NR-90 should stand on the maximum reverse thrust stop ($-38^{\circ} + 0.5^{\circ}$ on the limb) with tension.

Adjusting the power steering in the maximum reverse position and on the "Reverse" stop "off" is carried out by changing the length of the adjustable rods and tips, located in the engine control panel in the aircraft cockpit (paragraphs 13.3 and 13.4 TC No. 204 "Adjustment of the engine operating mode control system", section 76-11-00, p. 216, aircraft manual).

The adjustment of the RUR on the intermediate stop is carried out using the adjustment mechanism for engaging the small reverser, located in the engine control panel in the aircraft cockpit (clause 15 of TC No. 204 "Adjustment of the flight control system engine operation", section 76-11-00, p. 216, aircraft manual).

b) checking the synchronicity of the RUR deviation, no more than 16 mm (clause 1.6 of TC No. 203).
c) checking the force of moving the RUR, no more than 4 kgf with increasing forces on 2.8+3 kgf when the power steering lever passes through the small reverser stop (clause 1.7 of TC No. 203).

Thus, technological maps No. 203 and No. 204 of sections 76-11-00-03 and 76-11-00-04 The aircraft's operating instructions do not provide for checking the adjustment mechanism reverser locking and control (MCC). The checks specified in TC No. 203 and No. 204 are carried out when there is pressure in the hydraulic system No. 1 (left engine) and No. 3 (right engine) and without simulating the flight position of the chassis, which does not allow for checking the correct operation of the MUB.

In addition to the technical operation manual for the Tu-204-100V aircraft, the work When installing the engine on an aircraft, the PS-90A engine operating instructions are provided (technological map "Engine installation", section 072.00.00, p. 407). Clause 8.8 the specified technological map provides for connection to the engine of the system control in accordance with the aircraft's operating instructions.

The PS-90A engine manual also includes:

- process chart "Work performed when replacing an engine" (072.00.00, p. 619), paragraph 3 of which provides for inspection and testing of the system engine control in accordance with paragraph 073.21.00, p. 601, engine operating instructions;

- process map "Work carried out after testing again" installed engine" (section 72.00.00, p. 603), paragraph 8 of which provides inspect and test the engine management system in accordance with paragraph 073.21.00, p. 601, engine manual.

Technological map "Inspection and testing of the control system" (073.21.00, pp. 601..606, engine operating instructions) provides for checking in the absence of (clause 2.7) and presence (item 2.11) of pressure in the hydraulic system.

When performing work according to paragraph 2.7 of the process map "Inspection and testing control systems" (073.21.00, pp. 601...606) provides for the transfer of the RUR to inclusion reversing device until it stops, while:

- the KR-90 reverser control valve lever must be set to the position reverse thrust;

- cam for locking the control mechanism and locking the reverser the device must rest against the guide;

- the mark on the control lever indicator of the HP-90 unit must be in within the tracking area $14 - 20^\circ$ along the unit's limb.

During the investigation, an explanation was received from Aviadvigatel JSC 04.01.2013 No. 401-14-310", according to which "emphasis" should be understood as intermediate stop RUR (small reverser).

When performing work according to paragraph 2.11 of the process map "Inspection and "Checking the Control System" (073.21.00, pp. 601...606) provides for the transfer of the RUR to Maximum reverse thrust position. HP-90 unit control lever indicator

in this case it should rest against the hard stop of the reverse thrust mode. The value of the angle the rotation of the indicator along the limb must correspond to the formula value $\gamma - \gamma_{\text{max}}$

at maximum reverse thrust mode (or the rated value – in case of replacement

HP-90). After this, it is necessary to monitor the γ -RUD according to the readings on the KISS and compare with the angular position of the throttle-reverse lever on the regulator pump dial.

The difference in the positions of the DBSCT-220-1 sensor of the NR-90 unit ("RED Measurement") and the angular the position of the gas-reverse lever should not exceed $+1^\circ$.

In case of detection of discrepancies, adjustment of the MBU is provided for process chart "Checking and adjusting the control and locking mechanism" (073.21.01, pp. 205...208).

Checks according to the process chart "Checking and adjusting the mechanism" control and blocking" (073.21.01, pp. 205...208) are performed with reversing device fixed in the "Straight pull" position and disconnected from the cam control of the MBU traction NR-90. In accordance with paragraphs 15–17 of the specified TC, when moving the KR-90 lever to the reverse thrust position until it stops against the KR-90 surface "D". When At this point, the gap (1.4...1.6 mm) between the guide and surface "E" of the locking cam. In case of discrepancy, the clearance should adjustment is made (clause 17 of the TC) by changing the length of the rod connecting locking cam and control cam.

Installation of engine No. 3949044822130ÿ1 (left) on the Tu-204-100V RA-64047 aircraft

Since the start of operation of the Tu-204-100V RA-64047 aircraft, replacement of the left engine was produced three times:

- the first time the engine was installed after the aircraft was manufactured;
- the second time on 03.04.2010;
- the third time 06.03.2012.

After the last repair, engine No. 3949044822130ÿ1 was installed twice

by plane:

- first - 12/29/2011 on the Tu-204-100 RA-64019 aircraft as the first power installations;
- the second - 06.03.2012 on the Tu-204-100V RA-64047 aircraft as the first power installations.

Installation of engine No. 3949044822130ÿ1 (left) on the Tu-204-100V aircraft RA-64047 was produced by Red Wings Airlines personnel.

The sequence of operations for installing the engine is given in operational statement (appendix to work order card No. 560 dated 01.03.2012), complies with the requirements of the aircraft's operating manual. The operational statement was

The following work is planned to be performed:

- to inspect and check the engine control system and, if necessary, its adjustment (section 76-11-00 of the aircraft operating manual) – paragraph 61 of the operation sheet;
- to check the engagement of the reverser with the engine off from the ground installations (section 072.80.00, p. 203, engine manual) – paragraph 68 of the operational statements. When performing work under section 072.80.00, p. 203, of the engine operating manual

a check of the smoothness of the reversing device is provided and, if necessary, adjust the control and locking mechanism in accordance with section 073.21.00, page 205, of the engine operating instructions. The work is carried out under the presence of pressure in the hydraulic system;

- for inspection and testing of the reversing device (section 072.80.00, p. 205, RE engine) – item 69 of the operation sheet.

After completing the engine test, item 72 of the operation sheet the work was to be carried out in accordance with the process map "Work carried out after testing a newly installed engine" (section 072.00.00, p. 603). Clause 8 of this process chart provides execution of works in accordance with the process map "Inspection and testing of the system" management" (073.21.00, pp. 601...606).

The operational statement form used by Red Wings Airlines is the engine replacement complied with the requirements of the document "Basic Forms production and technical documentation of civil aviation technical bases aviation and methodological recommendations for their design and application", approved USSR MGA 29.03.1984 (annex to the letter of the USSR MGA of 29.03.1984 No 23.1.7-33).

However, the lack of information in the transaction statement does not allow us to do a conclusion on the extent to which the work was carried out in accordance with the section 073.21.00 RE of the engine in terms of control of the adjustment of the MBU and on the compliance of the gap between guide and locking cam in accordance with the requirements established by the engine operating instructions.

Installation of engine No. 3949042602003ÿ2 (right) on the Tu-204-100V RA-64047 aircraft

Since the start of operation of the Tu-204-100V RA-64047 aircraft, replacement of the right engine It was produced three times: the first time, the engine was installed after the aircraft was manufactured; the second - 10.09.2010; the third - 27.01.2011.

After the last repair, engine No. 3949042602003ÿ2 was installed for the first time 01/27/2012 on the Tu-204-100V RA-64047 aircraft as part of the second power plant.

Installation of engine No. 3949042602003r2 (right) on the Tu-204-100V aircraft RA-64047 was produced by the personnel of Tupolev Aviation Center LLC.

The sequence of operations for installing the engine is given in operational statement (appendix to work order card No. 36 dated 24.01.2011), complies with the requirements of the aircraft's operating manual. The operational statement was Inspection and testing of the engine control system is planned and, if necessary, its adjustment (section 76-11-00 of the aircraft operating manual) – clause 5.10.2 operational statement.

Unlike the operational statement for engine replacement at Red Airlines Wings", was not envisaged during the installation of the engine at the Tupolev Aviation Center of Technical Support LLC performing work to check the operability of the reversing device in accordance with section 072.80.00 of the engine operating instructions. Performing these works when replacing engine in accordance with the aircraft and engine operating instructions is not mandatory.

After completing the engine test, item 6.3 of the operation sheet the work was to be carried out in accordance with the process map "Work carried out after testing a newly installed engine" (section 072.00.00, p. 603). Clause 8 of this process chart provides execution of works in accordance with the process map "Inspection and testing of the system" management" (073.21.00, pp. 601..606).

The form of the operational statement for replacement used by Tupolev LLC the engine complied with the requirements of the document "Basic forms of production-technical documentation of aviation technical bases of civil aviation and guidelines for their design and application", approved by the Moscow State Archives USSR 29.03.1984 (annex to the letter of the USSR MGA of 29.03.1984 No 23.1.7-33).

The lack of information in the transaction statement does not allow us to draw a conclusion on the extent to which work was performed in accordance with section 073.21.00 of the RE engine in terms of monitoring the adjustment of the MBU and compliance of the gap between guide and locking cam and limb of the pump regulator requirements, installed engine manual.

Operational technical maintenance

An external inspection of the aircraft at the scene of the accident revealed that that there are no plugs on the total and static pressure receivers. In the channels engine air intakes and APU covers (plugs) that could have been left during the last maintenance of the aircraft, no. All remaining hatches for technical The aircraft's maintenance equipment was in its designated places in the closed position.

When departing from Vnukovo Airport, Red Wings Airlines personnel will the aircraft underwent operational maintenance work according to form A+OV (work order card) No. 6114 of December 29, 2012). The plane was refueled before departure from Vnukovo Airport. TS1+RT fuel in the amount of 12,200 kg (density 0.8 kg/cm³). Total refueling fuel load was 15,000 kg (according to the logbook). No comments were made No preparation for the flight was noted.

Before departure from Pardubice Airport, the aircraft underwent maintenance in accordance with the form VS+A+OV (work order card No. 6049 dated 12/29/2012). The work was carried out by engineering technical personnel of Red Wings Airlines who arrived at Pardubice Airport flight RVZ9267. There were no comments regarding the operation of the aircraft systems during the flight from Vnukovo to Pardubice. there was none (according to the entries in the flight log). The plane was refueled before takeoff. 8000 kg of Jet-A-1 fuel (density 0.798 km/cm³). Total fuel load fuel amounted to 13,000 kg.

According to the MSRP-A02, during the descent for landing at Pardubice Airport There was a failure of the excess pressure regulator 6709 of engine No. 2. Fact The malfunction of the 6709 unit is also confirmed by the printout of the digital control unit found on scene of the aviation accident. In violation of the established requirements, the recording of a malfunction detected in flight (accompanied by the activation of (the corresponding signaling) was not made in the logbook.

Unit malfunction 6709 is included in the list of minimum composition equipment (PMO) (RPP) - clause 21.10-5 category "A" (elimination no later than after one flight day from the moment the failure was detected). In this case, a failure is required special maintenance procedure (established by Part 3 of the PMO (GPMO) and the presence of information about inoperative equipment in the aircraft's logbook. The specified requirements of the PMO (GPMO) were not met.

Carrying out work according to bulletins and instructions

Taking into account the requirements of Section 5 "List of units (products) of systems with limited resource, subject to replacement or repair", appendices to forms

Based on the actual operating time and service life of the aircraft, replacements were made:

- 06/12/2011 fuel shut-off valve 766100A (resource and service life up to first repair 5000 hours, 8 years);

- plunger pumps NP123 (service life and life before first repair 7500 hours, 12 years). The pump NP123 No 0880478 with reference to the letter of OAO "Tupolev" was not replaced from 25.06.2012 No. 6986-42.01, according to which the operation of pumps was permitted NP123 within the operating time of 15,000 hours, 15 years before the execution of a joint decision of the JSC Tupolev - Red Wings Airlines;

- 09/25/2011 and 11/01/2011 electrical converters PTS-250BM (resource and service life before first repair 3000 hours, 10 years). There are no entries in the form about replacement of ZM1 frames (service life and lifespan before first repair 3000 hours, 10 years) converters PTS-250BM.

- 11/28/2012 at Vnukovo Airport (reverse was used until a complete stop).

According to the available documents, the aircraft was undergoing special technical maintenance according to paragraph 5.09.01 "Engine surge in mode" of the Technical Regulations maintenance. In fact, work had to be performed in accordance with the clause 5.07.01 "Using the "Maximum Reverse" mode at speeds below 120 km/h."

The most serious failures and malfunctions during the aircraft's operation

Tu-204-100V RA-64047

1. On June 19, 2009, while flying on the Perm-Antalya route, on an airplane the "Filter clogged" alarm was triggered on engine No. 1 (on the plane engines No. 3949042822111 and 3949043822136 were installed). On the ground, when draining sediment from the left feed compartment, contaminated water of dark color was found brown. After the work was completed, which included inspection internal surfaces of the tanks, the aircraft was cleared for further operation.

The form contains an entry dated 03.08.2009 about the work performed on the aircraft in accordance with "Program for maintaining the airworthiness of aircraft No. 64047" dated July 21, 2009, based on the assessment technical condition of the aircraft fuel system.

2. On December 18, 2011, during landing at Istanbul Airport, the reverse thrust failed. device of engine No. 1 (No. 3949043901009ÿ2). After turning on the reversing The "RU Lock" display did not activate. When performing work on During the troubleshooting, a crack in the lock lining was discovered reversing device 94-20-126-01. The malfunction was eliminated by replacing the lining.

Malfunctions of the engine control system, as well as failures in operation reversing device, for the period from 01/02/2012 to 12/28/2012 (according to tear-off logbook sheets and order cards for operational technical maintenance (the Tu-204-100B RA-64047 aircraft) was not there.

Analysis of engine repair cases

The engines underwent their final overhaul at Perm Motor Plant OJSC. In the analysis of engine repair cases, the technology and results of repairs were studied engine control systems and reverse locking and control mechanisms.

Engine No. 3949044822130ÿ1 (left)

The last (first) engine repair was carried out on 23.12.2011 with an operating time of 5896 hours. hours 43 minutes, 1443 cycles. During the last overhaul, the engine was equipped with Reversing device 93-20-800-01 No. RU-1140, last repaired on 12.12.2011.

According to the assembly map of the reversing device from 06.12.2011, when performing operations 0170 "Adjusting the control mechanism" and "Adjusting the mechanism blocking" (item 104), a gap was established between the surface "U" (guide No. 94-20-904) and cracker "C" (locking cam 94-20-895P) equal 1.5 mm (permissible range 1.4...1.6 mm). These works were carried out at disconnected rod of the HP-90 regulator pump.

The sequence of actions according to operation 0170 of the repair case corresponds to sequence of operations according to the process chart "Checking and adjustment control and locking mechanism" (section 073.21.01, pp. 205–208, engine manual PS-90A). There are differences in the requirements for adjusting the gaps between the rollers. switch and control rocker:

- repair work – 0.05...0.15 mm;
- section 073.21.01 RE, pp. 205, 206 – 0.05...0.25 mm.

As follows from the adjustment map of the throttle-reverse control system 95-00-890 from 12/14/2011, when checking the coincidence of the main positions of the distribution lever The following results were obtained for the RU crane with NR-90 switching platforms:

Operation name	Dimensions	
	according to TU	actually
Lever of the distribution valve KR-90 in in the middle position between the stops "T" and "U"	W=3.6+0.25 mm Risk at 12° Mismatch risk +0.5 mm	3.6 mm -3 + 0.3 mm
Lever of the distribution valve KR-90 in reverse thrust position. Lever NR-90 on support site.	Emphasis cam blocking V guide Risk of 14..20° 16°	
Lever of the distribution valve KR-90 in reverse thrust position. Lever NR-90 on switching platform.	Backdraft 6°...14°	12°

When checking the total backlash of the throttle-reverse control system, the backlash

amounted to 0.5 mm (according to technical specifications – no more than 0.7 mm).

During the bench tests of the engine after repair, the following was carried out: calibration of the engine management system, which showed the absence of unacceptable

³ The actual value of the risk position is not indicated on the map.

differences (more than $+2^\circ$ (more than $+1.5^\circ$ at the stops of maximum straight and maximum reverse thrust)) between $\ddot{\gamma}$ RUD (on the NR-90 limb) and $\ddot{\gamma}$ RED. The results of calibration in range of $\ddot{\gamma}$ RUD from idle to maximum reverse thrust:

$\ddot{\gamma}$ RUD, city. on the NR-90 limb		0	-10	-20	-30	-34...40 (-35,5)
	I channel down	0	-10,2	-20,0	-29,9	
		up	-0,2	-10,2	-19,9	-29,9
	II channel down	0	-10,2	-20,0	-29,9	
		up	-0,2	-10,2	-19,9	-29,9
Permissible difference $\ddot{\gamma}$ limb and $\ddot{\gamma}$ RED		+1,5	+2			+1,5

Engine No. 3949042602003 $\ddot{\gamma}$ 2 (right)

The last (second) engine repair was carried out on December 24, 2010, with an operating time of 8984 hours. hours 12 minutes, 1900 cycles. During the last overhaul, the engine was equipped with Reversing device 93-20-800 No. RU-7646, last repaired on 12.12.2010.

As follows from the engine repair case, the assembly of the reversing device was produced in December 2010 (reversing device assembly card 94-20-800 from 11.12.2010).

When performing operations 0170 "Adjusting the control mechanism" and "Adjusting the locking mechanism" (item 94), the gap between the surface "U" (guide No. 94-20-904) and cracker "C" (locking cam 94-20-895P) equal to 1.5 mm (permissible range 1.4...1.6 mm). Work data were performed with the HP-90 regulator pump rod disconnected.

The sequence of actions according to operation 0170 of the repair case corresponds to sequence of operations according to the process chart "Checking and adjustment control and locking mechanism" (section 073.21.01, pp. 205–208, engine manual PS-90A). There are differences in the requirements for adjusting the gaps between the rollers. switch and control rocker:

- repair work – 0.05...0.15 mm;
- section 073.21.01 RE, pp. 205, 206 – 0.05...0.25 mm.

As follows from the adjustment map of the throttle-reverse control system 95-00-890 from 12/14/2010 (paragraph 22), when checking the coincidence of the main positions of the lever distribution valve RU with switching platforms NR-90 were received the following results:

Operation name	Dimensions	
	according to TU	actually
Lever of the distribution valve KR-90 in the middle position between the stops "T" and "U".	W=3.6+0.25 mm Risk at 12° Mismatch risk +0.5 mm	3.6 mm 12° + 0.2 mm
Lever of the distribution valve KR-90 in reverse thrust position. Lever NR-90 on support site.	Cam stop blocking guide Risk at 14...20°	19°30'
Lever of the distribution valve KR-90 in reverse thrust position. Lever NR-90 on switching platform.	Backdraft 6°...14°	14°

When checking the total backlash of the throttle-reverse control system, it amounted to less than 0.7 mm (according to TU – no more than 0.7 mm).

During the bench tests of the engine after repair, the following was carried out: calibration of the engine management system, which showed the absence of unacceptable differences (more than +2° (more than +1.5° at the stops of maximum straight and maximum reverse thrust)) between $\ddot{\gamma}$ RUD (on the NR-90 limb) and $\ddot{\gamma}$ RED. The results of calibration in range of $\ddot{\gamma}$ RUD from idle to maximum reverse thrust:

$\ddot{\gamma}$ RUD, city. on the NR-90 limb	0	-10	-20	-30	-34...40 (-37)
Channel I down	-0,3	-10,1	-19,5	-29,7	
	up	-0,2	-10,1	-19,8	-37
II channel down	-0,3	-10,1	-19,5	-29,7	
	up	-0,2	-10,1	-19,8	-37
Permissible difference $\ddot{\gamma}$ limb and $\ddot{\gamma}$ RED	+1,5	+2			+1,5

Results of the authenticity assessment of the Tu-204-100V RA-64047 aircraft components

The last check of the authenticity of the components was carried out in 2010 – act No. 101/5721 assessment of the authenticity of aircraft components installed on aircraft of the type Tu-204-100B RA-64047, operated by Red Wings Airlines, is approved by JSC

"Red Wings" 11/12/2010 and approved by the Information and Analytical Center of the State Research Institute of Civil Aviation on 11/28/2010. During the inspection No inauthentic units were identified.

Analysis of compliance with the rules for maintaining number-based and production-technical records documentation

The audit revealed the following violations in the rules for maintaining the number and production and technical documentation:

1. The aircraft log does not always include information about changes in the composition components. Thus, after the aviation accident, components were removed from the aircraft items of aviation equipment whose numbers differed from those indicated in Airframe form (Part 2 "Aviation equipment"):

Product name	According to the form	Installed on the aircraft
BVUU-1-3M	07074299	03089076
	11078090	08080714
BVUU-1-5M	10077814	03089085
	10077817	12078226
	11078096	12078227

Changes in the complete set of products were made to the consolidated passport of the ASHU-204M.

2. Not all failures and malfunctions detected in the flight log are recorded in the flight log. flight. When analyzing the aircraft's flight records for the period from January 2, 2012, in a number of cases defects eliminated during operational maintenance (most likely manifested in flight), were not recorded in the aircraft's logbook.

3. Signature samples are not always attached to the work order card. personnel involved in performing work on the aircraft.

Analysis of failures and malfunctions of the engine control system and reverser devices on Tu-204 and Tu-214 aircraft

According to the ACS "Reliability" (letter of the Main Center of BP VT dated 01/28/2013 No. 101-250), for Between 1996 and November 2012, 14 accidents were recorded on Tu-204 and Tu-214 aircraft. failures (malfunctions) of the engine control system (all on Tu-204 aircraft) and 47 failures (malfunctions) of the reverser (including 7 on Tu-214 aircraft). During the period under review, there were no failures on the Tu-204 and Tu-214 aircraft. (malfunctions) of the engine control system associated with an increase in the mode operation of the engine(s) from the RUR to the relocation of the reversing device in reverse thrust position. Of the 14 control system failures (malfunctions) engines on Tu-204 aircraft, it can be noted that on May 9, 2007, on a Tu-204-100 aircraft RA-64022 a difference in γ ore between power units No. 1 and 2 was detected by more than 9 mm. It was established that the tension of the cable wiring of SU No. 1 did not comply with the technical specifications.

11 failures (malfunctions) of the reverser device on aircraft were recorded Tu-204 and Tu-214, which led to its non-inclusion. These failures were caused by the failure KR-90 (2 failures), hydraulic cylinders of the reversing device (3 failures), reversing lock devices (2 failures), products 94-20-875 (1 failure), PM-5 (1 failure). In 2 cases The name of the failed product was not specified.

Additionally, data on engine control system failures was studied Il-96 aircraft. From 1996 to 2012, there were 42 failures. Failures (malfunctions) of the engine control system associated with an increase in the mode operation of the engine(s) from the RUR to the relocation of the reversing device in reverse thrust position, not fixed.

During the same period, 242 failures of the thrust reverser were noted on Il-96 aircraft, In this case, there were 8 cases of failure of the reversing device to engage. In 6 cases, failure was eliminated by replacing the KR-90 or KE-72; in 2 cases, the failed product was not indicated.

One case of increased effort was noted when moving the power steering to the reverse position. thrust. On September 26, 2012, a malfunction was noted on the Il-96 RA-96010 aircraft – RUR No. 2 moves from the "Forward Thrust" position to the "Reverse Thrust" position with increased force. The nature of the malfunction (the failed product) was not specified.

According to the information recorded in the "Reliability" automated control system, on Tu-204 and Il-96 aircraft There were 10 failures of the reversing device, information about which, in accordance with the requirements of PRAPI-98 (clause 5 of Appendix 1) were not sent, the investigation was not was carried out.

According to the Automated Flight Safety System in Civil Aviation of the Russian Federation (ACAR), for the period from 1993 to 2012 16 incidents related to Tu-204, Tu-214 and Il-96 aircraft occurred failure to engage reverse.

The nature of the faults that led to the incidents is not significant differences from the data taken into account in the ACS "Reliability" (failures of KR-90, KE-72, hydraulic cylinders, etc.). The following incidents should be noted:

- On October 30, 2004, an incident involving a Tu-214 aircraft occurred at Domodedovo Airport. RA-64507 JSC Dalavia. During the run, the reverser of engine No. 1 did not switched to forward thrust mode. Failure to turn off the reverser of engine No. 1 occurred due to the destruction of the locking mechanism, loosening of the coupling and, as a consequence, an increase in length adjusting rod between the control cam and the locking cam;

- On September 20, 2005, an incident involving a Tu-214 aircraft occurred at Sheremetyevo Airport. RA-64505 FSUE GTK "Rossiya". After landing, the reverser of engine No. 1 did not engage, but

The reverser of engine No. 2 was engaged despite the left landing gear not being compressed. Violation in operation of the engine reverser interlock when both landing gear legs are not compressed was a consequence of the failure of the RES-52 relay (position 17) in the switching unit BK 024.57.04-116.

1.7 Meteorological information

Weather conditions in the Moscow air zone on 12/29/2012 were determined by the rear part of a quasi-stationary filling cyclone, the center of which was located in Vologda region. According to baric topography maps, the cyclone was tracked to level of AT300 hPa (9000 m), the axis of the high-altitude cyclone trough was oriented towards Moscow region. This cyclone was associated with the passage of secondary cold waves atmospheric fronts through the areas of Moscow airfields.

According to the Vnukovo Maritime Radiological Laboratory, during the day, within a radius of 100 km, in some places there was cumulonimbus clouds with an upper boundary of 3-5 km, heavy rainfall, which confirmed by images from the METEOSAT-8 satellite on 12/29/12 at 12:00 and 12:15.

During the passage of secondary cold fronts, a deterioration was observed visibility in heavy snow and increased surface winds.

At 04:45 on 29.12.12 a warning 1 was issued for Vnukovo airfield, valid from 05:00 to 15:00; wind speed of 15 m/s is forecast.

On the forecast map of significant weather phenomena FL 100-450, valid for 12:00 12/29/12, in the Moscow region below FL130 moderate air pressure was forecast turbulence and moderate icing in the clouds.

On December 29, 2012, at 10:05, the Tu-204-100B RA-64047 took off from Pardubice Airport. flight RVZ9267/RVZ9268 to Vnukovo, having previously received a package there meteorological documentation containing forecasts in TAF code and actual weather in code METAR for the departure airport Pardubice, for the landing airport Vnukovo and for alternates Domodedovo and Nizhny Novgorod airfields.

Forecast for Vnukovo airport at the time of the decision to take off, issued on 29.12.12 at 07:50, valid from 09:00 29.12.12 to 09:00 30.12.12:

TAF UUWW 290750Z 2909/3009 27008G13MPS 6000 BKN020 TEMPO 2909/2918 32008G13MPS 0700 +SHSN BLSN BKN003 BKN025CB TEMPO 2918/3003 1500 SHSN BKN005 SCT015CB BECMG 2903/2905 26005MPS=

Surface wind 270 – 8 m/s gusts 13 m/s, visibility 6000 m, cloudiness significant (5-7 October), the height of the lower boundary is 600 m, at times from 09:00 to 18:00 12/29/12 surface wind 320 - 8 m/s gusts 13 m/s, visibility 0700 m heavy rain snow, ground blizzard, significant cloud cover (5-7 Oct), lower boundary height

90 m, significant cumulonimbus clouds, lower boundary height 750 m,
 from 18:00 12/29/12 to 03:00 12/30/12 visibility 1500 showers, cloudiness
 significant (5-7 Oct), the height of the lower boundary is 150 m, clouds are scattered (3-4
 Oct) cumulonimbus, lower boundary height 450 m, gradually from 03:00 to 05:00
 12/29/12 ground wind 260 – 5 ft/s.

The forecast did not prevent the crew from making the decision to take off.

During the aircraft's approach and landing at the airfield

Vnukovo was in effect with a forecast issued on 29.12.12 at 10:50 with a validity period from 12:00
 12/29/12 until 12:00 12/30/12:

TAF UUWW 291050Z 2912/3012 26008G13MPS 6000 BKN020 530003 TEMPO
 2912/2921 32008G13MPS 0700 +SHSN BLSN BKN003 BKN025CB 650030 TEMPO
 2921/3003 1500 SHSN BKN005 SCT015CB BECMG 3004/3006 26005MPS=

Surface wind 260 – 8 m/s, gusts 13 m/s, visibility 6000 m, cloudiness
 significant (5-7 oct), lower boundary height 600 m, moderate turbulence in the layer
 ground - 900 m, at times from 12:00 to 21:00 12/29/12 wind at ground 320 - 8 m/s gusts
 13 m/s, visibility 0700 m, heavy snow showers, ground snow, cloud cover
 significant (5-7 October), the height of the lower boundary is 90 m, significant cumulonimbus clouds
 rain, lower boundary height 750 m, moderate icing in clouds in the layer from
 90 m to the upper limit, at times from 21:00 12/29/12 to 03:00 12/30/12 visibility 1500
 heavy snow, significant cloud cover (5-7 Oct), lower boundary height 150 m,
 scattered clouds (3-4 oct) cumulonimbus, lower boundary height 450 m,
 gradually from 04:00 to 06:00 12/30/12 ground wind 260 – 5 m/s.

At 12:04 the crew listened to the ATIS "Foxtrot" information with the actual weather
 at Vnukovo airport at 12:00:

wind at ground level 270 - 06 m/s, wind at circle altitude 260 - 15 m/s, visibility
 10 km, light snow, significant cloud cover (5-7 oct) stratocumulus, the height of the lower
 boundaries 740 m, air temperature minus 2 C, dew point temperature minus 7 C,
 atmospheric pressure at the threshold level of the runway-2 course 194 740 mm Hg/987 hPa, in
 There is slight icing in the clouds, the forecast for two hours is no significant changes,
 adhesion coefficient 0.5.

After receiving information from the crews approaching for landing at Vnukovo
 on-board weather reports of moderate icing and moderate turbulence were
 A special weather report for Vnukovo airfield was released, which was included in
 information from ATIS "Golf" at 12:09:

wind at ground level 270 - 07 m/s, wind at circle altitude 260 - 15 m/s, visibility 10 km, light snow, significant cloud cover (5-7 oct) stratocumulus, the height of the lower boundaries 740 m, air temperature minus 2 C, dew point temperature minus 7 C, atmospheric pressure at the runway-2 threshold level course 194,740 mm Hg/987 hPa, moderate icing in the layer from a height of 600 to 900 m, moderate on a straight line turbulence, two-hour forecast - no significant changes, coefficient clutch 0.5.

Due to the increase in wind speed near the ground, the meteorologist issued a warning special weather report, which was included in the information of the ATIS "Hotel" at 12:18:

wind at ground level 260 - 08 or 16 m/s, wind at circle altitude 260 - 16 m/s, visibility 10 km, light snow, significant cloud cover (5-7 october), cloud base height 740 m, air temperature minus 2 C, dew point temperature minus 7 C, atmospheric pressure at the runway-2 level is 194,740 mm Hg/987 hPa, moderate icing in layer from a height of 600 to 900 m, on a straight line there is moderate turbulence, the forecast for two hours is without significant changes, adhesion coefficient 0.5.

During the further landing approach, the crew of TU-204-100V RA-64047 12:29 received information from the landing controller: "...wind at ground 260 - 7 m/s gusts of 15 m/s, wet strip 0.5", then at 12:30 the dispatcher transmitted the next information: "9268 surface wind 270 - 7 m/s gusts 15 m/s." The crew confirmed obtaining information.

Note: *On the displays of the automated meteorological air traffic controllers*

measuring system "AMIS-RF" in minute-by-minute mode

information about wind parameters measured at three points is transmitted

Runway 2, course 194. Direction and average wind speed at ground level

calculated (averaged) by the AMIS-RF station for the previous

2 minutes, wind gusts are selected for the previous 10 minutes.

In the archive of the AMIS-RF station, data from parameter meters

winds are recorded every 15 seconds, wind parameter values

calculated for this 15-second interval.

The next regular weather report for Vnukovo airport has been included in the information ATIS "India" for 12:30:

wind at ground level 270 - 7 m/s, wind at altitude 15 m/s, wind at circle altitude 260 - 16 m/s, visibility 10 km, solid cloud cover (8 oct) stratocumulus, baseline height 720 m, air temperature minus 2 C, dew point temperature minus 7 C, atmospheric

pressure at the runway-2 level is 194,740 mfn Hg/987 hPa, moderate icing in layer from a height of 600 to 900 m, on a straight line there is moderate turbulence, the forecast for two hours is without significant changes, adhesion coefficient 0.5.

At 12:32 with the Tu-204-100B RA-64047 aircraft in the process of landing at the airfield An aviation accident occurred at Vnukovo.

At 12:34 the landing controller requested weather data from the OPN meteorologist conditions at the airfield due to an emergency landing. The meteorologist made observations, generated a special weather report and sent it to the displays of air traffic controllers and duplicated by GGS.

Control weather measurement for the emergency landing at 12:34:

wind at ground level 280 - 7 m/s, wind at altitude 12 m/s, wind at circle altitude 260 - 16 m/s, visibility 10 km, solid cloud cover (8 oct) stratocumulus, baseline height 720 m, air temperature minus 2 C, dew point temperature minus 7 C, atmospheric pressure – data missing due to cable break (consequence of aviation accident), moderate icing in the layer from a height of 600 to 900 m, moderate turbulence on a straight line, forecast for landing - without significant changes, adhesion coefficient 0.5.

After switching the AMIS-RF station to a backup measurement sensor atmospheric pressure was released by the meteorologist and transmitted to the displays ATC dispatchers received a special weather report, which was included in the ATIS information "Juliet" at 12:37:

wind at ground level 280 - 5 m/s, wind at altitude 12 m/s, wind at circle altitude 260 - 16 m/s, visibility 10 km, solid cloud cover (8 oct) stratocumulus, baseline height 720 m, air temperature minus 3 C, dew point temperature minus 7 C, atmospheric pressure at the runway-2 level is 194,740 mfn Hg/987 hPa, moderate icing in layer from a height of 600 to 900 m, on a straight line there is moderate turbulence, the forecast for two hours is without significant changes, adhesion coefficient 0.5.

Actual weather at Vnukovo Airport at the time of approach and landing the Tu-204-100B RA-67047 aircraft's weather conditions were consistent with the forecast. Forecasts weather forecast and Warning 1 for Vnukovo airport were justified in all respects meteorological parameters.

Meteorological equipment at Vnukovo airfield is installed in accordance with the requirements of NGEA-92 (taking into account Amendment No. 25 - 2005) and AP-139 and on at the time of the accident, all measuring instruments were in good working order and verified. were verified by the Federal State Unitary Enterprise "VNIIM named after D.I. Mendeleev" on 01.06.12 (the scheduled date next verification 01.06.13).

During the work of the Air Accident Investigation Commission

On January 10-11, 2013, specialists from the FSUE "VNIIM named after D.I. Mendeleev" an unscheduled inspection of the main wind parameter measuring instruments was carried out, installed in locations representative of the landing zone, middle and remote parts of the runway 2 course 194, which were operating at the time of the accident. Based on the results of the extraordinary inspection, the above-mentioned wind parameter sensors were recognized serviceable and suitable for use as a working measuring instrument, which confirmed by the verification certificates issued for them.

Thus, the actual wind values without taking into account magnetic declination (magnetic declination of Vnukovo airfield +10 degrees), measured by AMIS-RF at 3 points Runway 2 course 194 with an interval of 15 seconds, were:

Time (UTC)	Course 194	Middle of the runway	Course 014
12:31:06	280 - 7.3 m/s por 8.4 m/s	283 - 5.3 m/s por 6.1 m/s	287 - 10.2 m/s por 10.6 m/s
12:31:21	283 - 6.6 m/s por 7.5 m/s	297 - 6.5 m/s por 10.6 m/s	283 - 10.7 m/s por 11.6 m/s
12:31:36	289 - 5.9 m/s por 6.5 m/s	291 - 9.7 m/s por 10.6 m/s	290 - 9.9 m/s por 11.2 m/s
12:31:51	289 - 6.2 m/s por 7.1 m/s	285 - 8.3 m/s por 10.1 m/s	287 - 8.4 m/s por 9.0 m/s
12:32:06	290 - 6.6 m/s por 7.2 m/s	284 - 7.6 m/s por 9.1 m/s	277 - 9.3 m/s por 10.5 m/s
12:32:21	286 - 4.9 m/s por 5.7 m/s	285 - 6.4 m/s por 7.3 m/s	287 - 9.1 m/s por 9.7 m/s

Meteorological support for the flight operated by the Tu-204-100V aircraft RA-67047 on the route Vnukovo-Pardubice-Vnukovo, met the requirements regulatory and normative documents.

1.8 Navigation, landing and air traffic control aids

Navigation and landing aids are intended for control and monitoring of flights in the airfield area, ensuring navigation and landing of aircraft during the day and at night with the minimums established for the aerodrome (from MK-194 to the 2nd category of ICAO, from MK-014 to the 1st category of ICAO).

The state of radio equipment and aviation-air communications at the time the aviation accident complied with the operational and technical requirements documentation, Federal Aviation Regulations, Airworthiness Standards airfields. The facilities at Runway 2, course 194, were fully operational.

At the control points of the Air Traffic Control Center "Tower" of the Air Traffic Control Center (airfield command center) control center) installed:

Automation system for the air traffic control system "Sintez-2A (Vn)", automated control system for the air traffic control system "Terkas", KSA UVD "Alpha" and KSA PVD "Planeta".

Computing complex of the radar information processing system

MADC "Terkas" worked with 100% reserve.

Radar information display system "DS-800" and the system

The Alphascope planning information displays worked without any problems.

The MADC planning system operated with 100% reserve.

The main means of air traffic control is the KSA AKDP "Sintez-A2 (Vn)".

Runway occupancy signaling equipment is located at work stations control centers of the SDP, VSDP, PDP and RPA. Equipment control is carried out from the workstation of the SDP dispatcher.

The RPA workplace is equipped with a Kenwood radio station, which allows receiving information from the airport's main operator on the condition of airfield elements.

Alert to emergency rescue teams of Vnukovo Airport is carried out from the workstations of the dispatcher of the SDP, VSDP, PDP, DPR and RPA, for which Industronik equipment is used.

KSA AKDP "Sintez-A2(Vn)" factory No. 003, year of manufacture 2007, introduced into commission on November 17, 2008, operating time as of December 2012 (inclusive) 40,392 hours. TO-4 held on November 19-23, 2012.

KSA UVD "Sintez-A2(Vn)" and the KAP planning information display system "Synthesis-Alphascope" worked without any problems.

Comments on the quality of flight radio support equipment and aviation air communications from air traffic control and other airport services and no aircraft crews were received on December 29, 2012.

There were no deviations from the norms in the operation of the RTOP and aviation telecommunications equipment.

Radio navigation aids with MK-194

The SP-90 with the MKP-194 operated without any problems. From 12:32 (after the plane crash) the KRM SP-90 with MKP-194 was inoperable (partially destroyed);

The RMM-95 marker radio beacon with MKP-194 worked without any problems.

KRM SP-90, serial number 0644, year of manufacture 2006, put into operation November 20, 2009, operating time as of December 2012 (inclusive) 16,682 hours. Maintenance performed 17.10.2012. Installed with MKP-194.

Timing belt SP-90, serial number 0644, year of manufacture 2006, put into operation November 20, 2009, operating time as of December 2012 (inclusive) 21,597 hours. Maintenance performed 17.10.2012. Installed with MKP-194.

OPRS RMP-200 serial number 0561, year of manufacture 2007, put into operation 20.11.2009, operating time as of December 2012 (inclusive) 14624/9242 hours (first, second semi-kits). Maintenance carried out on 15.10.2012. Installed with MKP-194.

RMM-95 serial number 07112, year of manufacture 2007, put into operation 20.11.2009, operating time as of December 2012 (inclusive) 14624/9242 hours (first, second semi-kits). Maintenance carried out on 15.10.2012. Installed with MKP-194.

ARP-95 serial number 0626, year of manufacture 2006, put into operation on 24.12.2008, Operating hours as of December 2012 (inclusive) 35,064. Maintenance 3 was performed on December 17, 2012. Installed at the control tower of Vnukovo airfield.

According to the flight inspection report from 24.05.2012, the crew of the An-26 RA-26088 JSC "Flight Checks and Systems" equipped with ASLK-N flight control equipment serial number 0101, periodic (annual) flight inspection of RMS SP-90 has been carried out serial number 0644, BPRM RMM-95 serial number 07112, RMD-90NP serial number 0406. SP-90 factory instrument approach radio beacon system for aircraft No. 0644, BPRM RMM-95 factory No. 07112, RMD-90NP factory No. 0406 at the airport Vnukovo with MKP-194° meets the operational requirements for the second RMS categories and is suitable for providing flights without restrictions.

Radar equipment

The KPTS (software and hardware complex) "MC-SKALA" worked without comments with 100% reserve.

PRL RP-4G serial number T-066, year of manufacture 1985, put into operation 11/26/1986, operating time as of December 2012 (inclusive) 53862 hours. TO-3 completed 12/25/12. Installed in the middle of Runway 2.

The RP-4G radar worked without any problems.

The RLC RDC and MADC operated in the normal mode, there were no comments regarding the work.

Technical operation

Operation and maintenance of the air defense system at Vnukovo Airport
The ERTOS service is carried out by the Vnukovo branch of the Internal Affairs Directorate. The ERTOS service Certified as part of a branch.

Certificate compliance No. ANO.Ts.000271, issued Federal
by the air navigation service on June 21, 2010. The certificate is valid until 25.06.2015.

All products subject to certification have valid certificates.
suitability for operation, fit for the designated resource and service life.

The production activities of the ERTOS service correspond to the objectives and functions defined by the regulations on the ERTOS service, technical operation ERTOP and communication facilities are organized in accordance with the requirements of the Federal Aviation Administration "Radiotechnical support of aircraft flights and aviation telecommunications" approved by the order of the FAS dated November 26, 2007 No. 115.

The professional training of the RTO personnel corresponds to the qualification requirements requirements.

Lighting signaling system

Lighting equipment installed on runway 2, course 194:

The white approach lights are 896 m long, with a longitudinal interval for floodlights (30±3) m.

The light horizon lights are installed at a distance of 150 m and 300 m from the runway threshold. Above-ground lights of the UEL-1-150 type with a 150 W lamp were installed.

White landing lights, overground type VRE-2-150 with a 150 W lamp and recessed type FED-2-200 with 2x105 W lamps are located along the entire length of the runway in the form of two parallel rows at a distance of 1.5 m from the edge of the runway with an interval of 60 m. On The last 600 m of the lights emit yellow light.

FTH-1-200 recessed green entrance lights with 2x105W lamps and recessed type FTE-2-300 (input limiting) with 2x105 W lamps installed at a distance of 1 m from the outside of the runway threshold in the amount of 17 pieces (evenly spaced).

Runway limit lights, red, recessed type FTE-2-300 (input limiting) with a 2x105 W lamp installed at a distance of 1 m from the outside runway sides in the amount of 10 pieces (in two groups).

UEL-1-150 overhead approach side lights with 150W lamp installed on a section 270 m before the runway threshold and consist of two rows of red lights colors in accordance with Fig. 5.14 NGEA.

Runway centerline lights of the recessed type FRC-2-90 with 2x48 W lamps are installed on center line along the entire length of the strip at intervals of 15 m. Offset of the installation line The distance between the center lights and the runway center line is 0.6 m.

1.9 Communication means

VHF radio communication and interaction channels operated in normal mode without comments.

The loudspeaker and interphone communication worked in the normal mode without comments.

SKRS "Megafon" serial number 07701, production date 04.04.2007, introduced into Operation date: May 24, 2008; operating hours as of December 2012 (inclusive) 40,368 hours. TO-3 conducted on 18.12.2012. Installed at the control tower of Vnukovo airport.

SCRS "Megafon" in the modification "Emergency control panel equipment" radio communications" serial number 07709, date of manufacture 06/21/2007, put into operation May 24, 2008, operating time as of December 2012 (inclusive) 40,368 hours. Maintenance 5 completed 21.11.2012. Installed on the control tower consoles of the control tower and the SDP-194 at Vnukovo Airport.

Stable two-way radio communication was provided during the approach to landing and when landing the aircraft.

1.10 Aerodrome data

Moscow (Vnukovo) airfield is a civil airfield of class B (4E according to ICAO). Refers to the federal property of the state, is in economic under the jurisdiction of FSUE AGA.

Opening hours: 24 hours.

The aerodrome is suitable for receiving and releasing aircraft, according to Certificate of state registration of the airfield's suitability for operation from 25.01.1995 No. 10 (extended until 07.07.2016), day and night, all year round.

Based on Certificate No. 015A-M of June 30, 2011 (valid until January 15, 2015) aerodrome:

- complies with the certification requirements of the Standards of Fitness for Operation civil airfields (NGEA);
- equipped for instrument landing approaches, including ICAO Category I with MKpos – 194 °, 014 °, according to ICAO Category II with MKpos – 194;
- suitable for international flights.

Aerodrome location indicator (index):

Moscow (Vnukovo) – UUWW/UUWW (in the Russian Federation/in ICAO), IATA code – VNK/VKO.

In accordance with the decision of the head of the Federal Air Transport Agency transport from 24.04.2012 No. AN 1.04-1269 by the senior aviation chief of the airfield joint-based Moscow (Vnukovo) appointed General Director of JSC Vnukovo Airport.

The coordinate system used is PZ-90.02.

Vnukovo Airfield is located 27.8 km southwest of the Moscow city center and 5.6 km south of Vnukovo railway station.

Geographic coordinates of the airfield control point (ACP):

S55 35' 57" W037 16' 23".

Elevation (absolute height) of the airfield control point (ACP): +205.7 m.

Elevation (absolute height) of the airfield: +208.9 m.

Magnetic declination (γM): +10 °.

Time zone number – 2 (Tm = UTC+4 hours).

The airfield is triangular in shape and measures 4000x2240 m. The airfield surface the fields are flat, the ground is soft, the soil is loamy with grass cover, for take-off and the landing is not suitable.

The airfield has two intersecting runways with artificial surfaces:

Runway No. 1 (3300x300 m). Runway No. 1 (06/24) class "B" with a length of 3000 m. The width used is 60 m, constant along the entire length. The type of surface is cement concrete. Closed for renovation.

Runway No. 2 (3360x300 m). Runway No. 2 (01/19) class "B" with a length of 3060 m. The width used is 45 m, constant along the entire length. The type of surface is asphalt concrete.

True runway track angle 01/19 – 023 23'/203 24'. ° °

Runway thresholds 01/19 coincide with the start of the runway.

Bearing capacity (classification number of the pavement) of the IVPP-2:PCN 105/F/D/X/T.

The longitudinal slope of any part of the middle section of the runway is 0.00931.

Longitudinal slope of any part of the extreme sections of the runway:

with MKpos – 194° -0.00009;

with MKpos – 014° +0.01020.

Average longitudinal slope of the runway: 0.00008.

Transverse slope of any part of the runway: 0.0118.

Runway width with widening:

near MK – 194 – 45 m (adjacent to RD B1),

at MK – 014 – 75 m.

The runway extends transversely on both sides of the axis

The runway is 150 m long in each direction along its entire length. The planned part of the flight

The strip extends from the runway axis by 80 m in each direction.

The runway extends beyond the end of the runway:

from MKpos – 194 – 150 m.

from MKpos – 014 – 150 m.

The reinforced part of the airstrip leaves:

MKpos-194 has an internal width of 45 m, external width of 45 m, and length of 50 m.

MKpos-014 has an internal width of 45 m, external width of 45 m, and length of 50 m.

There are no objects within the planned part of the runways of runways 1 and 2, except for those located according to their functional purpose.

Within 60 m in each direction from the centerlines of Runway 1 and Runway 2 there are no obstacles.

The ground surface of the graded part of the runway strips IVPP-1 and IVPP-2 in at the points of contact with artificial surfaces it is located at the same level with them.

There are no stopways at the airfield.

The runway markings are made in accordance with the requirements of the "Guidelines for operation of civil airfields of the Russian Federation" (REGA RF-94).

Preparing the airfield for flights on December 29, 2012

12/29/2012 as a leading engineer - head of the airfield service shift

In order to assess the condition of the airfield, an inspection of the airfield was carried out and during the period 01:26 to 01:35 the friction coefficient was measured using an airfield brake trolley ATT-2 No. 1187 with subsequent entry in the Condition Record Log airfield of Vnukovo airfield. The standard friction coefficient was 0,51/0,53/0,58.

Airfield conditions at 02:54:

Runway 2 – wet, in places dry snow up to 2 mm, without foreign objects, KSC - 0.50/0.50/0.50, measurement of the friction coefficient using an airfield brake trolley ATT-2.

The inspection of the airfield's artificial surfaces was carried out in accordance with requirements of the Manual for the Operation of Civil Aerodromes of the Russian Federation (REGA RF), than there are entries in the Airfield Condition Record Book.

During further inspections of artificial surfaces between 01:35 and 11:10 The adhesion coefficient was not measured, since the condition of the coatings did not change.

The records in the "Airfield Airfield Condition Log" were analyzed. Vnukovo". It was established that the items entered into the log during the inspection of the airfield during the period from 01:26 to 01:35 the data was subsequently duplicated without execution control measurement of the friction coefficient on the runway and entered into the log at 06:30 and in 08:30, which is a violation of paragraph 7.6.1 of the "Instructions for flight operations in the area Vnukovo airfield" dated July 30, 2011.

Between 12:45 and 12:52, after the accident, the head of the
The airfield service shift measured the friction coefficient using
airfield trolley AT-EM No. 011, the Ksc was 0.67/0.65/0.63.

No runway clearing work was carried out between 12:52 and 13:55.

In the period from 13:55 to 14:01 on December 29, 2012, a commission consisting of the shift supervisor
airfield service of JSC Vnukovo Airport, safety engineer-inspector
flights of JSC Vnukovo Airport, state inspector of the inspection department
flight safety control of the MTU VT CR inspected the runway-2 and carried out
Measuring the coefficient of adhesion with MKpos-194. The commission found that VPP-2
clean, damp, in places dry snow up to 2 mm, without foreign objects. The KSC was
measured using the AT-EM No. 011 airfield trolley and was 0.71/0.74/0.68.

Based on the inspection results, a report was drawn up on 29.12.2012.

The commission for the investigation of the aviation accident in the period 08-09.01.2013
work has been carried out to determine the value of the coefficient of adhesion on the runway-2
MKpos-194 ° based on the results of which a protocol was drawn up on 10.01.2013. As a result
measurements of the coefficient of adhesion carried out by all available measuring instruments
an overestimation of the readings of the AT-EM trolley No. 011 by 0.15-0.16 units was detected.

The AT-EM 011 bogie was examined at JSC Research and Development
experimental design enterprise "Planeta" (developer of the bogie). In accordance with
Protocol No. P-01/01 of 29.01.2013 revealed wear on the bearing of the measuring device
braking force on the starboard side. This defect could have caused the overestimation
readings of trolley AT-EM No. 011.

Thus, as a result of the measurements and research carried out, it follows
assume that when conducting a control measurement of the coefficient of adhesion on
IVPP-2 12/29/2012 in the period from 13:55 to 14:01 the value of the coefficient of adhesion
ranged from 0.52 to 0.58.

1.11 Flight recorders

Parametric information registration system

The Tu-204-100V RA-64047 aircraft is equipped with a registration system
parametric information MSRP-A-02.

The on-board system records information:

- to the memory card of the solid-state operational drive TBN-K-4-1;
- on the protected memory module of the solid-state protected drive 1-3;
- on the RTA-45V aircraft printer.

As part of the work of the Investigation Commission, assessment work was carried out state and research of information carriers. Processing and analysis of information with ZBN-1-3 and TBN-K-4-1 were produced using specialized hardware. software package "WinArm"™.

When copying and analyzing flight information recorded by the system MSRP-A-02, installed:

- the registration system of the Tu-204-100V RA-64047 aircraft in flight on 12/29/2012 was is operational and has registered analog parameters in accordance with the list for Tu-204-100V aircraft and one-time teams in accordance with the conditions of their formation;

- the ZBN-1-3 carrier contains a record of the last 33 hours of flight information, including a recording of the emergency flight of the Tu-204-100B aircraft RA-64047 on 12/29/2012;

- operational flight information storage device TBN-K-4-1 contains a record 8 flights, including the emergency flight of the Tu-204-100B RA-64047 aircraft on 12/29/2012.

The TBN-K-4-1 block did not provide data recording for the ATSC system;

- after analyzing the recording on operational and protected media

It was decided to use storage devices as the main one in the future

recording of the protected on-board storage device, individual parameters were specified by recording operational storage;

- the quality of the registered information is satisfactory;

- during the descent for landing approach to Vnukovo Airport by the system MSRP-A-02 registered one-time commands "Failure of the excess pressure regulator pressure 6709 engine 2" (this one-time command is registered and when decreasing for landing in Pardubice) and "Failure of the Ukrainian Armed Forces";

- one-time commands and values of analog parameters indicating failures of aircraft equipment, except for the failure of the excess pressure regulator 6709 engine 2 and the APU were not registered during the descent for landing;

- during the aircraft's run along the runway, the MSRP-A-02 system recorded one-time commands "Failure of one pair of brakes of the main braking subsystem" and "Failure of the main braking subsystem."

As part of the investigation, flight data was processed information about the flights of the Tu-204-100B RA-64047 aircraft for December 2012.

Sound information recording system

The Tu-204-100V RA-64047 aircraft is equipped with a registration system parametric and sound information of the ZBN-GA. The system registers

audio and parametric information to the memory module of the protected solid-state on-board storage device ZBN-MR.

Sound information is recorded on four channels.

(information from the PIC, 2P, B/I and open microphone) during the last 2 hours of the flight.

Due to the fact that at the time of the study the manufacturer had not provided technology for reading information recorded by undamaged blocks

ZBN-MR in laboratory conditions, information was read

directly from the protected memory module ZMP-K of the ZBN-MR drive

assistance of a hardware and software complex of technical recovery tools

flight information TSVPI.

During the process of reading and analyzing the information the following was established:

- the protected solid-state on-board drive ZBN-MR contains a record speech and parametric information, including information about the emergency flight aircraft Tu-204-100V RA-64047 29.12.2012;

- standard software for copying and decrypting memory images protected memory module ZBN-K of solid-state drive ZBN-MR at the time the research provided copying of the full volume of registered information, however, it did not convert all the read information into the specified format; The software, which was improved during the research process, allowed transform registered information;

- reading of ZMP-K information from the first half of the microcircuits was carried out with a significant time delay. As a result of additional research It was established that the reason for the long reading of information from the board memory using a USB adapter in KNTOR AP MAK was a manufacturing defect memory boards. This defect affects the quality of the recorded information

did not provide.

Re-recording and processing of audio information was carried out at the KNTOR AP MAK with using the Sapphire-MAK-M software package. The total time of the copied audio information on channels 1-3 was 02 hours 39 minutes 18.25 seconds, on channel 4 – 02 h 38 min 55.5 sec. On channels 1-3 the quality of information is satisfactory, on channel 4 (open mic) the quality of information is poor. When listening to channel 4 It was found that background noise in the aircraft cabin does not allow for clear hear the crew members speak.

Information from the Internal Affairs Department

As part of the commission's work, an extract of the negotiations was prepared. The crew is a dispatcher. Radar data was used in the flight analysis. (RLK), represented by the control service of Vnukovo airport.

Synchronization of audio and parametric information

To synchronize information, UTC time was chosen as the base time. dispatch service. Based on the recorded conversations, the crew-dispatcher the time was synchronized with the time of the sound recorder information from the ZBN-MR. The time of negotiations was set at several points, corresponding to the aircraft crew's external radio communications.

Synchronization with the time of the parametric recorder was carried out using compliance with one-time commands "Exit to external radio communication" registered parametric recorder, and the beginning of the corresponding phrases on the control panel and on-board tape recorder ZBN-MR.

Flight trajectory calculation

The aircraft's flight path was constructed based on information protected on-board storage device ZBN-1-3.

System Overview

The Tu-204-100B RA-64047 aircraft was equipped with the following at the manufacturer: block "OBZOR MN27" (serial number 5008) produced by DNII "Volna" with Trail MSA DVR with a Toshiba MK8032GAX 80 GB hard drive.

The block was discovered at the site of the AP. The results of work with the block were, in particular number, it is established:

- the storage medium contains a recording of 10445360 frames of information;
- The last video fragment of the archive (frames 10444661...10445336) is dated 23rd December 2012. The fragment corresponds to the time interval 06:05:15...06:07:23 (duration – 00:02:08);
- The video archive does not contain any materials related to the last flight. Tu-204-100B RA-64047 aircraft on December 29, 2012.
- as a result of the analysis of technical documentation (Technical Manual aircraft operation, maintenance regulations, manual flight operation of the aircraft) it was established that it does not contain a description methods for testing the operation of the MN-27 REVIEW system in video archive recording mode

and any methods of monitoring the readings of the built-in clock of the video recorder during operation;

- The materials of the engineering and technical subcommittee indicate that the toggle switch "Overview" on the left panel of the Tu-204-100V RA-64047 aircraft after the AP was in the "On" position, thus, in accordance with The aircraft's flight manual, regardless of the selected operating mode of the system, The built-in video recorder was supposed to record images of those or other cameras during the aircraft's last flight;
- Based on the materials presented, it is possible to clearly establish the reason for the absence recording video information on the built-in video recorder of the "REVIEW" unit MH27" was not possible.

1.12 Information on the condition of the aircraft components and their location at the scene of the incident

The aircraft landed on runway 2 with a heading of 194° (01/19). Runway 2 has dimensions 3060 x 45 m, surface type - asphalt concrete. The runway extends beyond the end of the runway at 150 m, the reinforced part of the runway has dimensions of 50 x 45 m. The ground surface of the planned part of the runway 2 in places The connection with the artificial surface is located at the same level with it. End There are no braking strips at the airfield.

An inspection of the runway 2, carried out immediately after the accident, showed that some or there are no aircraft fragments on the runway, traces on the runway related to The emergency landing of the Tu-204-100B RA-64047 aircraft was not identified.

The aircraft rolled out of the runway 2 almost along its axis (from deviating to the right about 4 m). At a distance of about 5 m from the end of the concrete surface strip there is a fallen approach light. On the snow cover behind Outside the runway 2 there are traces of the wheels of the nose and main landing gear. In the process the movement resulted in a gradual deviation of the aircraft to the right of the extended axis Runway 2. Two more runway lights were knocked down and damaged by the aircraft outside the runway. approach lights at a distance of 30 m and 90 m from the end of the concrete pavement of Runway 2 (Fig. 4.) Judging by the traces, the collisions with the lanterns occurred with the wheels of the left support. chassis. The absence of aircraft fragments in the collision area indicates that at this no destruction of the aircraft occurred at this stage of movement. At a distance of 215 m from the end concrete pavement of the runway-2 and a lateral deviation of about 7 m from the extended axis On runway 2 the aircraft collided with the control center antennas (Fig. 5). Collision with a concrete

the parapet (about 25 cm high) and the base of the antennas were formed by the wheels of the main landing gear supports, there are no traces of impact with the nose landing gear wheels.

As a result of the collision, the antennas of the missile launcher were damaged and felled (only the four antennas located to the left of the extended runway axis), the hardware control center also was damaged as a result of the impact with the left wing of the aircraft. Directly behind the control center equipment (in the direction of the aircraft's movement) the approach light canopy was destroyed. Fragments of the aircraft's landing gear were found in the area of the collision with the cruise missile launcher's antennas (fragments of brake cylinder blocks KT-196M.150, fragments of brake levers, main chassis beam brake lever mounting bolt), as well as small fragments of the wing skin and engine nacelle (Fig. 4). The presence of these fragments allows us to conclude that from this moment the destruction of the aircraft began, and the main landing gear was damaged as a result of the collision.

At a distance of 240 m from the end of the concrete pavement of Runway 2, the plane went into a ravine. The ravine on the airfield boundary has a two-stage profile. The first stage of the ravine 3...3.5 m deep ends with a patrol road, followed by an airfield fence and the second stage of the ravine with a depth of 6.5...7 m (Fig. 4). When descending into the ravine (the first stage ravine) two wheels of the main landing gear separated, then the plane was damaged lighting equipment mast, flew across the road and landed on the main landing gear in the area of the airfield fence (Fig. 6). At the point of impact, the main landing gear fragments of the KT-196M.150 brake cylinder blocks were found in the chassis, as well as fragment of the brake disc of the main landing gear. No traces on the slopes of the ravine and on the road indicates that the plane is moving at high speed.

After colliding with the airfield fence, the plane was 270 m from the end concrete pavement of the runway-2 went into a ravine (the second stage of the ravine), flew over the second slope damaged and knocked down the masts of the lighting equipment and collided with the bottom ravine. As a result of the impact, the left engine was torn from its standard mounting location. As the plane continued to move, the nose of the fuselage collided with the opposite slope of the ravine (the base of the Moscow-Kyiv highway), and the left half-wing - with a platform of lighting equipment. As a result, destruction of the fuselage and wing of the aircraft, as well as the outbreak of a fire.

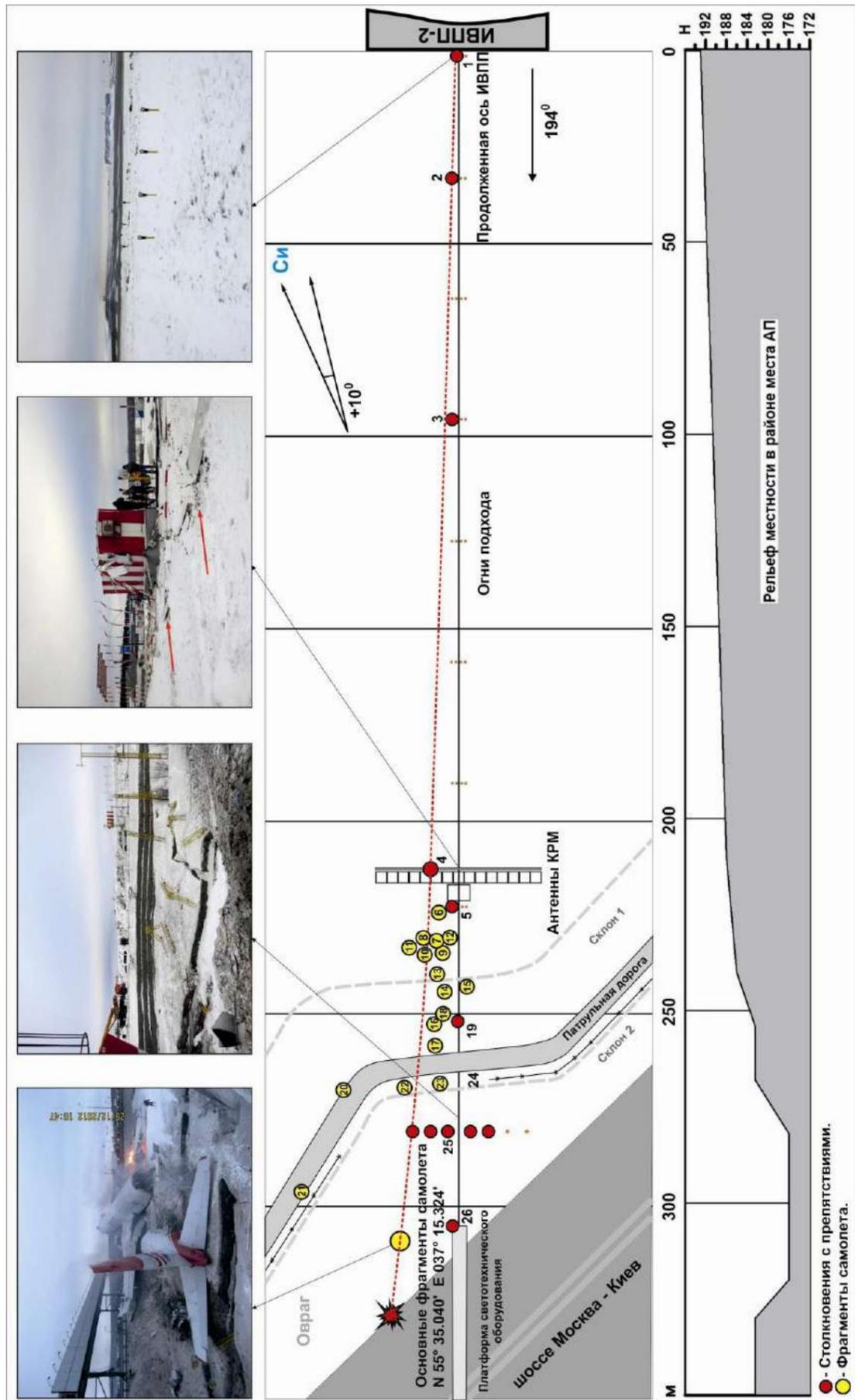


Fig. 4. Sketches of the accident site with the Tu-204-100B RA-64047 aircraft in near Vnukovo Airport (Moscow) on December 29, 2012.

No. Fragment

01. Fallen approach light lantern.
02. Fallen approach light.
03. Damaged approach light.
04. Place of collision with the airfield control center antennas.
05. Damaged approach light.
06. Access hatch to the drain tank from the engine nacelle.
07. Fragment of the brake cylinder block KT-196M.150.
08. Brake lever mounting bracket.
09. Fragment of the brake lever.
10. Clamp for fastening the hydraulic system pipeline of the main chassis support.
11. Fragment of the brake cylinder block KT-196M.150.
12. Brake rod eye.
13. Main chassis support beam brake lever mounting bolt.
14. Wing skin element.
15. Wing skin element.
16. Brake lever.
17. Fragment of the right flap panel.
18. Fragment of the sheathing.
19. Broken lighting equipment mast.
20. Main landing gear wheel.
21. Main landing gear wheel.
22. Fragment of the brake cylinder block KT-196M.150.
23. Fragment of the brake disc of the main chassis support.
24. Damaged airfield fence.
25. Broken and fallen masts of lighting equipment.
26. Damage to the lighting equipment platform.

The appearance of the aircraft after the stop is shown in Fig. 7. The aircraft is in normal (not inverted) position, the landing gear is broken. Crew cabin separated from the fuselage, located directly on the road surface of the highway, strongly damaged and deformed. The fuselage is also damaged, the fuselage fracture occurred in the tail section area. The left engine is torn off the pylon and is located near the tail parts of the fuselage. The wing has severe damage and destruction as a result collision with obstacles. The plane stopped at the point with coordinates: N 55°35.040' E 37°15'32.4'. The distance from the end of the concrete pavement of the runway-2 was 330 m, lateral deviation – about 20 m to the right of the extended axis of runway 2.



Fig. 5. The location of the aircraft collision with the airfield control center antennas. The arrows indicate places of collision of the wheels of the main landing gear with a concrete parapet (about 25 cm) and the base of the CRM antennas. Damage to the CRM hardware as a result of the impact the left wing of the aircraft.



Fig. 6. Traces of the main landing gear touching the ground (marked with arrows). Damaged and fallen masts of lighting equipment.



Fig. 7. Aircraft Tu-204-100B RA-64047 at the scene of the accident.

1.13 Medical intelligence And brief results pathological and anatomical studies

According to the forensic examination, the captain and the second pilot used seat belts, the flight engineer did not use seat belts.

Of the two flight attendants who died, flight attendant No. 5 was at the time incident at scene "E", row 35 and was not wearing a lap belt;

Flight attendant #3 was at seat "F", row 4 at the time of the incident and was fastened with a lap belt. The senior flight attendant was at his work station and was fastened with shoulder and lap seat belts. Flight attendant No. 4 was at his workplace and was wearing only a lap seat belt. Flight attendant No. 2 occupied passenger seat "A", row 5 and was wearing a lap belt.

The deaths of the victims occurred as a result of injuries incompatible with life. Alcohol, morphine and its derivatives were not found in the bodies of the deceased.

Analysis of medical records

KBC

Passed the last medical examination at the Central Medical Expertise Commission on 04.06.2012 and under Art. 21.2; 6.2; 31.2; 39.2; 63.2; 56.2 group II FAP MO GA - 02 fit for flight work, taking into account functional preservation of the cardiovascular system.

According to the psychological examination, clinical and psychopathological
No deviations were found. Conclusion: the central range is average.
preservation of basic mental functions.

There have been no sick leave certificates registered over the last two years,
He was never suspended from flights due to health reasons. He underwent six-monthly medical examinations.
in a timely manner, with a full scope of examination.

There were no extensions to the flight time sanitary norms. Days off were granted.
in a timely manner.

I was on vacation from 10.01.2012 to 12.02.2012; from 27.02.2012 to 09.03.2012;
From 23.11.2012 to 17.12.2012 at home.

The flight time for the last month (from 01.12.2012 to 29.12.2012) was 29 hours 20 minutes.
The flight time over three days was 13 hours 20 minutes, on the day of the incident – 4 hours 30 minutes.
The pre-flight rest period lasted more than 12 hours at home.

Co-pilot

The last medical examination by the VLEK was on July 26, 2012 and under Articles 21.2; 8.2; 31.2;
34.2; 52 gr. II FAP MO GA-02 is fit for flight work as a pilot. According to the data
Psychological examination revealed no clinical or psychopathological abnormalities.
The level of basic mental functions is average.

There have been no sick leave certificates registered over the last two years,
He was never suspended from flights due to health reasons. He underwent six-monthly medical examinations.
in a timely manner, with a full scope of examination.

The extension of the sanitary norm for flight time was in February 2012 (81 hours 28 minutes) and
In August 2012 (89 hours 13 minutes). Days off were provided on time.

I was on vacation in November 2012.

The flight time for the last month (from 01.12.2012 to 29.12.2012) was 28 hours 52 minutes,
The flight time over three days was 14 hours 42 minutes, on the day of the incident the flight time was 4 hours 30 minutes.
The pre-flight rest period lasted more than 12 hours at home.

Flight engineer

The last medical examination was conducted on 20.12.2012 and under Article 21.2; 6.2; 20.2;
23.2; 31.2; 15.2; 63.2; Group II FAP MO GA-02 is fit for flight work as a flight engineer,
taking into account the functional integrity of the cardiovascular system.

Psychological examination showed the presence of the upper limit of the average
level of preservation of basic mental functions.

Sick leave for the last two years was from 10.04.2012 to 13.04.2012

with a diagnosis of acute respiratory viral infection.

There were no extensions to the flight time sanitary norms. Days off were granted in a timely manner.

I was on vacation from 13.01.2012 to 19.02.2012; from 31.05.2012 to 10.06.2012; From 12/01/2012 to 12/21/2012 at home.

The flight time for the last month (from 01.12.2012 to 29.12.2012) was 9 hours 10 minutes, for three days - 9 hours 10 minutes, on the day of the incident - 4 hours 30 minutes. Duration pre-flight rest was more than 12 hours at home.

Based on the requirements set out in the order of the Ministry of Transport of the Russian Federation dated November 21, 2005 year No. 139 "On approval of the Regulation on the specifics of the working hours regime and rest time for crew members of Russian civil aviation aircraft Federation", violations related to exceeding working hours standards and There was no evidence that crew members were provided with full and timely rest. There was no state of fatigue during the last flight.

1.14 Data on the survival of passengers, crew members and others

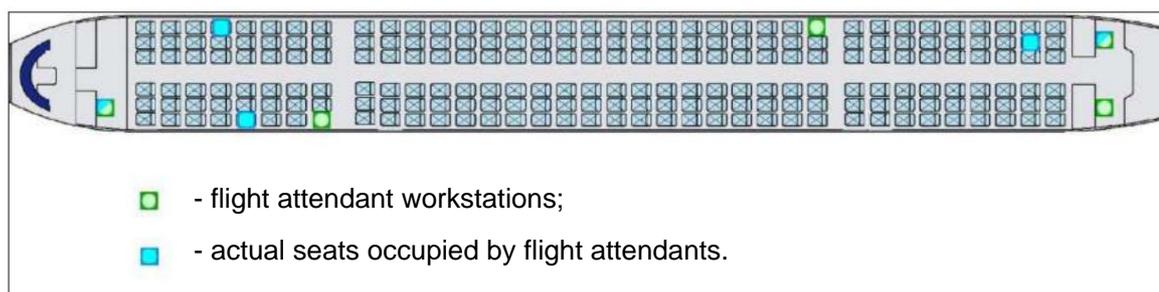
persons in an aviation accident

During descent for landing approach and in case of collision with an obstacle, all members flight crew were at their work stations and as a result of the aviation The accident resulted in injuries incompatible with life.

The cabin crew operating the flight consisted of the following members: senior flight attendant, Flight attendant #2, flight attendant #3, flight attendant #4, flight attendant #5.

The senior flight attendant was at his work station and was wearing a shoulder harness and lap seat belts. Flight attendant #4 was at his work station and was wearing a lap seat belt. Flight attendants Nos. 2, 3, and 5 were located in the passenger seats:

- flight attendant No. 2 – seat "A", row 5, was wearing a lap belt;
- flight attendant No. 3 – seat "F", row 4, was wearing a lap belt;
- Flight attendant No. 5 – seat "E", row 35, was not wearing a lap belt.



The senior flight attendant and flight attendant No. 2 left the plane on their own through the resulting crack in the nose of the fuselage.

When the plane collided with an obstacle, flight attendant No. 3, together with a passenger seat was thrown from the plane onto the roadway of the Kyiv highway a crack formed in the fuselage. Flight attendant No. 4 left the plane independently through the left emergency exit No. 2.

Flight attendant No. 5 was thrown forward by inertial forces several rows of seats, with the help of eyewitnesses she was evacuated through a crack formed in the middle part of the fuselage.

The senior flight attendant was taken to the medical unit by car. Vnukovo Airport, after first aid was provided by an ambulance team

At 17:44, after receiving medical assistance, he was hospitalized in City Clinical Hospital No. 1 named after N.I. Pirogov.

Flight attendant No. 2 was given first aid by the team at 17:33 an ambulance, which at 6:35 p.m. delivered the victim to the research institute named after N.V. Sklifosovsky.

By an ambulance crew on the way to the city hospital At 18:00 in Moscow, flight attendant No. 3 was pronounced dead.

Flight attendant No. 4 was given first aid by the team at 17:10 ambulance and at 18:05 the victim was taken to City Clinical Hospital No. 1 named after N.I. Pirogov.

Flight attendant No. 5 was given first aid at 17:16 and at 18:24 The victim was taken to the 7th City Clinical Hospital in Moscow, where she The next day she died.

When examining the condition of the flight attendants' workplaces at the scene of the incident special attention was paid to the presence and integrity of the shoulder and waist belts safety. Damage and destruction of flight attendant workstations in the cabin There is no aircraft, except for the seat of the senior flight attendant.

At the time of the aviation accident, the persons on the plane were subject to alternating shock braking loads and moments of force associated with destruction fuselage of the aircraft. Bodily injuries sustained by the flight and cabin crew have a direct connection with the collision of the aircraft with an obstacle and its destruction.

As the plane debris scattered in the direction of the Kyiv highway, the front wheel The landing gear hit a passenger car driven by a private individual, who When visiting a medical facility on December 31, 2012, a fracture was diagnosed cervical vertebrae.

1.15 Actions of emergency rescue and fire teams

Emergency rescue operations, including fire extinguishing operations on site aviation accident, organized and carried out by the personnel of the SPASOP and emergency rescue team of Vnukovo Airport in accordance with the "Plan emergency response at Vnukovo Airport OJSC.

Interaction with the forces of the Russian Ministry of Emergency Situations was carried out in accordance with "Agreement on the procedure for interaction and exchange of information of JSC "Airport"

Vnukovo" with the Main Directorate of the Ministry of Emergency Situations of Russia for the city of Moscow."

The events of December 29, 2012 unfolded as follows:

- at 12:32 a.m., the SASS-1 observer visually detected the aircraft rolling out beyond the runway-2 from MKpos-194. The observer immediately gave the fire alarm rescue crews of the SASS-1 by turning on the sound alarm, then by loudspeaker. The communications specialist notified the crews of the SASS-1 fire trucks about the cause of the emergency alarm.

Fire and rescue teams of SASS-1 on three airfield fire trucks dispatched to the scene of the aviation accident. The time of arrival of the SASS-1 crews at the scene AP, the start of extinguishing the fire and evacuation of victims - 12 hours 34 minutes;

- at the same time, at 12:32 a.m. the flight director at the airport was A code "Red" emergency alert has been issued on the emergency notification system. about the Tu-204 aircraft rolling out of the runway 2 from MKpos-194. After the announcement emergency alarm fire and rescue teams with SASS-2 under the leadership the head of the duty fire and rescue team at three airfield fire stations vehicles left for the scene of the accident. The crews arrived SASS-2 to the accident site – 12 hours 36 minutes. After receiving the information, the shift supervisor - head of emergency rescue operations of the airport's SPASOP (hereinafter referred to as the head ASR) switched to the "Emergency Rescue Works" channel and on the Ural-4320 vehicle "Search" has left for the scene of the aviation accident;

- at 12:33 while moving along the runway 2, the head of the ASR gave order - "All airport emergency response teams should arrive at the accident site - the end of runway 2 with MKpos-14", while establishing contact with the RPA, DA (s), received information about the aircraft rolls out of the airfield fence and a fire occurs on the aircraft, informed through the RPA, DA(S) about the need to call in additional forces and funds from the Ministry of Emergency Situations and medical crews from Moscow;

- at 12:34 pm the head of the ASR gave the command to use the monitor nozzles to extinguish the fire and evacuate passengers and crew;

- at 12:36 the head of the ASR arrived at the scene of the AP. Through the RPA, DA (s) gave command to close traffic on the Moscow-Kyiv highway.

He gave the command to the traffic police representatives via loudspeaker to organize cordoning off the Kiev highway and removing unauthorized persons and vehicles 100 meters from the aircraft due to a fire and possible fuel explosion. Repeatedly command to evacuate passengers and crew and inspect the aircraft for casualties.

Received information from the PSR squad leader about the absence of passengers on the plane;

- upon receipt of information by the operational duty shift of the Federal State Institution "Central Control Center of the Main Directorate of the Ministry of Emergency Situations"

of Russia for the city of Moscow", at 12:37 a.m., they arrived at the scene of the aviation accident on-duty forces and resources were dispatched in accordance with the "Action Plan for prevention and elimination of emergency situations in the city of Moscow." In total, PC-10 units, Centrospas detachment, TsRPSO;

- at 12:39 pm the head of the ASR gave the command to the SAB to cordon off the area incidents (on the Kyiv highway);

- at 12:40 the head of the ASR gave instructions to the medical unit crew the airport emergency rescue team should immediately begin providing medical assistance assistance to the victims. Received a report on the discovery of victims and the beginning of their evacuation. At 12:50 pm – end of evacuation of victims – 5 (five) people;

- in the period from 12:34 to 13:02 by fire and rescue teams SPASOP conducted localization of the fire. At 5:17 p.m. – liquidation of the fire, fuel spill treatment with foam;

- at 13:05, the SPASOP forces began dismantling the nose section of the fuselage, where Two crew members were found and extracted from the cabin, and the fact of their death was established. At 13:50 the third dead crew member was pulled out of the cabin wreckage;

- at 14:36 the group of forces of the Ministry of Emergency Situations in the area of the incident amounted to 90 people and 24 units of equipment;

- at 15:05 the transfer of control of the evacuation operations was carried out and clearing the scene of the incident under the control of the Ministry of Emergency Situations;

- at 15:05 the emergency alert was cleared for the Vnukovo Airport ASC crews in agreement with DA (s).

As a result of the rescue operations, people were rescued and evacuated from 5 people were taken to medical facilities in Moscow after the accident.

Directly involved in extinguishing the fire and evacuating victims on site
Fire and rescue teams were involved in the aviation accident
The Vnukovo Airport JSC rescue team, consisting of 26 people, operates at six airfields.

fire trucks. Assistance in extinguishing the fire and evacuating victims

The fire and rescue teams of the Main Directorate of the Ministry of Emergency Situations provided assistance Russia for the city of Moscow and the 206th Fire and Rescue Squad of the State Institution Moscow "Fire and Rescue Center".

The Vnukovo Airport emergency rescue team carried out an emergency rescue operation consisting of number of 80 people and 15 units of equipment.

An analysis of the search and rescue operations showed that the collection and actions The emergency rescue team of Vnukovo Airport carried out the work without any problems.

Shortcomings and omissions in the search and rescue operations that had an impact

The impact on the severity of the consequences of an aviation accident was not identified.

1.16 Testing and Research

1.16.1 Study of control mechanisms and blocking of reversing

devices in the main power supply unit

On the instructions of the Aviation Accident Investigation Commission at the Main Center of the Aircraft BP the control and locking mechanisms of the reversing device were investigated engines and limit switches VKP-V322 for compressing the left and right shock absorbers aircraft landing gear removed from the aircraft.

As a result of the research it was established.

Engine operating mode control panel, control mechanism elements and blocking of their reversing devices, as well as limit switches VKP-V322 compression of the shock absorbers of the left and right landing gear of the Tu-204-100V RA-64047 aircraft on the moment of its collision with the obstacle were operational. Deformations and destruction of the investigated elements of the kinematics of the operating mode control system engines occurred due to the action of excessive loads that arose as a result collision of an aircraft with an obstacle.

To evaluate the backlash in the kinematic joints of the MUB RU, as well as in the joints adjustable rods of the engine control panel are not submitted for compliance with the technical specifications possible due to deformation of the MUB RU rods, the control panel itself and destruction of the starting rollers cable wiring from the impact of the aircraft on an obstacle and the thermal effects of a fire.

Attachment points for the rods from the intermediate roller to the locking cam and valve KR-90 MUB RU, as well as lock nuts for threaded connections of adjustable rods with The RUD and RUR and their tips show no signs of destruction, the connecting bolts and The lock nuts are tightened and locked. Therefore, it can be stated that The reliability of these connections was satisfactory.

Adjustment of the engine management system during operation when replacing engines and the execution of form F2 (on the right engine) was not carried out, which
The following factors indicate:

- similarity of twisting of safety wire on adjustable rods and the ends of the throttle rods of the left and right engines in the control panel, adjustable thrusts of the propulsion part of the control system and the MUB RU of the left and right engines;
- similarity of the material of the safety wires and the chemical composition of the marking paints on adjustable and non-adjustable elements of the control panel;
- similarity of the material of the safety wire of the left and right engines

respectively.

At the moment of the aircraft collision with the obstacle, the left and right reverser doors
The right engines were in a position close to maximum reverse.

1.16.2 Research of piloting techniques during landings

On the instructions of the Aviation Accident Investigation Commission at the Main Center of the Aircraft BP a study was conducted on piloting techniques when performing landings by crews aircraft of companies operating aircraft of the Tu-204 (Tu-214) family (Red Wings, Vladivostok Avia, Aviastar-Tu, SLO Russia and Transaero airlines), data from onboard flight data recorders.

The following characteristic features were identified as a result of the study: piloting, as well as deviations from the recommended parameters, which the PIC airlines are allowed to perform landings on Tu-204 aircraft.

Red Wings Airlines

1. All PICs perform pre-landing descent at elevated instrument altitudes. speeds, on average 25.8 km/h higher than established by the RLE (excluding statistical indicators of the deceased PIC - by 24 km/h). The landing of the PIC also are carried out at an increased instrument speed, on average 15.9 km/h more than the flight manual (excluding the deceased captain) was set at 13.9 km/h.

2. All PICs begin leveling at an altitude greater than that recommended by the flight manual, The actual height is on average 16.7 m, the recommended height is 7...6 m.

3. All PICs perform the first touchdown of the aircraft on the runway with low vertical the speed at which the average value of the maximum vertical overload in during the touch process is 1.24 units.

4. Average time to lower the nose landing gear for all PICs on average is 6.3 seconds (the standard time for lowering the front pillar, laid down in nomograms of the flight manual for calculating the required landing distance is 4 sec).

5. The peculiarity of the piloting technique of the deceased PIC in relation to another aircraft commander of this airline is to withstand higher indicated airspeeds - on average, the pre-landing descent rate is overestimated by 30.3 km/h, and upon landing – by 21 km/h, in relation to the speeds, installed RLE.

6. When the PIC reverser was turned on, the following were detected:

deviations from the recommendations of the Flight Manual:

- in every third landing (33%) the PIC (without the dead PIC) is incorrect, up to REVERSE alarm was triggered, large reverse was turned on;

- the deceased captain engaged the large reverser until the REVERSE alarm was triggered in almost every second landing (in 48% of cases), and in every third landing (35%) included full reverse in one go.

7. In two cases, when the air brakes are not released automatically and interceptors due to failure of the main landing gear interceptors, the PIC did not use manual release of interceptors.

Vladivostok Avia Airlines

1. The pre-landing descent and landing of the PIC is carried out at a slightly increased instrument speeds - on average, the excess is 12.9 km/h pre-landing descent (according to the flight manual, an increase in speed by 10 km/h is permitted) and 6.4 km/h at landing.

2. The alignment of the aircraft begins at an altitude greater than the recommended altitude. RLE. The actual height of the beginning of alignment is on average 14.5 m, with recommended RLE – 7..6 m.

3. The first touchdown of the aircraft by the PIC is carried out at a vertical speed, at which the average value of the maximum vertical overload during contact is 1.29 units, which practically ensures normal operation of the KB

main landing gear.

4. The average time for lowering the front landing gear is overestimated and amounts to 5.8 seconds. (the standard time for lowering the front strut, specified in the nomograms of the flight manual for calculation of the required landing distance is 4 seconds).

5. The inclusion of the reverser by the PIC corresponds to the recommendations of the Flight Manual – The large reverser of the KVS is turned on after the ZMK and REVERSE alarms are triggered. In one of the cases, due to instability of the main landing gear operation, the inclusion a large reversal occurred before the stable REVERSE signal passed.

Aviastar-Tu Airlines

1. The pre-landing descent and landing of the PIC is carried out at elevated altitudes at indicated airspeeds - on average by 21 km/h during pre-landing descent (according to the flight manual an increase in speed of 10 km/h is allowed) and 11.7 km/h upon landing.

2. The alignment of the aircraft begins at an altitude greater than the recommended altitude. RLE. The actual altitude of the start of alignment is on average 14.5 m (RLE recommends starting leveling at a height of 7...6 m).

3. The first touchdown of the aircraft by the PIC is carried out at a vertical speed, at which the average value of the maximum vertical overload during contact is 1.28 units.

4. The average time for lowering the front landing gear is overestimated and on average is 7.3 seconds (the standard time for lowering the front pillar, laid down in nomograms of the flight manual for calculating the required landing distance is 4 sec).

5. The PIC did not turn on the reversing device in 3 out of 16 cases complies with the recommendations of the Flight Manual - the large reverser of the PIC was turned on twice before triggering of the ZMK alarm and in one case before the REVERSE alarm.

SLO Rossiya Airlines

1. The alignment of the aircraft begins at an altitude greater than the recommended altitude. RLE. The actual altitude of the beginning of alignment is on average 14.9 m (RLE recommends starting leveling at a height of 7...6 m).

2. The first touchdown of the aircraft on the runway is carried out by the PIC "softly", with vertical the speed at which the average value of the maximum vertical overload in during the touch process is 1.25 units.

3. The average time for lowering the front landing gear is overestimated and on average is 6.9 seconds (the standard time for lowering the front pillar, laid down in nomograms of the flight manual for calculating the required landing distance is 4 sec).

4. Turning on the reversing device in all presented for research In some cases, the procedure was carried out in accordance with the recommendations of the RLE. In two cases (with failures of the right landing gear strut) the normal opening of the doors occurred reversing devices of both engines.

5. In 4 cases out of 14, the air vents did not release automatically. brakes and interceptors - in two cases due to failure of the automatic systems release and in two cases due to failure of the right main landing gear.

The actions of the PIC in this case correspond to the recommendations of the flight manual.

Transaero Airlines

1. The airline's captain carries out pre-landing descent and landing on at increased instrument airspeeds - on average by 14 km/h during pre-landing descent (according to the flight manual, an increase in speed of 10 km/h is permitted) and by 7.8 km/h during landing.
2. The alignment of the aircraft begins at an altitude greater than the recommended altitude. RLE. The actual altitude of the beginning of alignment is on average 13.2 m (RLE recommends starting leveling at a height of 7...6 m).
3. The first touchdown of the aircraft on the runway is carried out by the PIC with a vertical speed, at which is the average value of the maximum vertical overload during contact is 1.23 units.
4. The average time for lowering the front landing gear is overestimated and on average is 6.6 seconds (the standard time for lowering the front pillar, laid down in nomograms of the flight manual for calculating the required landing distance is 4 sec).
5. Inclusion of the reverser device by the PIC in all presented cases complies with the recommendations of the Flight Manual.

1.16.3 Full-scale ground-based modeling of the operation of the blocking system and reverse control

Experiment on the Tu-204-100B RA-64050 aircraft

On the instructions of the Commission for the Investigation of the Aviation Accident at the branch JSC Tupolev ZhLI and DB with the participation of JSC Gromov Flight Research Institute, State Research Institute of Civil Aviation, JSC Tupolev, Aviadvigatel OJSC, Perm Engine Plant OJSC, and ACTO LLC Tupolev and Red Wings JSC conducted full-scale ground-based modeling of the system's operation blocking and control of the thrust reverser of PS-90A engines on Tu-204-100V type aircraft.

Ground simulation was carried out on the Tu-204-100B RA-64050 aircraft, Released on March 31, 2009, SNE-8995 flight hours, 2584 landings.

SU1 – SNE 9268 flight hours, 2429 cycles, PPR – 3297 flight hours, 928 cycles;
SU2 – SNE 23425 flight hours, 3763 cycles, PPR – 92 flight hours, 34 cycles.

The purpose of the ground modeling was to investigate the possibility and conditions exit of PS-90A engines to the direct thrust mode from the RUR handle when the reversing device flaps in the direct thrust position and controlled by the RED.

Study of the possibility of using PS-90A engines on the Tu-204-100V aircraft RA-64050 for direct thrust mode from the RUR handle, when in reverse devices in the forward thrust position (flight simulation) showed the following:

a) when debugging the control and blocking mechanism of the RU in accordance with Technical operation manual for the PS-90A engine 94-00-807RE and applications to the RUR of forces up to 30 kgf, i.e. non-design forces exceeding the forces, required for moving the RUR (3...7 kgf), as well as exceeding operational efforts, minimum standardized according to strength conditions (15 kgf), the output of the studied The PS-90A engines did not switch to direct thrust mode from the RUR handles.

b) when applying off-design forces (more than 19...22 kgf) applied to reverse control handle, and the presence of a gap between the locking cam and the guide of the reversing device is more than 2.0 mm (i.e. outside the tolerance of 0 mm), PS-90A 1SU engine output to direct thrust mode from the RUR, during debugging intermediate stop of the RU in the position of minus 22° is possible.

When the RU is locked, the change in the position of the RUR (ΔRUR) occurs proportional to the applied forces and reaches maximum values at the maximum effort that a pilot can develop. The maximum value changes in the position of the RUR, recorded by the limb, KISS, GEMU and ASK-90 amounted to: $\Delta RUR = 7^\circ \dots 8^\circ$ (1 ΔRUR), $\Delta RUR = 8^\circ \dots 8.3^\circ$ (2 ΔRUR). Changes in the ΔRUR readings according to sensors in the cabin was $\Delta RUR = 11.8^\circ$ (1 ΔRUR) and $11.2 \dots 14.8^\circ$ (2 ΔRUR). Comparison changes in ΔRUR when applying excessive force on the working and non-working engine 2SU shows that on a running engine with a gap of 5 and 6 mm the value ΔRUR is 0.4° and 0.8° less than when not in use.

Comparison of the movement of the RUR engine 1SU from intermediate to physical stop for 1.1 sec and for 0.4 sec revealed a difference in position $\Delta RUR = 1.3^\circ$. Comparison simultaneous movement of the RUR of engines 1 and 2 of the control system from intermediate to physical the stop for 2 seconds and for 0.4 seconds revealed a difference in position $\Delta RUR = 1.4^\circ$. Increasing the tempo The movement of the RUR leads to an increase in the amplitude of movement by $1.3^\circ \dots 1.4^\circ$.

When moving one RUR with the engines not running, the values of ΔRUR on 0.3...0.6 degrees more (taking into account the sign) than when the displacement is performed simultaneously by both levers. This is explained by the fact that the forces applied the pilot to two and one RUR lever, the maximum possible and the same magnitude, but in the first case these efforts are divided between the levers in half.

Exit to the range $\Delta RUR \approx -32^\circ$ when applying off-design forces to the RUR on the 2SU engine, it occurred with a gap of 6 mm between the locking cam and the guide RU, on 1SU with a gap of 4 mm, when adjusting the pass-through stop minus 18° on both engines. The probable reason for this discrepancy may be the large difference in operating time of the 1SU engine compared to the 2SU engine.

Checking the aircraft part of the engine control system with the engine locked the thrust going to the driven roller showed that applying a force of $\sim P=30$ kgf to the RUR resulted in a change in the RUR position reading according to the DSK-1 sensor in the cabin by $\Delta\alpha = 11.6^\circ$.

As a result of the experiment, the following conclusion was made:

Study of the possibility of PS-90A engines entering the direct thrust mode from RUR handles, when the reversing device is in the forward thrust position (flight simulation), established:

a) when debugging the control and blocking mechanism of the RU in accordance with Technical operation manual for the PS-90A engine 94-00-807RE and application of forces up to 30 kgf to the RUR, i.e. non-design forces exceeding the forces, required for moving the RUR (3...7 kgf), as well as exceeding operational efforts, minimum standardized according to strength conditions (15 kgf), engine output PS-90A is not capable of direct thrust from the RUR handles.

b) with non-design forces (more than 19...22 kgf) applied to the handle reverse control, and the presence of a gap between the locking cam and the guide reversing device more than 2.0 mm (i.e. outside the tolerance of 0 mm), engine output PS-90A in the direct thrust mode from the RUR, when adjusting the intermediate stop of the RUR in position minus 22° is possible.

Technical report on full-scale ground-based modeling of the operation of the blocking system and control of the thrust reverser of PS-90A engines on Tu-204-100V aircraft was signed with comments from the head of the Federal Air Transport Agency's UPLG, the essence of which is as follows:

"...In general, the Findings and Conclusion are incorrectly drawn up. They indicate reasons that make it possible or impossible for engines to reach higher speeds mode with the reverse valves not repositioned. However, these reasons can be recognized only if the engines are operating on the main automatic mode, since when operating on With the backup automatic system, the engines will reach a higher mode when the γ_{RUD} decreases below the tracking platform (-20 degrees). In none of the studied cases, when applying force to the RUR, the γ_{RUD} did not correspond to the tracking platform, and was located significantly lower."

Experiment on the Tu-204-100B RA-64022 aircraft

As part of the work of the Air Accident Investigation Commission, A study was conducted with the participation of Tupolev JSC, Red Wings JSC and the Federal Air Transport Agency possible reasons for the misalignment of the PS-90A engine control system, leading to a possible increase in the direct thrust of the engine from the power steering handle when reversing device flaps in the forward thrust position.

According to the results of the study conducted on the Tu-204-100 RA-64022 aircraft in Vnukovo Airport 07.06.2013, established:

- on engines SU No. 1 and SU No. 2 when performing inspection and testing work engine operating mode control systems (RE PS-90A TK073.21.00 pp. 601-606 pp. 1-2.8) when performing point 2.7, the risk on the unit control lever indicator NR-90 is at minus 20.5° (SU No. 1) and at minus 20.2° (SU No. 2);

- when moving the RUR from the MG position towards maximum reverse to physical support with a force of approximately 25 kg, maximum values were recorded RUR on KISS and on the NR-90 limb on SU No. 1 minus 33.6° and 33.5°, respectively, and on SU No. 2 minus 30.1° and 30.2° respectively (before the start of work it was established that adjustment work after installation of both engines by specialists (the operating organization did not produce any).

At SU No. 1, the RUR values were recorded on the KISS and on the NR-90 limb, exceeding the threshold value (-32°) for switching the RED-90 to an increase in the mode engine operation. Switching of the RED-90 is confirmed by the appearance of the corresponding KISS indications.

On control unit No. 2, when moving the RUR from the MG position towards maximum reverse until the physical stop with a force of approximately 25 kg on the KISS along the NR-90 limb is recorded values close to the threshold value for switching the RED-90 to an increase in mode engine operation.

Based on the results of additional studies conducted on the aircraft Tu-204-100 RA-64022 at Vnukovo Airport on July 18, 2012 and July 25, 2012, the following was established:

- on the engine of the No. 1 control unit with the cardan shaft connected when the throttle lever is in the "low throttle" position, the low throttle marks on the engine drive roller do not match, the indicator on the NR-90 limb is in the +1° position. When the RUR is in the intermediate position stop (small reverse) – the locking cam does not reach the guide (gap ~1.4 mm), the pointer on the NR-90 limb is in the minus 19.5° position. With further translation of the RUR to the cam stops in the guide, the pointer on the NR-90 limb moves to the position minus 20.5°. With the cardan shaft disconnected: when rotating the engine drive roller up to the combination of the low gas risks on the NR-90 limb recorded a value of minus 2°; rotating the engine drive roller in the reverse direction until the cam stops in the guide pointer on the NR-90 limb moved to the position of minus 22.5°; when To fix the pointer on the NR-90 limb in the minus 20° position, you can rest the cam locking into the guide by turning the control cam by hand.

- on engine SU No. 2 with the cardan shaft connected when the throttle lever is in the "low throttle" position, the low throttle marks on the engine drive roller are practically match, the indicator on the NR-90 limb is in the $+1^\circ$ position. The cardan shaft does not disconnect was produced;

- when checking the play of the control and locking mechanism in accordance with the TC "Adjusting the control system" (engine manual, book 2, part 2.073.21.00, p. 504, point 7) it was established that on engine SU No. 1 the play is 0.3...0.4 mm, and on engine SU No. 2 backlash 0.35...0.4 mm, according to TU - no more than 0.7 mm.

The results of the conducted research (based on the provisions of the technical documentation for the aircraft Tu-204-100V and the PS-90A engine, in operation on 29.12.2012) indicate:

The engine is supplied from the manufacturer (repair plant) completely adjusted in accordance with the technical specifications. On an engine adjusted at manufacturing (repair) in accordance with the technical specifications, the position of the mark on the lever indicator control of the HP-90 unit with the reverse valve fully open and the cam stop The locking temperature in the guide can be in the range of minus 14 ... minus 20 degrees, including extreme values.

The aircraft's manual contains process charts that determine the installation procedure. engine on the aircraft, as well as the procedure for checking and, if necessary, adjusting engine operating mode control systems after its installation. Adjustment is carried out by changing the lengths of the rods and the position of the tips in the control panel engine control in the aircraft cockpit.

After installing the engine on the aircraft in accordance with the aircraft operating instructions, with the power steering position on the intermediate stop (small reverse), the position of the mark on the lever indicator the control temperature of the HP-90 unit can be in the range of minus 18 ... minus 22 degrees, including extreme values, with the requirement to control the cam fit There is no locking to the guide in the aircraft's control unit.

Technological maps of the aircraft's operating instructions, which determine the order of engine installation on aircraft, as well as the procedure for checking and, if necessary, adjusting the system control of the engine operating mode after its installation, do not contain references (in part the procedure for checking and, if necessary, adjusting the control system) on technological maps of the engine manual.

In accordance with the engine operating instructions, it is the main document for its maintenance. In case of violation of the provisions of the engine operating manual, The engine manufacturer does not guarantee the normal operation of the engine.

The engine manual contains a list of works that must be performed when installing the engine on an aircraft. Among other things, it is necessary to check that, in the position The RUR is on a stop (it is not specified on which one), the locking cam is adjacent to guide, and the mark on the indicator of the control lever of the HP-90 unit is in range of minus 14 ... minus 20 degrees. If the specified values do not correspond to the RE The engine control system is adjustable. The adjustment specified control system is carried out on the engine, disconnected from the aircraft wiring control. Thus, direct adjustment of the position of the mark on the pointer control lever of the HP-90 unit in the range of minus 14 ... minus 20 at the position There is no RUR on the intermediate stop. Falling within the specified range should be provided automatically, based on the design of the engine, when implementation of the adjustments provided for in the engine manual, while the requirements for there is no specific value within the specified range.

The engine operating manual requires complete adjusting the system according to the aircraft's operating instructions after connecting the propeller shaft aircraft to the drive roller of the engine control system.

Operations for adjusting the engine control system and control mechanism and the interlocks provided by the operating instructions are intended to ensure that the engine complies the technical conditions established for it. Subject to the adjustment engine at the manufacturer's plant (repair plant) in accordance with the additional technical specifications No adjustments should be required when installing the engine on the aircraft. Therefore, when the engine control system adjustment goes beyond the established operating instructions engine range when mounting the engine on an aircraft (due to the wider (plus two degrees) of tolerance in the aircraft's manual) adjust the complete control system of the mode engine operation (aircraft and engine parts) is only possible with the use of adjustments to the aircraft part of the power plant control system.

At the same time, failure to fully implement the operating specialists organizations of inspection works provided for by the engine manual after installation engines for the Tu-204-100V RA-64047 aircraft (06.03.2012 by the personnel of Red Wings JSC left engine No. 3949044822130ÿ1 and 01/27/2011 by the personnel of Tupolev Aviation Center LLC right engine No. 3949042602003ÿ2) was one of the reasons that led to non-reversible flaps of the reversing devices to allow the crew to move RUR and, accordingly, the indicators on the limbs of the pump regulators for the value, exceeding the threshold value (-32°) for switching the RED-90 operation to increase engine operating mode.

1.17 Information on organizations and administrative activities, related to the incident

Red Wings Airlines operates the Tu-204-100V aircraft.

RA-64047, has operator certificate No. 57, issued by the Federal Air Transport Agency of the Ministry of Transport of the Russian Federation.

The airline's legal address is: Russia, 119027, Moscow, Zavodskoe shosse 19. Postal address: Russia, 119027, Moscow, Zavodskoe shosse 19. Tel/fax: (495) 229-25-30, (495) 229-25-40 SITA MOWAFXH AFTN Code – yyyyyyyy E-mail: general@flyredwings.com.

Red Wings Airlines is registered as a legal entity and in accordance with the Federal Law "On State Registration of Legal Entities" an entry was made in the Unified State Register of Legal Entities for the main State Registration No. 1027700281091, Certificate Series 77 No. 010306132 Issued on September 1, 2008 by Interdistrict Inspectorate of the Federal Tax Service No. 46 for Moscow.

The charter of Red Wings Airlines was approved by the decision of the sole shareholder. No. 16 of 20.08.2008, registered by the Interdistrict Inspectorate of the Federal Tax Service Service No. 46 for the city of Moscow.

In accordance with the Charter, Red Wings Airlines carries out domestic and international commercial air transport.

Red Wings Airlines is based at Vnukovo Airport. Geographical areas of operation: Africa, Middle East, Europe, Indochina, Oceania, Russia, CIS, Central Asia, Southeast Asia. Code for flights on domestic routes: IN, on international routes: RWZ. All aircraft are registered in State Register of Civil Aircraft of Russia, have a Certificate of registration, Certificate of airworthiness, Certificate of noise fitness for areas, permission to use radio stations.

The aircraft equipment of the Red Wings airline has resources sufficient for flight operations.

Based on the results of the unscheduled inspection, the certificate is valid

The operator's operations have been suspended since 31.01.2013.

It should be noted that the day before the aviation accident, on December 28, 2012, Red Wings Airlines was inspected by the State Aviation Administration supervision of transport security in the Central Federal District district of the Federal Service for Supervision of Transport. The inspection did not deficiencies were identified that required measures to suspend the operation operator certificate.

1.18 Additional information

1.18.1 Exercise equipment

On the instructions of the Commission, a group consisting of: chief specialists of the KRAP MAC, Adviser to the Flight Safety Management Department of the Safety Inspectorate Directorate flights of the Federal Air Transport Agency, the leading test pilot of the Gromov Flight Research Institute, the leading pilot-Tu-204 and Tu-214 instructors of Transaero Airlines conducted a condition check

Tu-204 KTS simulators of the Federal State Unitary Enterprise "Educational and Training Center" of St. Petersburg and the Federal State Educational Institution Higher Professional Education "Ulyanovsk Higher Aviation School of Civil Aviation", Ulyanovsk.

In the work of the group on the Tu-204 KTS at the Federal State Educational Institution of Higher Professional Education "Ulyanovsk Higher Aviation School of Civil Aviation" participated the flight engineer-instructor and flight engineer-tester of JSC participated in the Civil Aviation School Aviastar-SP. The inspection revealed the following.

General Provisions

In the Air Code of the Russian Federation by the Federal Law of July 28, 2012 Federal Law No. 129-FZ amended Article 54 to provide for requirements (clause 6 Article 54), according to which: "Flight simulation training devices, used for the purpose of training and monitoring the professional skills of flight crew members crews of civil aircraft are allowed to use in the manner established by the authorized body in the field of civil aviation. Requirements for such training devices and the procedure for their use are established federal aviation regulations."

This change to the Air Code of the Russian Federation regulates the need to adopt FAPs establishing requirements for training facilities has been established devices and the procedure for their use.

By order of the Ministry of Transport of Russia dated 27.12.2012 No. 453, amendments were made (come into force on May 29, 2013) in paragraph 5.85 of the Federal Antimonopoly Service "Preparation and implementation flights in civil aviation of the Russian Federation", approved by order

Ministry of Transport of Russia dated July 31, 2009 No. 128:

Previous version of paragraph 5.85	New version of paragraph 5.85
Flight training is carried out on training simulation devices conditions fields, admitted authorized body in the region civil aviation for this purpose.	Simulation training device flight is applied for the provided these rules of preparation or checks of aircraft crew members, to which this training device is

	<p>flight simulations are permitted by an authorized person authority in the field of civil aviation.</p> <p style="text-align: center;">In other cases, the operator organizes preparation or verification aircraft crew members:</p> <p style="text-align: center;">a) using simulating work aircraft systems of training aids, in the aircraft cabin on the ground - for preparation or checks skills operation of aircraft systems;</p> <p style="text-align: center;">b) in flight without passengers on board - for training or testing skills aircraft control</p> <p>operation of aircraft systems...</p>
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New edition of paragraph 5.85 of the FAP "Preparation and execution of flights in Civil Aviation of the Russian Federation" provides for the need for admission training device for specific types of training established by the FAP. When the impossibility of using the training device for these purposes, it is established requirement to complete cockpit and airfield training.

Thus, the current approaches to acceptance into operation and the use of training devices were formed only by the end of 2012 (came into force at the end of May 2013). The relevant FAPs at the time of preparation This Report has not been developed.

Previously, the state requirements for training devices could be be used:

- Standards of suitability of automated training systems for training aviation personnel of air transport, approved by the Federal by the Russian Aviation Service on 15.05.1998 (hereinafter referred to as NG AOS);

- Guidelines "Procedure for interaction of organizations and enterprises in the process creation, production, testing and operation of technical means of preparation aviation personnel of air transport", approved by the Federal by the Russian Aviation Service on May 15, 1998.

NG AOS were to be used for:

- certification, operation, modernization and repair of those located in operation of the AOS;

- development of technical specifications for prototypes of new AOS;
- design, production and testing of AOS.

The NG AOS data included two types of criteria:

- objective categories of fitness;
- subjective categories of fitness.

The objective categories of suitability of the AOC provide for an assessment of the differences between characteristics (mathematical model) of the simulator and the prototype aircraft.

Subjective fitness categories are intended to determine compliance AOC characteristics of the prototype aircraft through flight evaluation.

For this purpose, Appendix 1 to the NG AOS provides: "Subjective flight assessment the simulator is carried out by a test pilot (test crew) who has sufficient experience in flying an aircraft in all flight conditions assessed, including emergency situations and special flight cases."

In accordance with the Regulation on the Federal Air Transport Agency, approved by the RF Government Resolution No. 396 of July 30, 2004, this the state body, in addition to everything else, carries out:

- "...issuing permits for the use of integrated flight simulators

for training aviation personnel;

- approval of training programs for aviation training centers

civil aviation personnel in accordance with the lists of positions."

Administrative Regulations of the Federal Air Transport Agency provision of public services for issuing permits for use

integrated flight simulators for training aviation personnel have been approved

was not, the responsible structural unit implementing these functions was not definitely.

Technical condition of exercise equipment

Tu-204 KTS simulator (serial number 0101)

Developed by PC BM (Penza) in 1992, belongs to the Federal State Unitary Enterprise "Educational-Training Center" in St. Petersburg, operating since January 2002.

Over the past period of time, the technical condition of the simulator has been constant supported by the implementation of monthly, quarterly and semi-annual regulatory work in accordance with the "Plan for carrying out routine maintenance on the simulator". Data the work was carried out by specialists from the center who have certificates for performing this type of work.

These certificates were issued to the center's specialists after completing the "Program admission to operation of the Tu-204 KTS simulator", which is included in the "Nomenclature areas (specialties) of training levels, retraining, programs additional education of the Federal State Unitary Enterprise "Educational and Training Center" specified in Certificate No. 1 for conducting educational activities. The certificate was issued by the Directorate flight operation license of the Federal Air Transport Agency dated November 26, 2010 and is valid until November 25, 2013.

The latest permit No. 20.14.-687 for the training of flight crew members crews of the Tu-204/214 aircraft on this simulator was issued by the Head of the Flight Department operation of the Federal Air Transport Agency (hereinafter referred to as the Administration) on April 20, 2010. This permit and the documentation attached to it does not fully comply with the standard documentation, specified in the NG AOS. In particular, the subjective (flight check) of the simulator, was carried out only by the crews of the operators without the involvement of specialists from the State Research Institute Civil Aviation or Flight Test Center. The data will be included in the composition of the certification commission the crews were not included, their authority to conduct this inspection is provided by orders or are not confirmed by orders of the Administration.

It should be noted that during the period since the last flight permit was issued evaluation of the simulator, at the request of the head of the Federal State Unitary Enterprise "Educational and Training Center", was carried out by the flight crew twice: on August 18, 2011 by the airline crew "Vladivostok AVIA" and on November 14, 2012 by the crew of Transaero Airlines, which is not contradicts the requirements of the NG AOS. However, these checks by orders or not confirmed by orders of the Administration.

The equipment in the simulator cabin does not fully correspond to the real one equipment installed on the Tu-204 family of aircraft. There are no EGPWS systems, TCAS, RDR locator. Limit switch operability (operation) indication There is no provision for compression of the chassis struts on the KISS.

It should be noted that this indication is not present on all modifications of the Tu-204 family of aircraft. According to the flight crews of the operators, this indication is not used in practice in preparation for execution and execution landing of the aircraft. At the same time, in the Flight Manual of the Tu-204-100V aircraft, paragraph 8.9.3.(1) it is prescribed to check display of "landing gear compressed position symbols" during takeoff preparation.

The visualization system library is limited to seven airfields. It is necessary It should be noted that the simulator's employees purchased the video programs themselves flight visualization for five airfields to implement recommendations based on the results simulator testing in 2010, during the investigation of the accident involving the Tu-204-100 aircraft RA-64011, which occurred on March 22, 2010, in the area of Domodedovo Airport.

The visualization system allows simulating weather conditions both during the day and at night, with provision for simulating meteorological conditions corresponding to I and II ICAO categories. For these aerodromes, the radio navigation situation is simulated, radio-technical means of landing and communication.

The basic software of the simulator corresponds to the aircraft modification Tu-204-100. In the simulator cockpit, the inscriptions, stencils and indicators are made in English. The speech informant and KISS allow the corresponding information in both English and Russian.

Replacement of a complex of obsolete computers modern allowed the simulator to have the property of reversibility, which allows use training software on Tu-204-100 modifications, Tu-204S, Tu-204-100E, Tu-204SE, Tu-204-300, Tu-204-120SE. Required software The provision was received from the manufacturer of the PC BM simulator (Penza).

At the customer's request, the simulator also allows simulating the work of strength training installations in the version with PS-90A engines and with RR-211-535E4 engines (option Tu-204-120SE).

Despite the similarity with some modifications, formally the modification The Tu-204-100V is not included in the simulator software.

The simulator equipment allows for recording flight parameters and their further evaluation in the flight departments of operators. However, this possibility is not used by the command and instruction staff of customers to analyze the implementation crew training.

The simulator does not have the ability to enter an automatic release failure interceptors and air brakes on landing after touchdown (simulation failure of the limit switches on the chassis struts). At the same time, it is possible to enter failure of interceptor deployment in flight. To practice the crew's actions in the absence of automatic release of interceptors after landing (manual release) by the instructor staff of Vladivostok-Avia, after the accident with the plane RA-64047, the following methodology was proposed on an initiative basis:

- before landing, the instructor enters "failure to release interceptors";
- after landing, the crew discovers that the interceptors have not been released automatic mode and makes a decision on their manual release;
- at the moment the flight engineer moves the interceptor release handle,

The instructor "removes" the "failure to release the interceptors."

According to the simulator staff, before the accident, this
The situation was not worked out by the crews of all airlines.

Due to the design differences between the real aircraft and the simulator, the latter does not have the ability to simulate the blocking mode of the RUR movement to the "MAX" position. REVERSE" when the reverse valves are not open (not repositioned).

The mobility system is 6-stage, with hydraulic drive, and is operational on all stages from taxiing to landing and rollout. However, the correct configuration of the system mobility (adequacy to the actual flight stages) should be assessed additionally.

Taking into account the above mentioned shortcomings, this simulator is accredited by the airline. "Cubana" (Republic of Cuba) for training its crews. In 2006, the simulator was accredited by the Chinese aviation authorities for training the crews of the Chinese Tu-204-120 airlines. In October 2006, the simulator was certified by the Chinese aviation authorities by the authorities under the FFS class "C" category (meets the requirements for Level I simulators according to the ICAO classification DOC 9625) and certificate No. 2006-043 was issued for it.

Tu-204 KTS simulator (serial number 0001).

Developed by PC BM (Penza) in 1992. Installed and in operation since 1996
Federal State Educational Institution of Higher Professional Education "Ulyanovsk Higher Aviation School of Civil Aviation". The latest permit for Use of the simulator for the preparation and training of flight personnel issued on March 16, 2009 (permission No. 7.1.14-286, signed by the Head of the Flight Standards Department (Rosaviatsia). This permission was granted on the basis of the Flight Evaluation Report of the simulator from 10/31/2008, carried out by the flight crew of the airline LLC Aviastar-TU, without involvement of specialists from the State Research Institute of Civil Aviation or the flight test center.

Over the past period of time, the technical condition of the simulator has been constant supported by the implementation of monthly, quarterly and semi-annual regulatory work in accordance with the "Plan for carrying out routine maintenance on the simulator". Data The work was carried out by specialists from the school's training center. Certificates, confirming the competence to perform this type of work by specialists
The training center was not presented. The conditions for certification of specialists in This type of work is not provided for by regulatory legal acts on exercise machines.

Repeated flight tests of the simulator were carried out after scheduled ones. scheduled maintenance by the simulator instructor staff who are not authorized to fly on Tu-204 family aircraft. The last check was recorded on December 29, 2012. Permission for the use of the simulator has not been updated since 2009, while the certificate for conducting educational activity No. 5, which includes activities on simulator training, was issued on September 20, 2011 and was valid until September 28, 2014.

The equipment in the simulator cabin does not fully correspond to the real one equipment installed on the aircraft. There are no EGPWS, TCAS, or radar systems RDR. An outdated SRPBZ system was installed, the operability of which corresponds to parameters embedded in it. There is no indication of the serviceability (operation) of the limit switches for compressing the landing gear struts on the KISS4 .

The visualization system library is limited to one airfield in Ulyanovsk. Flight visualization allows simulating meteorological conditions during landing according to I and ICAO Category II only at night. In this case, the headlights are simulated, as in both taxiing and landing modes is absent, which does not allow for full practice such elements as taxiing, takeoff, and landing of aircraft. At the same time, the movement of the aircraft when approaching for landing at minimums of Category I and II in night conditions (based on the results (flights on the simulator of the commission members) is simulated with a sufficient degree of reality.

The simulator simulates the radio navigation situation without visualization. ten airports with flight areas, radio-technical landing and communication facilities.

The simulator's computing system is built on the basis of six CM1700 computers, informationally united according to the principle of "common memory field". This system is obsolete. This system requires warming up to operate. equipment within 30-40 minutes. It does not provide the ability to quickly removal and recording of flight parameters for their further evaluation and flight analysis in flight divisions of the operator.

The simulator software corresponds to the aircraft modification Tu-204-100 with versions VSS-85, SPKR-85, VSUP-85, VSUT-85 and allows to perform Training is only available in the Russian-language cabin layout. Program reversibility the simulator is missing, which does not allow for full-fledged training, simulating other modifications of Tu-204.

During the flights on the simulator, the commission members checked the operation of the SPKR-85 system, which showed satisfactory results for the Tu-204-100 modification. There was also a check of the reliability of the control system operation in the event of engine failure was carried out takeoff and landing, which showed close similarity to a real flight. The system 6-degree mobility, hydraulically driven, operational. However, due to limited stroke of hydraulic cylinder piston rods (stroke length 1 m) and the absence correct configuration of the system, not in all cases (especially when moving on the ground – run-up, run) a sufficient degree of reality of sensations is achieved.

⁴ The opinion on the necessity of this indication is presented above in the description of simulator No. 0101.

There is no possibility to enter the failure of automatic release of interceptors and air brakes on landing after touchdown (simulation of failure of the end brakes) switches on the chassis struts). Also, there is no provision for a release failure input interceptors in flight. For these reasons, crew training in manual release interceptors on landing if they are not released automatically is impossible.

Due to the design differences between the real aircraft and the simulator, the latter does not have the possibility of simulating the mode of blocking the movement of the power steering gear in the "MAX" position. REVERSE" when the reverse valves are not open (not repositioned).

In the opinion of the commission, special attention should be paid to the imitation of landing with failure of the reverser of two engines (failure to reposition the reverser flaps). At this simulator when introducing a failure of the reverse of two engines and switching the RUR to the mode "MAX. REVERSE" (when the KISS indication is more than 30 degrees) simulates the appearance "direct" thrust on engines close to the nominal mode, and, accordingly, acceleration Armed Forces, which cannot be reproduced on the simulator of the St. Petersburg training center.

Conducting training for flight personnel

Flight crew training on simulators of the Federal State Unitary Enterprise Training Center of St. Petersburg and Federal State Educational Institution of Higher Professional Education "Ulyanovsk Higher Aviation University" conducts training according to the programs of operators Tu-204 aircraft, which are an integral part of the RPP airlines approved by the Flight Standards Department of the Federal Air Transport Agency. Assessment the possibility of executing these programs given the actual capabilities available The Management did not conduct any training of simulators.

The commission inspected the airline's flight crew training program.

"Red Wings", which is approved by the Flight Standards Department of the Federal Air Transport Agency of the Ministry of Transport of the Russian Federation 04.09.2009.

This program does not have procedures to compensate for the deficiencies simulators. In particular, there are no procedures to compensate for the lack of systems TCAS and EGPWS.

The list of mandatory elements to be worked out, specified in Program 3, Appendix 1 of the airline's RPP does not provide for the training of actions in the event of failure of the reverser flaps of one or two engines, failure of the wheel brakes, failure to release interceptors and air brakes in automatic mode during landing, since the possibility of such a complex failure is not provided for in the Tu-204 aircraft flight manual.

When checking the training log on the simulator and training assignments There have been cases among airline crews where flight crew checks were carried out simulator instructor. Due to the fact that the position of instructor-examiner,

introduced by order of the Federal Air Transport Agency No. GK-91R dated May 25, 2009, cancelled by order of the Federal Air Transport Agency No. 292 of 09.08.2010, these actions contradict the recommendations of the "General Provisions" p. 4 "Programs of periodic flight training and crew training on simulator" of the airline "Red Wings", where these powers are granted only to the airline's instructor and flight crew. That the data powers are delegated to the trained instructor staff of the simulator, not This is specified neither in the airline's operating instructions nor in the contracts for the provision of simulator services.

In general, the technical condition of these simulators can continue to be used for preparation, training, complex and targeted checks of flight composition. To compensate for deficiencies in hardware and software simulators in the simulator training programs for Tu-204/214 aircraft operators modifications, taking into account the technical capabilities of the simulators, should be developed and the relevant procedures agreed with the Federal Air Transport Agency have been implemented.

1.18.2 Flight evaluation

At the request of the Commission, a flight evaluation was carried out by a group consisting of:

- Honored Test Pilot of the Russian Federation, LII them. M.M. Gromova;
- Honored Test Pilot of the Russian Federation, Deputy General Director -

Head of the State Research Institute of Civil Aviation;

- test pilot 1st class, M.M. Gromov Flight Research Institute;
- test pilot 1st class, State Research Institute of Civil Aviation;
- Deputy General Director, Flight Director of Vladivostok-Avia;
- Honored test pilot of the Russian Federation, pilot-instructor-examiner of the Armed Forces

Tu-204/214.

During the work, an assessment was made of the adequacy of the RLE recommendations. Tu-204-100V in terms of landing performance, as well as a comparative analysis relevant sections of the FCOM/QRH aircraft Boeing-747/757/767/777, A-318/319,/320/321, Falcon-7X, CRJ-900.

In addition, the analysis used materials from a ground-based experiment, conducted on the Tu-204-100B RA-64050 aircraft on February 13-14, 2013, as well as materials flight experiment on February 12, 2013, conducted by Tupolev JSC.

Analysis of the actions of the crew of the Tu-204-100B RA-64047 aircraft during landing in Vnukovo Airport, December 29, 2012

The approach was carried out on runway 19 (L=3060 m) of Vnukovo Airport in a crosswind on the right. During landing, the crosswind component of the gusts reached 10...11 m/s. Mass

The aircraft weighs 67.5 tons and has a center of gravity of 26.5% MAC. The aircraft was flying without passengers or cargo. Remaining fuel 5.9 tons (empty aircraft weight without fuel 59.7 tons, crew – 8 people).

The approach was carried out in director mode in accordance with the pre-landing briefing given by the PIC, with the PIC performing piloting and control engines, and the second pilot carried out communications, navigation and control actions. Before Upon entering the landing course, piloting was carried out using flight control computer system (FCC) in the GOR NAV (lateral) modes channel) and STAB. AND UPR Vy (longitudinal channel), as well as the computing system thrust control (TC) in the STAB SPEED mode, and after reaching the landing zone direct - in the helm control mode according to the ILS system using director bars and the VSUT turned off. The flight until the exit to the PC was without deviations in piloting technique. The ACS was switched off before entering Glide path. The crew disengaged the autopilot using a button on the control column.

During the descent and landing approach, the crew was not present The control chart "At a distance of 20-25 km from the end of the runway" was completed.

During the approach, the crew maintained a speed significantly exceeding recommended approach speed. According to the flight manual, at landing weight 67.5 t gliding speed with flaps at 37° is 210 km/h, and the angle of attack is The glide path should be 5...7 degrees. If there is turbulence, the flight manual recommends increase the approach speed by 10 km/h (paragraph 4.6.1(9)), and if there are signs of icing – by another 10 km/h (p. 4.6.6(2)). During pre-landing preparations (11:57:09... 11:58:00.) The PIC clarified: "We will maintain 230..." In fact, the glide speed along the glide path, the speed was maintained in the range of 220...275 km/h. After releasing the chassis and flaps to 37 degrees and perform the map before landing speed was maintained in the range of 250...275 km/h. With the required angle of attack of 5...7 degrees on The actual angle of attack on the glide path was 1.4...1.6 degrees. Thus, the deviation from the set speed was 20...45 km/h.

Piloting on the glide path was carried out with disproportionately long movements of the steering wheel in the longitudinal channel with significant changes in the mode engine operation. At the same time, the normal glide load varied on average in range of 1.2...0.8. The maximum values of overload change reached 1.4...0.7. When performing the checklist after the release of the mechanization, the crew cross-checks with the formalized chassis release report, flaps, current flight speed and angle of attack. Execution of the control chart the "Before landing" check (after releasing the flaps to the 37° position) was not carried out according to

all points (there is no control over the retracted position of the interceptors), not all members the crew responded in the established manner (there was no response from the PIC and the second pilot about control of the released position of the chassis and flaps in the landing position).

The glide path parameters had to be controlled by the crew. Thus, when

If the speed increased by more than 20 km/h, the second pilot was required to report: "Speed "great" (RLE p. 4.6.3.2). However, if the deviation from the set speed is 20..45 km/h, There was no corresponding report.

In addition, according to the RPP of Red Wings CJSC, part A, paragraphs 25.1.2 and 25.1.3, Upon reaching an altitude of 300 m (1000 ft), the crew is required to go around failure to maintain the calculated **Vzp along the specified trajectory**. This was not done.

Note: In the RPP of Red Wings CJSC, Part A it is stated:

- **25.1.2 Heights and boundaries of stabilization.**
- **The aircraft must be stabilized to an altitude of:**
 - **300 m (1000 ft) when landing using precision systems;**
- **In case of non-compliance with the above conditions there must be an aborted landing approach was made (go-around).**
- **25.1.3 Definition of a stabilized approach.**
- **The approach is considered stabilized only when it is completed the conditions listed below until the established heights:**
 - *the position of the aircraft corresponds to the calculated one in the vertical and horizontal plane;*
 - *only minor changes in course and pitch are required to maintain the calculated trajectory;*
 - *aircraft in landing configuration;*
 - *the pre-landing checklist has been completed;*
 - **the operating mode of the engines has been selected and set the calculated Vzp is maintained along the given trajectory;**
 - *The approach speed is usually considered to be $V_{ref} + 5$ kt (10 km/h).*

The runway threshold was crossed at a speed of 260 km/h, i.e. 40..50 km/h faster prescribed by the flight manual. The increased gliding speed resulted in a flight of ~1000 m from start of the runway and landing at increased speed with a slight left bank 1...1.5°. The angle of attack upon contact was 2.2...2.5°, speed 230 km/h.

Increased landing speed combined with a "soft" landing ($n\ddot{y}=1.12$) and a relatively small roll of $1..1.5^\circ$ did not lead to the simultaneous compression of the main landing gear and automatic release of spoilers and air brakes. Crew (flight engineer) did not control the release of the interceptors and did not release them in manual mode, thereby violating the RLE section 4.7.1.3. According to the RLE, after landing The PIC was supposed to set the RUR (reverse control levers) to the intermediate position "SMALL REVERSER" and only after receiving a report from the flight engineer "Small reverser engaged" and nosewheel lowering, move the power steering to the "MAXIMUM REVERSER" position. According to the MSRP recording, the power steering of both engines was moved to the "MAXIMUM REVERSER" position without being locked on the "SMALL REVERSER" pad immediately after touchdown and nosewheel lowering.

The transfer of the PIC RUR immediately to the "MAXIMUM REVERSE" position could be caused by increased psychophysiological stress associated with a long flight and landing at high speed, or with erroneous actions the use of reverser by a particular pilot, which requires an analysis of previous flights in terms of the procedure for turning on the reverser on landing.

Almost simultaneously with the lowering of the nose wheel and the transfer of the RUR to in the direction of maximum reverse, the crew applied braking from the pedals. However, braking was ineffective due to poor wheel grip on the runway surface with insufficient load on the main landing gear **due to high speed** (the plane, with its interceptors not deployed, was practically "flying" over the runway).

As a result of a combination of unfavorable factors (non-compression of the ends of both main landing gear and, as a result, failure to release the interceptors and air brakes in automatic mode and non-reversal of the reverser flaps; movement of the power steering gear in the direction of "MAXIMUM REVERSE" if the lock does not operate when (unshifted reverse valves) there was an increase in the operating mode of both engines up to $N_{vd}=90\%$ (direct thrust) with acceleration of speed up to 230...240 km/h. In this case, effective braking of the wheels did not occur due to underloading main landing gear due to high speed.

During the landing run up to the moment the aircraft rolls out, the interceptors are not released. was controlled and not produced manually.

During the landing, the PIC made three attempts to engage the reverser. In the first two In attempts, the RUR was moved from the "REVERSE OFF" position to the "MAXIMUM REVERSE" POSITION in one movement, bypassing the intermediate stop ("SMALL REVERSE"), and held in this position

respectively 8 sec. and 3 sec. with subsequent return to the "REVERSE" position "OFF". At the same time, the PIC applied certain efforts to keep the RUR in upper position. 4 seconds before the aircraft rolls out (200...250 m before the exit runway threshold) a third attempt was made to engage the reverser. In the third attempt The RURs were also moved in one motion to a position close to the "MAXIMUM REVERSE" position for 1...2 seconds, followed by moving the RURs to the intermediate stop "SMALL REVERSE".

As shown by a ground experiment conducted on a Tu-204-100V aircraft RA-64050 February 13-14, 2013, the maximum effort a pilot can realistically apply applied to hold the RUR in the upper position, amount to about 25...30 kg. When this is the actual position of the throttle in the cockpit and the position of the throttle sensor on the limb the engine regulator pump do not match. The magnitude of the force on the power steering when moving mainly depends on the amount of adjustment of the cam clearance of the locking mechanism reverser engagement. The larger this gap, the easier it is for the pilot, applying quite acceptable efforts to the RUR, move them (and along with this the entire system of rods and rockers) into a position in which a command is sent to the pump regulator to increase engine operating mode (more than 32° on the HP dial). In this case, it is possible precisely because of the increased clearance of the cam of the locking mechanism reverser and setting the RUR by the pilot to a position close to the position "MAXIMUM REVERSE" with relatively little effort (about 10 kg) conditions arose that made it possible to switch the engines to a higher mode. Since The reversing of the valves did not occur, which led to an increase in forward thrust.

The crew did not establish the reason for the increase in speed, as evidenced by three attempts to engage the PIC's reverser, including at the flight engineer's prompt, attempting to use automatic braking mode, which was turned off the co-pilot accidentally pressed the pedals, which not only led to disabling automatic braking, but also to the fact that further mileage was carried out without using the brakes until leaving the runway. In addition, Conversations inside the cabin indicate the presence of internal psychological installations (dominants) aimed at braking (stopping) the aircraft, even then, when the remaining runway length would clearly not be sufficient for a safe stop aircraft. Analysis shows that having a sufficient speed of 220...240 km/h, which the plane had during the last 10 seconds before rolling out, quite was enough to perform a takeoff with flaps extended to 37° (such maneuver is not provided for by the RLE). However, due to a lack of understanding of the current situation, and

also due to the psychological unpreparedness of the crew, primarily the captain, in
Due to the current emergency situation, this opportunity was not realized.

**It should be noted that this feature cannot and should not
used by crews as a "normal" means of eliminating the consequences
unstabilized landing approaches.**

In case of unstabilized landing approach it is absolutely necessary
perform a go-around from the established flight altitude.

Of course, the takeoff procedure itself with flaps extended to 37° is from the end
The runway is already unusual at the landing stage, and such a procedure is unlikely to ever be carried out
The PIC carried out the order. Perhaps the pilot could have been influenced by the fact that in this
in this case, you will need to give explanations and explain the reasons for your actions, while
his erroneous actions and deviations made before the transition may also be revealed
situations in an emergency.

**The disaster occurred as a result of a sequential combination of the following
main reasons:**

- Increased approach speed (20...45 km/h higher than prescribed)
RLE), violation of the provisions of the airline's RPP (clauses 25.1.2 and 25.1.3), which prescribe
In this case, the go-around and the decision to land led to a landing with
a long flight (950...1000 m) from the beginning of the strip and landing at an elevated altitude
speed of 230 km/h. This circumstance alone, upon further
the actions of the crew in accordance with the flight manual could not have led to a flight accident,
however, it significantly reduced the available braking distance and significantly
increased the psychophysiological load on the crew.
- The crew did not comply with the requirements of the Flight Manual, paragraph 4.7.1.3., regarding the **release
interceptors** and the use of reverse after landing. This circumstance was
one of the dominant factors in the development of a special situation and its transition to a catastrophic one.
- It should be noted separately that the release of interceptors in manual mode after
landing could have prevented further development of the special situation. The remaining
The runway length allowed for the safe completion of the runway. The flight analysis conducted by JSC
Tupolev 12.02.13 on the Tu-204SM aircraft, with initial data similar to
the emergency flight (weight, center of gravity, landing speed) showed that if the crew
in an emergency flight, even after the first unsuccessful attempt to engage the reverser and
the current speed of 250 km/h released the interceptors manually, while the engines were running
in the MG mode, he would be guaranteed to be able to stop the aircraft within the runway.

In this case, the actual length of the run would be 800...850 m (with the available the remaining runway length at that time was approximately 1200 m).

- One of the major causes of disaster is unintentional exit engines at increased forward thrust speeds when using the power steering levers. It should note that the fact of the unauthorized exit of both engines to the direct thrust mode is not was recognized by the crew, and the subsequent increase in speed during the run turned out to be crew unexpected. In the current situation: under conditions of time constraints, the remaining the length of the runway and the sharply increased psychophysiological load, the crew was unable to take action appropriate measures to prevent the situation from becoming catastrophic.

- When analyzing the negotiations, it was noted that the crew did not comply with the prescribed procedures. During the descent and final approach, the crew did not The control chart "At a distance of 20..25 km from the runway threshold" was completed. When performing checklists after the release of the mechanization, the crew conducts a cross-check check with a formalized report on the release of the chassis, flaps, and retraction interceptors, current flight speed and angle of attack. When performing the control chart "Before landing" check (after releasing the flaps to the 37° position) check not carried out on all points (there is no control over the retracted position of the interceptors), not all crew members responded in the established order (no response from the PIC and 2nd pilot to control the released position of the chassis and flaps in the landing position).

- Deviations from the prescribed standard procedures, including at the landing stage, could have been identified in advance during the analysis of flights by the relevant services in the airline.

Comparative analysis of the recommendations of the flight manual of the Tu-204-100V aircraft performing landing procedures with similar sections of FCOM/QRH individual Western-made aircraft.

Analysis of the recommendations of the flight manual for the TU-204-100V aircraft in comparison with similar ones FCOM/QRH sections Boeing-747/757/767/777, A-318/319,/320/321, Falcon-7X, CRJ-900 showed that, despite the differences in design solutions, the procedure for The operation of the reverser and interceptors differs slightly. Thus, the translation of the RUR into the position of the reverser after contact and control of the output of the interceptors is recommended on Falcon-7X and Airbus-320 aircraft (on the A-320 aircraft, it is permitted to set the power steering levers to the MAXIMUM REVERSE position immediately after landing).

Engaging the reverser after releasing the interceptors is recommended on aircraft Boeing and CRJ 900. Increasing the thrust of the reverser only after the reverser reaches the minimum mode (reverse shift occurred) is recommended on Tu-204, Falcon-7X aircraft,

Boeing 747/757/767/777, CRJ-900. Section of reverser failures on landing with increase
There are no revolutions on direct thrust in any of the FCOM/QRH compared aircraft, because
The design of the reverse control systems, when properly adjusted, eliminates
the possibility of increasing the direct thrust mode above the "low throttle" mode at
unshifted flaps of the reversing device.

As a result of the analysis, the following conclusions can be drawn:

1. The recommendations of the flight manual for the Tu-204/214 family of aircraft are generally similar
FCOM recommendations for similar aircraft.

2. The existing differences in the crew's actions are caused mainly by differences in
design and operational limitations of individual systems, as well as three-member
by the crew of Tu-204/214 aircraft.

3. The flight manual for Tu-204/214 aircraft has **more detailed recommendations on execution of the run**. A significant difference is the indication on the aircraft
Tu-204/214 on **forced manual release of interceptors** in their absence
automatic release. On Tu-204/214 aircraft, activation and activation control
a small reversal of engines is required to be performed before checking the release of interceptors
or releasing them manually. In practice, these two important actions are performed almost
simultaneously after landing at the initial stage of the run.

Note: *In the Flight Crew Training Manual - FLIGHT CREW TRAINING*

*MANUAL (FCTM) of the BOEING family of aircraft, in great detail,
the technique and practical justification for the implementation of these or
other provisions of FCOM, including during landing and take-off.*

*For example, in the FCTM of the Boeing 757/767 aircraft in section b
«SPEEDBRAKES» said:*

*- Releasing interceptors and air brakes on landing reduces
lift force on the wing and redistributes the weight of the aircraft onto the struts
chassis, providing the best braking effect.*

*- Until the interceptors are deployed after landing, the effectiveness
wheel brakes can be reduced to 60% at the beginning because
only a small part of the weight of the plane is on the wheels and
Applying the brakes may cause the wheels to slip.*

*- Usually the interceptors are released automatically. **Both pilots
must monitor the release of interceptors after landing and
in case of failure of automatic release they must be***

released manually immediately. Position awareness interceptors are very important to prevent an increase length of the run. The position of the interceptors should be reported on stage landing pilot carrying out control piloting. This improves understanding in crew and develops a good skill that can prevent the consequences of a system failure or malfunction release of air brakes.

Recommendations for using the thrust reverser are given in the same In the manual, in the REVERSE THRUST OPERATION subsection. Thus, the emphasis is on training pilots in practicing procedures for using interceptors and reversers when training and coaching of crews. It should be noted that There is no similar FCTM methodological guide for Tu-204.

4. It is necessary to draw the attention of the Tu-204/214 crews to strict compliance recommendations of the Flight Manual regarding the use of reverser and the release of interceptors during landing, conduct classes and practice the necessary procedures on the simulator.

5. Representatives of the aircraft developer, together with test pilots and line pilots, conduct an additional feasibility assessment Recommendations set out in temporary amendment No. 33 to the Flight Manual for Tu-204 aircraft (change in the crew's procedure for landing), and make an appropriate decision.

1.18.3 Flight Safety Management System at Red Wings Airlines

According to the submitted documents, the management system The airline began implementing flight safety measures in July 2010. At the time the second version of the document, approved by the aviation accident, was in effect The General Director of the airline and approved by the Head of the OIBP MTU VT CR and the Head of the Safety Inspection Department of the Federal Air Transport Agency. An analysis of the contents of the Safety Inspection System showed that that the theoretical provisions contained in it basically correspond to similar ones provisions of ICAO standard documents. The style of presentation is generally adapted for perception by ordinary flight and engineering personnel.

The document revision (first revision number 0) was changed twice: in 2011 and in 2012, in both cases due to a change in the General Director airlines, while no other changes were made. Thus, the SMS

the airline did not reflect changes in the airline's operations that lead to the emergence of new or changes in existing risks.

The SMS also contains a practical part of flight safety management applicable to a specific fleet of airline aircraft. The SMS defines a number of risks, their quantitative assessment is given (distribution according to the risk matrix) and a task is set target level of security. At the same time, the Commission notes that the process the identification of possible risks does not fully comply with management principles flight safety. Thus, the list of risks included only events that had already occurred place in operation (retroactive approach). Proactive and predictive approach The airline did not apply the definition and classification of risks. Moreover, all Certain risks relate only to events that occurred in 2009, after This list of risks has not been updated.

In a statement by the airline's management on the principles and policies for ensuring flight safety notes that it is necessary to conduct at least twice a year special discussions with staff to identify structural flaws in their activities divisions of factors affecting flight safety, and at least once a month to submit recommendations and Risk mitigation methods. Quarterly at Security Council meetings flights were to discuss the measures taken to improve flight safety and make decisions on conducting necessary additional measures. These SMS provisions were not implemented by the airline.

According to the SMS, each structural division of the airline must to identify and assess existing and potential hazards and associated risks, draw up risk maps and develop recommendations for their reduction. These risk maps must be sent with a delivery confirmation to the airline's flight safety inspection, which, after summarizing, should provide a summary document to the airline's Flight Safety Council. This The airline's SMS provisions were also not implemented.

In quantitatively assessing the risks, the airline applied a standard an approach that breaks down risks by frequency (in airline terms, event category) and severity (in airline terms – event class) of the consequences. There are five in total classes (from 1 (least severity of consequences) to 5) and categories (from A (most rare event) to E). Thus, the risk matrix consists of 25 cells, each cell an alphanumeric code is assigned, consisting of the corresponding class and categories, as well as a conventional number that determines the resulting degree of risk (from

1 (lowest risk in terms of frequency-severity of consequences) to 25). Depending on various corrective measures are provided for the resulting degree of risk, up to the involvement of the airline's management in solving problems.

It should be noted that the breakdown of actual risks by class (severity consequences) was carried out on the basis of the airline's assessment of the degree of danger, arising from the actual implementation of risks, from class 1: potential events, not affecting flight safety, but which may lead to the development of events affecting flight safety⁵ up to class 5: events leading to catastrophic situation. In this case, class 1, that is, events that do not affect flight safety, deviations and comments in piloting techniques were attributed, not related to aviation incidents.

For example, in the existing risk map in the SMS, the risk of exceeding the specified approach speed is assessed as 1C3, that is, belonging to class 1 (not affecting flight safety⁶), category C (frequency of more than one event per annual value of the fleet's flight hours, but less than one event per 1/10 of the annual flight hours)⁷, with a resulting risk level of 3 and the required impact: monitoring, management for further improvement. Risk of non-compliance with the order inclusion of a reversing device on landing in the airline's risk map absent.

The analysis showed that the speed limit was exceeded by more than 15 km/h compared to the recommended flight manual. the landing approach speed was allowed by the airline crews in 90% of flights, then in terms of the airline's SMS, this risk should have been categorized as E. The minimum resulting risk level for category E is 5 units. (for a class 1 event). For this resulting risk level, the following is provided: conducting an investigation of the event, discussing it, monitoring and managing it. The events in question were not investigated by the airline, and therefore no measures were taken. no action was taken to prevent them.

Thus, the shortcomings of the SMS associated with incorrect quantitative assessment of the resulting degree of danger of the risk associated with exceeding the specified approach speeds, as well as failure to take into account the risk of crews violating the rules turning on the reverse thrust during landing (more than 30% of landings by airline crews and

⁵ This is written in the SMS.

⁶ The justification for setting such a low level of risk is questionable.

⁷ The airline's actual flight hours for 2012 amounted to 17,686. Thus, the specified range is 17686-1768.6.

(About 50% of the PIC landings were carried out with deviations from established procedures) did not allow the said deviations to be identified in a timely manner and prevented aviation accident.

The airline's SMS requires improvement. The aforementioned deficiencies were facilitated by the absence in the Russian Federation of a procedure for the development and application of a standardized standardized management system (SMS) operators, as well as the procedure for collecting and analyzing data on risk factors that create flight safety conditions⁸. The airline's revised documents must be reviewed and approved by Rosaviatsia.

1.18.4 Activities to improve flight safety, conducted by the developers of the aircraft and engine in during the investigation into the crash of the Tu-204-100 RA-64047 aircraft

A temporary change to the flight manual for Tu-204/214 aircraft has been issued, emphasizing attention to the procedure for performing the actions prescribed by the flight manual by the crew members, in part release of interceptors during landing.

A series of meetings was held with the flight crews of airlines operating Tu-204/214 aircraft, with the participation of test pilots from Tupolev JSC and the Flight Research Institute named after Gromov with the aim of analyzing and explaining the features of the completed landing and the order of performing the actions prescribed by the RLE.

Flight experiments were conducted, confirming the adequacy of the recommendations of the flight manual to safely complete a flight under conditions similar to those that led to the disaster.

In order to ensure guaranteed operability of the end

Changes have been made to the design documentation for switches in order to improve the reliability and electrical performance of the aircraft, tightening the frequency of inspection and maintenance of end mechanisms switches for controlling the position of the landing gear during the winter period.

Changes have been introduced to the aircraft and engine ED, harmonizing these documents in parts of the numerical values of the power plant control system adjustments, as well as establishing additional checks of the state of the control mechanism and engine reversing device locks.

⁸ On December 25, 2012, Federal Law No. 260-FZ "On Amendments to the Air Code of the Russian Federation" was signed (effective September 23, 2013). These amendments stipulate that the implementation of the state flight safety management system for civil aircraft in the Russian Federation is carried out in accordance with international ICAO standards. The Government of the Russian Federation establishes the procedure for the development and implementation of flight safety management systems. The authorized body in the field of civil aviation, in accordance with the procedure established by the Government of the Russian Federation, collects and analyzes data on hazards and risks that pose a threat to flight safety.

Changes have been introduced to the production documentation of JSC KAPO named after S.P. Gorbunov" and JSC "Aviastar-SP", establishing additional checks the state of the control mechanism and the engine reversing device lock.

JSC Aviadvigatel developed and implemented on the entire operating fleet engines, measures to increase the rigidity of the control and locking mechanism reversing device.

1.18.5 A serious incident occurred on December 20, 2012, at Tolmachevo Airport.

On December 20, 2012, during flight WZ-123 on the Moscow-Novosibirsk route a serious incident occurred with the Tu-204-B RA-64049 aircraft of the Red Airlines Wings". After landing, the plane used up the entire length of the runway and rolled beyond its limits. 300 meters, while receiving damage to the tires of seven wheels of the main landing gear with melting of thermal witnesses, damage to the brakes of the wheels of the main landing gear and lower panel of the wing fairing.

According to the conclusion of the Commission of the West Siberian Interregional Territorial Administration of the Federal Air Transport Agency for Investigation this incident, the aircraft rolling off the runway was a consequence technical failures of aircraft systems and incorrect actions of the crew. Technical aircraft system failures:

- failure of the limit switch drive VKP-V322 for compression of the left shock absorber main landing gear, which resulted in the failure of the reversing devices of both engines and failure to release interceptors and air brakes in automatic mode;
- the right engine reaches a mode close to the nominal one, with the creation of corresponding direct thrust with the reversing device and RUR not engaged maximum reverse position;
- delay (up to 2 minutes) in the appearance of brake pressure in the rear pair of wheels left main landing gear when the main and backup braking subsystems are operating.

Incorrect actions of the crew:

- failure to use the manual mode for releasing interceptors;
- maintaining the maximum reverse mode until the end of the run if available signs of its non-inclusion;
- failure to determine the fact that the right engine has reached speeds close to nominal mode on direct thrust, with the reverse not engaged.

2. Analysis

The flight of the Tu-204-100B RA-64047 aircraft on December 29, 2012 was carried out along the route:

Vnukovo Airport (Russian Federation) – Pardubice Airport (Czech Republic) – Vnukovo Airport (Russian Federation).

2.1 Flight to Pardubice Airport.

Takeoff from Vnukovo Airport was at 06:59:45. Flight to Pardubice Airport. was carried out at an altitude of 10,400 m, at 08:39:30 the crew began to descend for landing approach. Climb, fly at flight level, and descend were performed automatically.

The landing approach was also carried out in automatic mode, piloting

The captain was in charge, and radio communication was conducted by the second pilot. An analysis of the crew's communications showed that the second pilot experienced constant difficulties in conducting radio communications in English.

Before entering the glide path, the aircraft was in the landing configuration:

flap position – 37, slats – 23 ° the chassis were in the released position position, the APU was engaged. The aircraft's landing weight was 85.8 tons, the center of gravity – 24%, which did not exceed the limits established by the flight manual of the Tu-204-100V aircraft.

The PIC was actively piloting the aircraft during landing. Glide path descent was carried out automatically without significant deviations, the specified The indicated airspeed was 255 km/h. Analysis of cockpit communications indicates that the given speed was close to the speed that was planned withstand: KVS: *"We will withstand 250"*, 2P: *"Two hundred forty, two hundred fifty"*. For a landing weight of 85.8 tons and a flap position of 37, the recommended speed according to the flight manual is The landing approach speed is 236 km/h (approach in turbulent conditions – 246 km/h). The change in the vertical overload record ($\pm 0.05g$) during flight along the glide path shows, that there was practically no turbulence. Thus, the set and maintained speed on the glide path, the values recommended by the flight manual were exceeded.

After the report *"(100 meters)"* the PIC command was recorded: *"Landing."* At an altitude of about 60 meters, the A/P9 and AT were switched off. From an altitude of about 20 meters, the PIC began increase the pitch angle to level the aircraft before touching the runway. At altitude 12...15 m the indicated airspeed was ~270 km/h, which was significantly higher RLE recommendations.

⁹ In this report, the terms A/P and VSUP, as well as AT and VSUT, are used as synonyms to denote the autopilot and autothrottle, respectively.

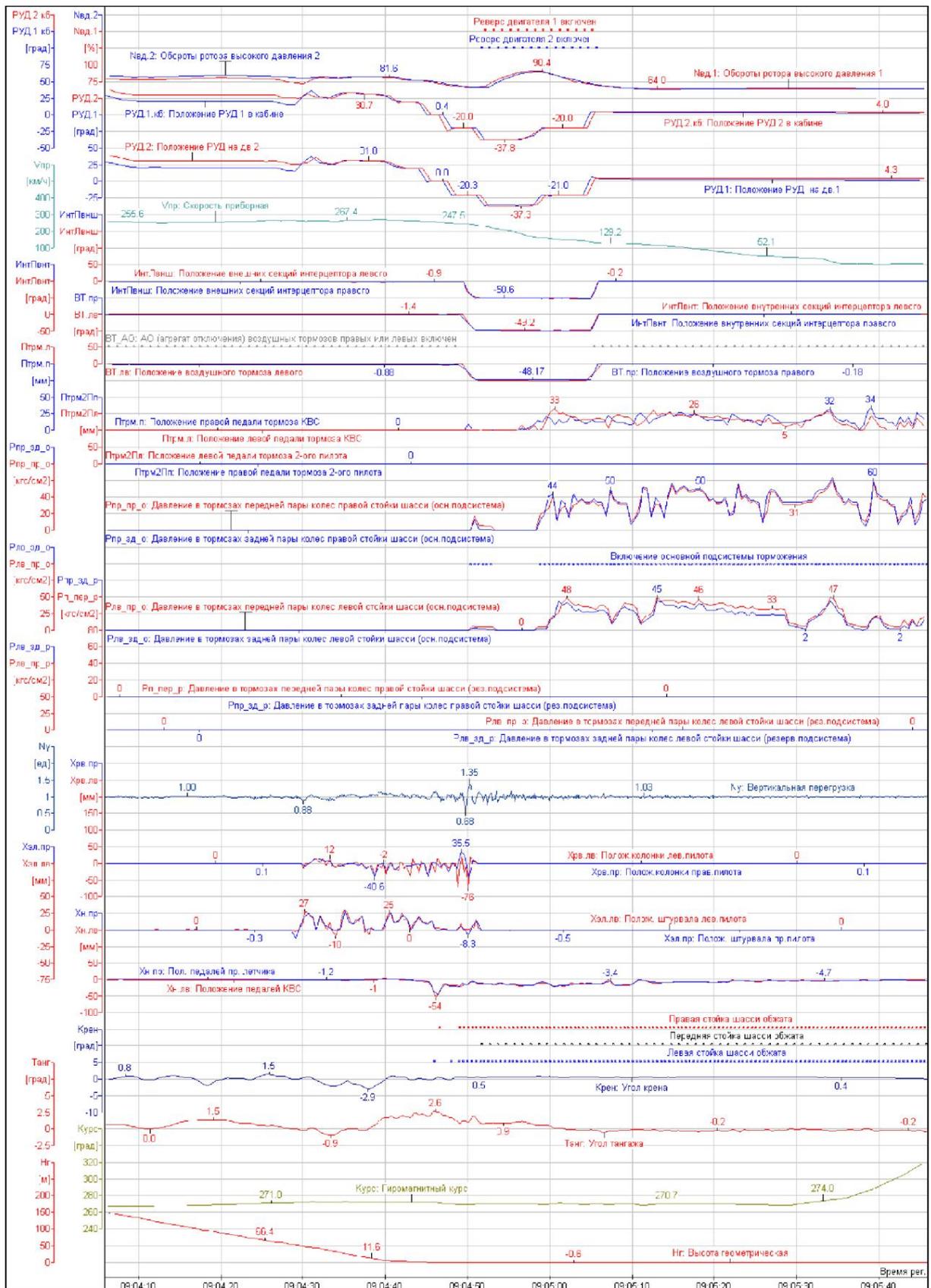


Fig. 8. Flight parameters of the Tu-204-100V RA-64047 aircraft on 12/29/2012 (landing at a/p Pardubice).

The plane landed at 09:04:46, at a speed of ~255 km/h, at an angle pitch angle of ~2.5°, practically without roll (Fig. 8). Vertical overload at the moment

landing was ~1.12 units. According to the registered information, at the first upon contact, a short-term and non-simultaneous compression of the main landing gear occurred, after which the plane separated from the runway, as evidenced by the disappearance of one-time commands compression of the main landing gear. From this point on, the PIC began to decrease the angle pitch and moved the RUR to the intermediate stop (small reverser position). 3 seconds later, the main landing gear was re-compressed and released automatically. interceptors and air brakes. The control stick is pushed away from you and practically the simultaneous release of interceptors and air brakes led to a sufficient hard impact with the runway of the front landing gear (the maximum recorded vertical overload was 1.43 units)¹⁰, which was clearly unexpected for the PIC (about This is evidenced by the fact that the captain at that moment briefly pressed the brakes pedals, as well as his phrase *"Fuck yours"*, recorded almost simultaneously with (report of the B/I on the release of interceptors). In accordance with the distribution of responsibilities in the crew during landing, B/I checked and reported on the inclusion reverse and release of interceptors: *"Reverse", "(On)", "Interceptors released!"* 3 seconds after re-landing, almost simultaneously with the descent front landing gear and the appearance of the "Reverse on" signal, engine power steering were moved to the maximum reverse position. After the PIC reverser was engaged, applied the wheel brakes from the pedals and further movement and braking of the aircraft were of a routine nature.

2.2 Description of the flight Pardubice Airport – Vnukovo Airport and analysis of aircraft movement.

Before the flight on the route Pardubice Airport – Vnukovo Airport on board The plane had 8 crew members, no passengers or cargo. The takeoff weight of the plane amounted to 75.8 tons, the center of gravity was 26% (according to the on-board registration system), which is not exceeded the limits established by the flight manual for the Tu-204-100V aircraft.

The takeoff from Pardubice Airport was carried out at 10:06:36. The takeoff was carried out from with the autothrottle engaged. After takeoff, at an altitude of about 560 m, turning on the VSUP, at the initial stage of climb the crew used the mode combined control, then the "Horizontal navigation" mode was activated. In During the climb, the crew used the "Exit to the specified altitude" operating modes of the aircraft echelon" and "Stabilization and control Vy" in the longitudinal channel, in the lateral channel The "Horizontal navigation" mode was used.

¹⁰ The fact that the front landing gear strut was lowered rather roughly is also confirmed by the video recording, made by one of the passengers in the aircraft cabin during landing.

Note: *Automatic controls may be used when gaining flight altitude.*

modes and manual control in any combination (aircraft flight manual)

Tu-204-100V, p.4.3.1.(4)).

Minimum altitude for activating automatic modes

"Combined control", "Altitude stabilization", "Horizontal

navigation" is 120 m, the modes "Exit to the specified flight level" and

"Vertical speed" – 400 m (aircraft manual of the Tu-204-100V aircraft,

clause 8.16.1.2).

At 10:21:18 the aircraft reached flight level 330 (~10,100 m). The flight at this level took place in automatic mode. In the longitudinal channel, the "Altitude Stabilization" mode was performed, 10 minutes after reaching the flight level in the lateral channel, the crew briefly I activated the "Set Course Angle" mode and then used the "Horizontal" mode. navigation." The AT operated in speed stabilization mode during flight at cruising altitude. (the set speed was 505 km/h). Analysis of the recorded information allows conclude that the flight at the flight level was normal, in automatic mode, with maintaining the specified parameters (altitude and speed).

At 11:46:55 the crew contacted the Moscow-Control dispatcher:

"Moscow-Control, good afternoon Red Wings 9268, MOSON, flight level 330, to Vnukovo."

The controller gave permission to continue the flight at flight level 330, and after additional request, transmitted information about the runway for landing:

"Nineteenth." The crew acknowledged receipt of the information. During the flight

2P maintained radio contact with the dispatcher.

At 11:51:43 the onboard tape recorder recorded the PIC's command to carry out pre-landing preparation: *"We are starting pre-landing preparation"*, after which the on-board tape recorder records the listening of information for 20 seconds ATIS. However, the ATIS information was not fully listened to.

At 11:56:31 the PIC informed the crew: *"Let's listen to the information:*

The weather on the main and backup is above minimum, we will be entering Vnukovo on the 19th strip, 194 degrees, in director mode, with flaps extended to... 37

degrees, our minimum is 60 to 550, reserve 120 to a thousand. Landing weight is 67 tons,

center of gravity 25, calculated on the glide path 210, we will maintain 230. In case of departure

on the second circle in a straight line uh one hundred and fifty... uh, 150 meters to the left, course 162 degrees from dial 600 for OSTIS, then proceed to the waiting area according to the instructions

The dispatcher is making a retry; we'll use the alternate route to Domodedovo. What are the specifics?

below a hundred the speed is no more than two hundred and fifty, vertical no more than 15 meters in "One second. We're transitioning... RV 60... 60th echelon."

Subsequently, the PIC informed the crew about the distribution of responsibilities during performing the landing and gave the command to carry out the checklist:

"Transition 60, on landing we will use small and large reverse, braking at a speed of 180 kilometers per hour or less, release after landing left on the nearest one. Piloting, reverse, braking on the left, communication on the right, pressure at landing airfield 986, control by map."

According to the reports of the PIC and the B/I: the approach pattern for runway 19 was prepared, The ILS frequency of 111.5 MHz and the decision height of 60 m were established. It was also The aircraft's braking system was checked for proper operation.

After the controller's permission: *"Red Wings 92-68 descend to flight level 2-9-0"*, At 12:03:34 the descent from flight level began. At the initial stage the crew used "Vy Stabilization and Control" mode in the longitudinal channel, in the lateral channel the "Horizontal navigation" mode continued to be executed (Fig. 9).

After the descent began, on command from the PIC, the 2nd pilot listened to the ATIS information. "FOXTROT". The ATIS information contained the following weather data for the area destination airfield: *"...normative friction 0-5... Weather: ground wind 270 6 degrees, gusts 12, circle 260 degrees 15, visibility more than 10 kilometers..."*.

The controller gradually gave permission to descend to levels 270, 250, 230. The descent was carried out automatically with a vertical speed -5...-10 m/s, which corresponded to the specified one. The maximum recorded The indicated airspeed during descent was ~475 km/h (Fig. 9).

At 12:10:20 the crew contacted the Moscow-Approach 127.2 dispatcher: *"Moscow - Control, good afternoon, Red Wings 92-68 have passed Gagarin, we are descending to flight level 230, in Vnukovo"* (2P called the dispatcher incorrectly - instead of *"Moscow-Approach"* he called *"Moscow-Control"*). The controller gave the order to maintain flight level 230, the crew confirmed receiving information. When approaching the designated altitude (~7000 m), the crew used The aircraft operating mode was "Altitude Stabilization". The flight then proceeded at an altitude of 7000 m with instrument airspeed of 430...440 km/h.

Note: *Automatic and manual modes can be used in the reduction*

control in any combination (aircraft manual of the Tu-204-100V aircraft, clause 4.5.1.(3)).

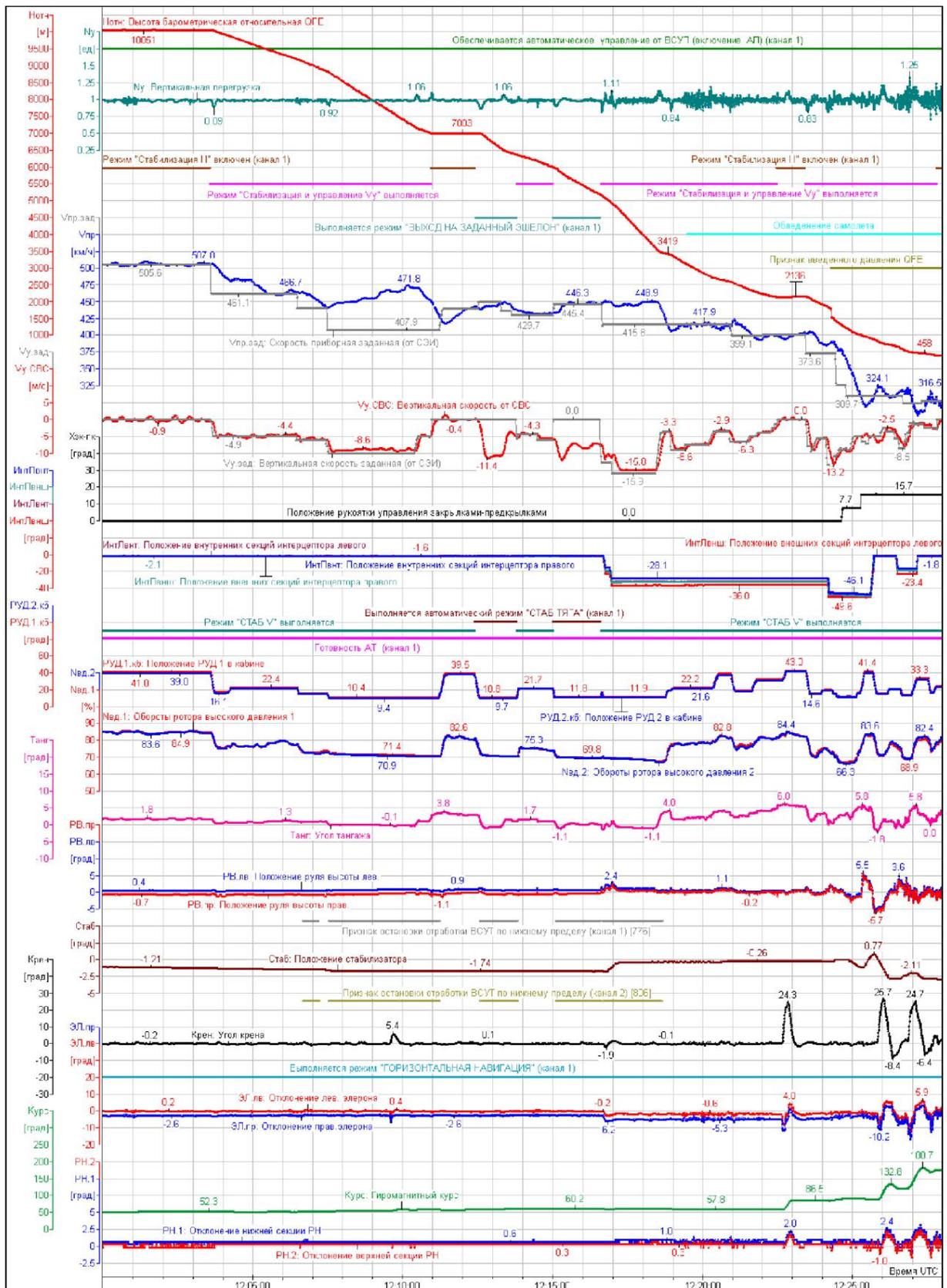


Fig. 9. Flight parameters of the Tu-204-100V RA-64047 aircraft on 12/29/2012 (decrease in Vnukovo airport).

At 12:12:18 the controller gave permission for further descent: "Red Wings 92-68, descend to level 200." To carry out the descent, the crew engaged the "Exit" mode .

to the specified flight level" in the longitudinal channel. Immediately after the start of the descent, when transferring RUD to the idle position, a drop in air flow in SVC 2 to 1270 kg/h was recorded (air flow in SVC 1 remained at the level of 2360...2380 kg/h)¹¹ .

45 seconds after the drop in air flow in SVC 2, its shutdown was registered, and further reduction was carried out only with the operating SCR 1.

At 12:13:47, at an altitude of about 6,300 m, the dispatcher, after coordinating with the crew, determined the arrival pattern of Ivanovskoye 19 Alpha:

D: *"Red Wings 92-68, can you come to Ivanovskoye 19 Alpha?"*

2P: *"Yes, we can, Red Wings 9268."*

D: *"Red Wings 92-68, descend, flight level 1-8-0."*

2P: *"Down 1-8-0, Red Wings 92-68."*

During the descent, the Moscow-Approach 127.2 dispatcher consistently gave instructions to descend to levels 180, 160, 130, 120, after which he transferred the crew under control of the Moscow-Approach 122.7 dispatcher. The descent was carried out in automatic mode, during the descent the crew used the "Exit to specified flight level" and "Stabilization and control Vy" in the longitudinal channel, in the lateral The channel was in the "Horizontal Navigation" mode. The crew followed instructions dispatcher, the flight was carried out without deviations from the route. The descent was carried out with a vertical speed of -7...-11 m/s, the indicated airspeed was about 440 km/h. For Interceptors were used to slow down during the descent.

At 12:17:36 the crew contacted the Moscow-Approach 122.7 dispatcher:

"Moscow-Approach, good afternoon, Red Wings 92-68, descending to flight level 120, Ivanovskoye (19)". The controller confirmed the arrival pattern and gave permission for further descent: *"Red Wings 92-68, Moscow-Approach, good afternoon, Ivanovskoye 19 Alpha, descend "Level 1-1-0".* The crew confirmed receipt of the information.

At this stage the descent was carried out with a vertical speed of about -15 m/s, the indicated airspeed was ~445 km/h. The flight was carried out in automatic mode. mode, in the longitudinal channel the "Stabilization and control Vy" mode was performed, in side – "Horizontal navigation" mode. Registered vertical the rate of descent corresponded to the set one, the descent was carried out in accordance with the dispatcher's instructions.

When approaching an altitude of 3400 m (FL 110), the crew reduced the vertical speed up to -3...-4 m/s. At 12:18:37 the controller cleared the aircraft to descend to flight level

¹¹ An analysis of the reasons for the drop in air pressure is given in section 2.3.

80: *"Red Wings 92-68, descend, flight level 8-0."* Receipt of information confirmed

PIC: *"We are descending, Red Wings 92-68"* (up to this point, 2P was in charge of external radio communication).

After receiving the controller's permission, the descent was carried out with a vertical at a speed of -7...-8 m/s, the specified instrument speed was 416 km/h.

Starting from an altitude of 3100 m, the descent was carried out in icing conditions, as evidenced by is evidenced by the appearance at 12:19:30 of a one-time command "Icing of aircraft" (Fig. 9), and also recorded speech information. Approximately one minute before When the icing alarm was triggered, the activation of the engine anti-icing system was registered.

At 12:20:15, at an altitude of 2760 m, the launch of the APU was registered. After the launch and exit The Armed Forces of Ukraine (VSU) registered the activation of the SVC 2 and the switching of the selection at 12:23:05 air in the air handling unit from the engines to the APU.

At 12:21:28 the crew listened to the ATIS information "HOTEL". ATIS information contained the following weather data in the area of the destination airfield: *"Vnukovo - ATIS, information HOTEL 12-18, ILS approach, runway 19, wet, patchy dry snow 2 millimeters, standard adhesion 0-5, transition level 0-6-0, ARD apron snowy, slippery, drive carefully, Charlie 8 is closed, in the airfield area and Flocks of birds are possible on the landing approach. Weather: ground wind 260 degrees 8, gusts 16, circle - 260 degrees 16, visibility more than 10 kilometers, light snow, significant 740, temperature minus 2, dew point minus 7, pressure 7-4-0 millimeters, 9-8-7 hectopascals. Warning: moderate icing, layer from altitude 600 to altitude 900, moderate turbulence on the landing straight without significant changes."*

At 12:22:02 the crew received instructions from the controller to maintain flight level 07 and reduce speed up to 210 knots. At this moment, the aircraft was at a distance of about 39 km from runway 19 threshold and proceeded to the Ivanovskoye point. At 12:22:29 the crew activated the "Altitude stabilization" in the longitudinal channel, the specified altitude was 2130 m, indicated airspeed - 400 km/h (216 knots). Thus, the crew followed the instructions dispatcher, the flight was carried out in accordance with the arrival scheme (Fig. 10). while following at a constant altitude, a right turn was performed with a bank up to 24° (right bank), which was completed at 12:23:08. After completing the turn, the flight passed with a magnetic track angle of ~90°.

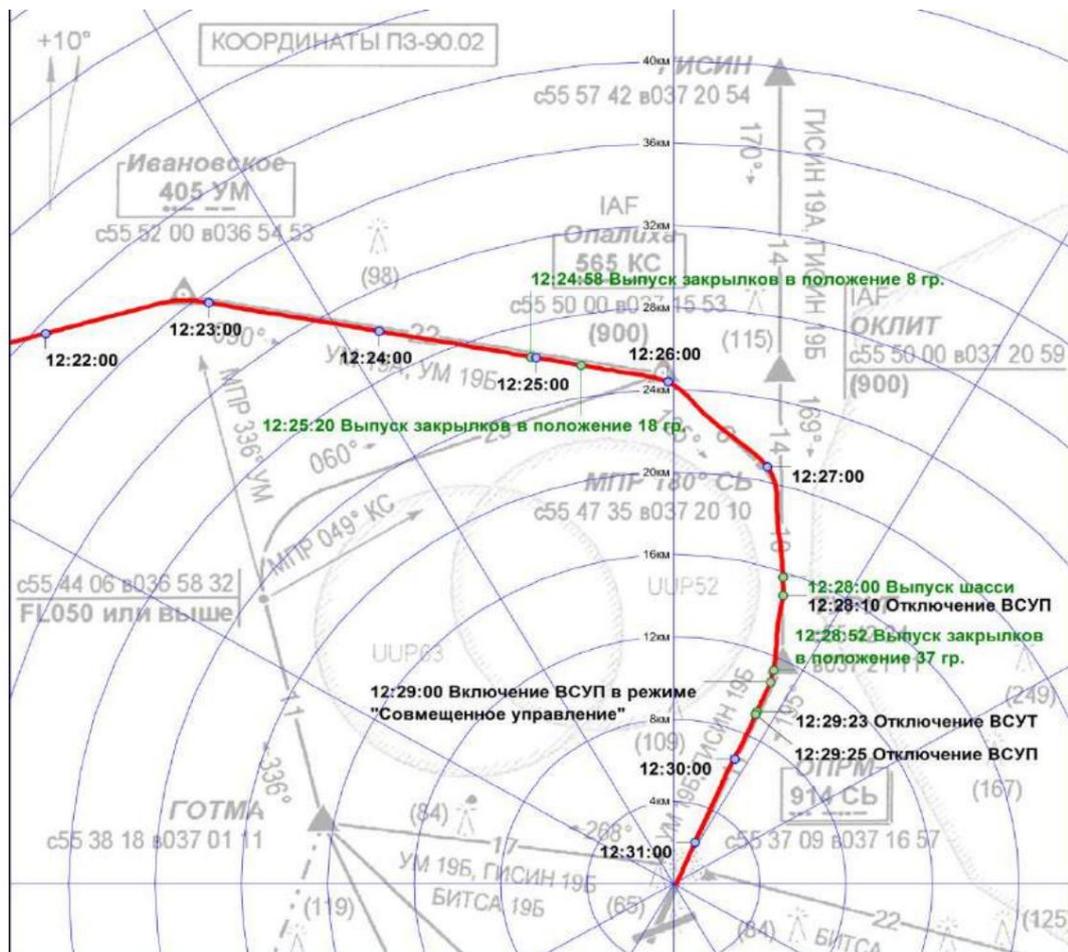


Fig. 10. Flight trajectory of the Tu-204-100B RA-64047 aircraft on December 29, 2012. Final landing approach phase at Vnukovo Airport.

At 12:23:19 the controller gave the crew permission to continue the descent: "Red Wings 92-68, descend to flight level 6-0, proceed to Vnukovo-Krug, 126 comma 0." Crew confirmed receipt of the information, and the further flight was carried out under the control of Vnukovo-Krug dispatcher. At 12:23:43, the co-pilot contacted the dispatcher: "Vnukovo-Krug, good afternoon, Red Wings 92-68, descending flight level 6-0, information PAPA." The information from the ATIS "RARA" was listened to by the crew during departure from Vnukovo Airport, At the time of landing, the crew had to be guided by information ATIS "HOTEL" for 12:18 (as noted above, the crew received this information (I heard). The Vnukovo-Krug dispatcher paid attention to the discrepancy in the ATIS information. did not pay attention and at 12:23:52 he allowed the descent to an altitude of 900 m: "Red Wings 92-68, Vnukovo-Circle, hello, Ivanovskoye 19 Anna, according to the pressure 9-8-7, decrease to 900." For to carry out a further descent, the crew activated the "Stabilization and Vy control", the side channel still used the "Horizontal" mode navigation" (Fig. 9). The descent was carried out with vertical speeds of -9...-12 m/s, The indicated airspeed was about 390 km/h.

At 12:24:17 the QFE pressure setting of the landing airfield was recorded. The set pressure of 987 hPa corresponded to that transmitted by the dispatcher and ATIS HOTEL information. At the same time, a change in the specified speeds up to 326 km/h (the flight was carried out with the VSUT turned on in automatic mode) and additional extension of the interceptors to the 50° position (fully extended). The flight took place in accordance with the arrival pattern (Fig. 10). At 12:24:58, on the command of the PIC, the flaps were released to the 8° position. At the moment the mechanization begins to release, the airspeed was 373 km/h, flight altitude – 1280 m. During the process of releasing the flaps, the specified instrument The speed was reduced to 310 km/h. After the flaps were released, the onboard tape recorder The completion of the control check card "After the transition to pressure" was registered airfield." The checklist was completed in full, and the crew had no comments¹². The crew once again determined the landing position of the flaps to be 37°, planned glide path speed is 230 km/h.

PIC: *"Map control."*

B/I: *"Altimeters".*

PIC: *"On the left 987, 1250, 987, 1250, the readings are the same."*

2P: *"9-8-7 established."*

B/I: *"Landing data: mass sixty... five..., sixty-six tons, fuel (inaudible), third tank (empty)."*

2P: *"Sixty-five... sixty-six tons."*

PIC: *"Flaps 18."*

B/I: *"Centering 25 and 5".*

2P: *"18".*

2P: *"(Speed/Set)"*

B/I: *"Speed with flaps 37".*

PIC: *"We will... we will hold out, this very same two hundred and thirty."*

At the moment of releasing the flaps to the 18° position, the aircraft was at a distance about 25 km from the end of runway 19 (Fig. 10), the flight altitude was 980 m, instrument speed – ~305 km/h.

Starting from 12:25:00 the MSRP system started to register a one-time command "Control of the course zone in the lateral channel in LANDING mode has been prepared." the text KUR ZON in blue should have appeared in the cockpit on the control panel, after which

¹² During the execution of the checklist, the flaps were extended to 18°.

the crew had to turn on the LANDING mode on the left and right PU SEI to call landing indication, including indicators of deviation from the equisignal zone.

At 12:25:22 2P reported to the controller: "*Red Wings 92-68, transition level, pressure 9-8-7 established, descending (900)*". The controller gave permission to carry out the approach to in accordance with the scheme and to maintain speeds at the discretion of the crew. The crew confirmed receipt of the information. At 12:25:50, at an altitude of ~820 m, it was registered performing a right turn with an exit to a magnetic course angle of ~120°. Flight took place automatically in accordance with the entry pattern.

At 12:26:51, a right turn was initiated with a bank angle of up to 24° (right roll), which was completed at 12:27:36 with an exit to a magnetic course angle of ~170°.

During the turn, the onboard recorder recorded the following report:

"(Can't reduce), don't reduce speed, 280." The report sparked a strong reaction .

PIC: *"Quiet!", "Fuck!"* Before the turn, the set speed was

reduced from 310 km/h to 300 km/h, the interceptors were released to the 25° position.

Following the B/I report, the interceptors were retracted. It should be noted that

The VSUT has a certain delay when operating in automatic mode. Analysis

the registered information indicates that upon reaching the specified

the speed has increased the operating mode of the engines, however, in the current situation

situation, the AT was unable to maintain the parameters specified by the crew, and the indicated airspeed

briefly decreased to 280 km/h from the set 300 km/h. After exiting

the engines to a higher mode, the instrument airspeed increased, and after

After 20 seconds, it became consistent with the target. Over the next minute, the average

the indicated airspeed was 301 km/h with the target speed being 300 km/h, which indicates that

normal operation of the VSUT.

After completing the turn and reaching the magnetic course angle of ~170°, the mode the operation mode of the VSUP "Stabilization and control of Vy" was changed to the "Stabilization" mode

heights." The specified height was 400 m (corresponding to the height of the circle), the specified speed

– 300 km/h. The rest of the flight took place at an altitude of about 400 m, the indicated airspeed

was ~300 km/h, the interceptors were retracted, the flaps were in the 18° position.

At 12:27:55, the PIC's command was recorded: *"Release landing gear."* 2P confirmed.

Executing the command: *"Release the chassis."*

After 4-5 seconds, the dispatcher allowed the crew to continue the approach: *"Red Wings 2-68, approach to fourth, approach cleared, proceed with landing 118 comma 3."*

The crew confirmed receipt of the information.

"Landing" on the PU-56M (Fig. 11). At this time, the aircraft was approaching the fourth turn and was located at a distance of about 15 km from the end of runway 19, the angle of approach to the equisignal course line was $\sim 25^\circ$, the deviation from the equisignal zone course ~ 0.32 RGM (more than 2 points).

Immediately after the mode was turned on, the execution of the right (on landing course) turn with a bank angle of up to 15° . 7 seconds after the turn began The PIC switched off the VSUP and switched to manual piloting, the AT continued to operate in speed stabilization mode. After switching to manual control, performing a left turn with a bank of up to 12° and reaching a magnetic heading of $\sim 180^\circ$, i.e. with taking into account a drift of about 10° (due to a strong crosswind from the right), the flight continued according to the entry diagram (Fig. 10).

At 12:28:23 2P contacted the Vnukovo-Posadka dispatcher: *"Vnukovo-Landing, good afternoon, Red Wings 92-68, approaching the landing zone, 400 (meters).*

The controller informed the crew: *"Red Wings 9-2-6-8, Vnukovo - Landing, good day, distance 12, 200 meters to the right, landing to the right, 400 to the glide path."* To this at that moment the plane left the icing zone, as evidenced by the one-time command "Icing of the aircraft" was lost. The engine control system was turned off during the aircraft's descent along the glide path.

After contacting the controller, the crew reduced the specified indicated airspeed from 300 km/h to 249 km/h, and then released the flaps to the landing position of 37° . As in During the descent, during the landing approach, the PIC and 2P practically did not make any announcements changes in the operating modes of the VSUP and the set values of altitudes and speeds. At the moment the flaps were released into the landing position, the aircraft was at a distance of 11 km from the threshold of runway 19, the flight altitude was 390 m, the indicated airspeed – 262 km/h. The approach was carried out in director mode.

After the B/I reported on the release of the flaps, the on-board tape recorder The completion of the "Before Landing" checklist has been recorded.

At 12:28:56 the "Entering the course zone" mode was replaced by the "Entering the course zone" mode "Control is performed along the course zone in the roll channel in the Landing mode," which indicates that the aircraft is approaching the equisignal course zone. At this time the flight was carried out in the director mode, the left and right switches of the director indications on the VSUP control panel were turned on (Fig. 11).

At 12:28:58, the repeated activation of the VSUP in the "Combined" mode was registered. control" and the execution of a right turn with an exit to the landing course. Judging by registered information, the PIC allowed a descent to an altitude of 360 m and, having increased

pitch angle to 6...7°, stopped the descent and put the aircraft into a climb. After 5 seconds after the VSUP was turned on, a one-time command was lost "Control is performed along the course zone in the roll channel in the Landing mode," which may indicate that the "Landing" mode was turned off by the crew. At this point the plane was located at a distance of about 10 km from the threshold of runway 19. Further flight was carried out with a slight climb, with a course close to the landing course, the indicated airspeed was about 245 km/h (with a target of 249 km/h). The VSUP was operating in the combined control mode, VSUT – in the instrument airspeed stabilization mode. The approach was carried out in accordance with the plan.

At 12:29:22, while en route to the TVG, the shutdown of the VSUT (AT) was recorded. After 3 seconds, the B/I reported: *"Autothrottle off."* After 4 seconds after the shutdown of the air-supply system, the shutdown of the air-supply system was registered. At this moment, the aircraft was located at a distance of 8.5 km from the runway-19 threshold on the landing course, there was still a distance left to the TVG 1.1 km. At 12:29:29 (4 seconds after the VSUP was turned off), the crew again turned on the mode "Landing", as evidenced by the appearance of one-time commands "Exit to the zone is in progress course" and "Director control is provided by the VSUP", i.e. further flight was carried out in director mode with the automatic throttle disabled.

Note: *According to the diagram, the runway head for runway 19 is at an altitude of 400 m and at a distance of 7.4 km from the end of the strip.*

In an effort to maintain speed, the PIC constantly moved the throttle levers from the position idle throttle to 40...50° (Fig. 11). This type of throttle control was maintained almost to the point of alignment.

At 12:29:33 the dispatcher transmitted the following information to the crew: *"9-2-6-8, wind at The ground temperature is now 260 degrees 7, gusts 15, the strip is wet, 0.5."*

The descent along the glide path began at 12:29:32 at a distance of 7.5...7.6 km from the threshold. Runway 19. According to the recorded information, before entering the glide path, the aircraft was at an altitude of 430 m in landing configuration: flap position – 37 slats – 23 ° the landing gear was in the extended position, the APU was turned on. The PIC's decision altitude was set to 60 m. Landing the aircraft's mass was 67.5 tons, the center of gravity was 26.5%, which did not exceed the limits, installed flight controls of the Tu-204-100V aircraft.

The descent along the glide path was carried out in the director mode with the engine off. autothrottle. At the initial stage of descent along the glide path, the indicated airspeed was close to the speed of 230 km/h planned by the PIC. However, after the reports of 2P and B/I about

reducing the speed to 220 km/h (B/I: "230 speed", 2P: "Well, more speed", B/I: "220, 220 speed"), the PIC increased the indicated airspeed. At 12:29:57 Report No. B/I registered: "240".

During the descent, at 12:30:18 the appearance of one-time commands was registered "Glide path in progress" and "Glide path control in progress in the channel" pitch in the "Landing" mode, which indicates that the aircraft has entered the glide path.

While following the glide path, after the PIC's question: "*Landing... is cleared us?*" 2P requested permission from the controller to land: "*Red Wings 92-68, on glide path, ready for landing...*". The controller cleared the landing, and after confirmation from the crew, transmitted additional information about the weather conditions in Vnukovo Airport: "*92-68, surface wind 270 degrees 7, gusts 15.*"

By this time the flight altitude had decreased to 270 m, the indicated airspeed was 250 km/h, the aircraft was at a distance of about 4600 m from the threshold of runway 19 (Fig. 10). The descent was carried out with a vertical speed of about -4...-5 m/s, angle attack (true) was 1.4...1.6, the indicated air speed increased to 250...260 km/h.

Thus, the indicated approach speed in an emergency flight significantly exceeded the recommended flight manual: for a flight weight of 67.5 tons and position flaps 37 the recommended approach speed is 210 km/h (at approach in turbulent conditions – 220 km/h). Analysis of the recorded values vertical overload during flight along the glide path indicates the absence of in an emergency flight, turbulence is higher than weak.

After the report "*100 meters*" the captain commanded: "*Landing.*" Flyby The OPM was performed at 12:31:10 at an altitude of ~50 m relative to the runway threshold, with an instrument speed of 260...265 km/h. According to the approach pattern, the altitude of the OPRM flight is 65 m. The deviation from the glide path was approximately half a point according to the indicator on the KINO, the permissible deviation value is one point. The vertical rate of descent to this moment decreased to ~3 m/s.

Starting from the time 12:31:18 (from the height of about 30 m) the PIC began to smoothly increase the pitch angle to level the aircraft before touching the runway. At 12:31:21...22 the aircraft crossed the runway 19 entrance threshold at an altitude of 12...15 m and an indicated airspeed 260 km/h. After 9 seconds, the engine throttles were switched to idle mode, the angle pitch attitude increased to 2...3 of pitch-up. Despite the reduction in engine thrust and there was no increase in the aircraft landing pitch angle (Fig. 12). Due to the increased At this speed, the plane continued to fly over the runway, gradually losing altitude and speed. This is also confirmed by the crew's in-cabin communications - starting from 15 meters

the flight engineer kept track of the gradually decreasing flight altitude over the course of 14...15 seconds, while the flight from a height of 4 m to touchdown lasted about 10 seconds.

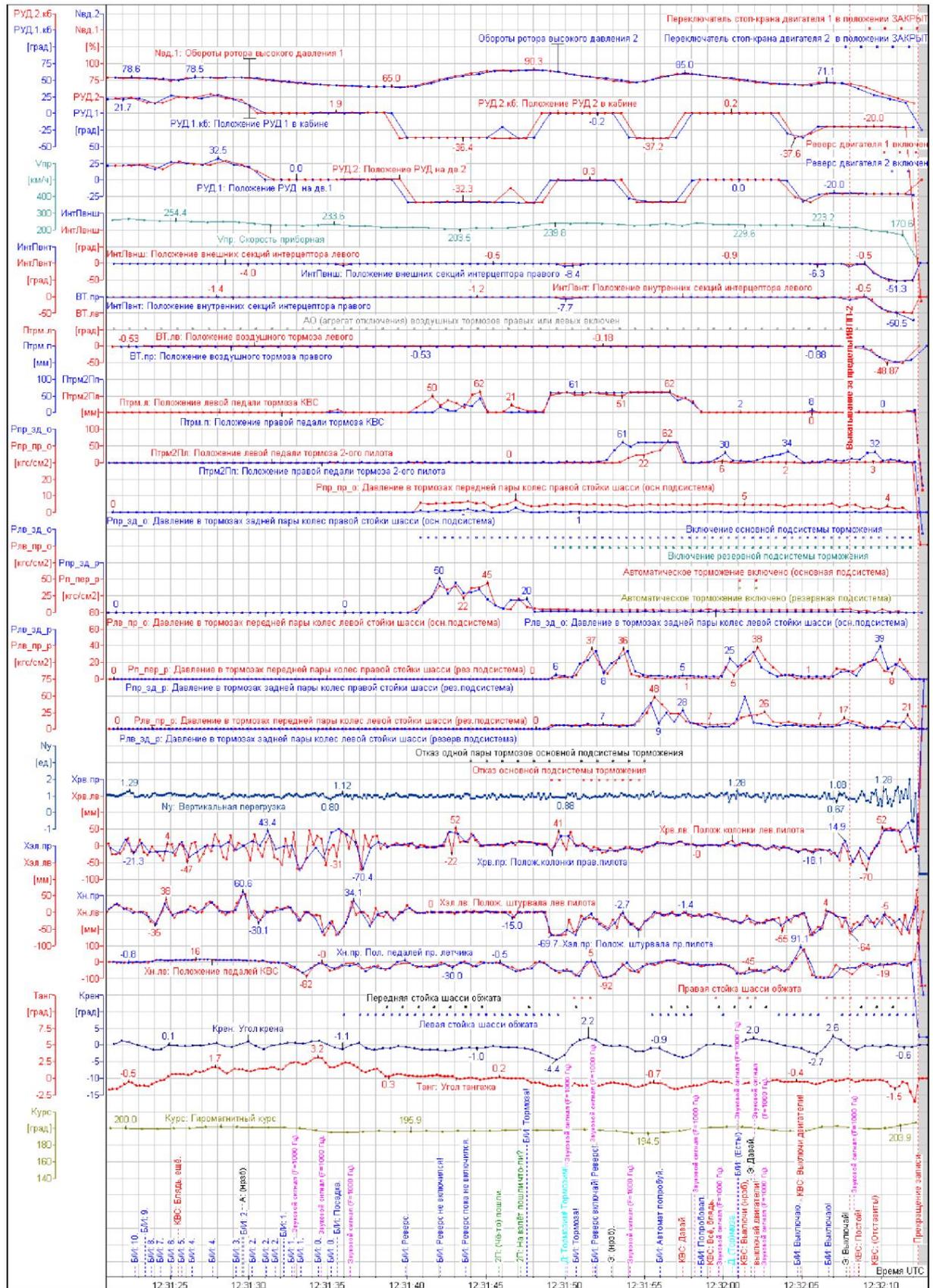


Fig. 12. Flight parameters of the Tu-204-100V RA-64047 aircraft on 12/29/2012 (run, landing in Vnukovo airport).

The plane landed at 12:31:36 at a speed of 230 km/h and a distance 950...1000 m from the input end of runway 19 to the left landing gear support (Fig. 12). Vertical The overload at the moment of landing was ~1.12 units. 3 seconds after landing The nose landing gear lowered. The right landing gear did not compress, the plane was moving with a left bank of -1...-1.5°. most likely due to a crosswind from the right.

Note: *According to the archive data of the AMIS-RF station (data from wind parameter meters are recorded every 15 seconds), maximum actual components of crosswind gusts in during landing and takeoff were ~11.5 m/s.*

At 12:31:40, almost simultaneously with the lowering of the front landing gear, the crew moved the engine power steering to the maximum reverse position (the power steering was transferred in one step to position -37) and applied wheel braking from the pedals. Judging by the fact that braking was carried out from the left pilot's seat, active The PIC was in control during the landing phase (Fig. 12).

At the initial stage of the run, the aircraft's braking was recorded - through 7-8 seconds after the first touchdown, the indicated airspeed decreased to 200-205 km/h (the minimum indicated airspeed to which the aircraft slowed down during takeoff), longitudinal overload was -0.05...-0.1.

At the moment of transferring the RUR to the position of maximum reverse and the beginning When braking, the aircraft was at a distance of 1200...1300 m from the entrance edge of runway 19 (1860...1760 to the exit end of runway 19).

After switching the RUR to the maximum reverse mode, the reverser flaps are not shifted happened. A mandatory condition for switching the reverse valves to the reverse mode The thrust for the Tu-204-100V aircraft is the compression of both main landing gear supports. After the landing of the aircraft, the compression of the right landing gear did not occur (about this (This is evidenced by the absence of a one-time command "Compressing the right landing gear"), which led to the blocking of the reverse valves. For the same reason, it did not happen automatic release of air brakes and interceptors after landing (for more details see section 2.3.2.3). The crew did not manually release the interceptors, The interceptors and air brakes remained in the retracted position until the aircraft overruns the runway. In this situation, the interceptors are deployed would lead to compression of both main landing gear legs, activation of the reverser and effective braking the aircraft with the main wheel brakes.

When the RUR is moved to position -37, the indicators on the limbs of the control pumps engines move to the position -33¹³, when the position is more than 13 -32, the increasing the engine operating mode. As a result, both engines began to increase Direct thrust mode. 2 seconds after the power steering is moved to position maximum reverse followed by the flight engineer's report: *"Reverse did not engage! Reverse until it turned on."* The RURs continued to remain in the maximum reverse position, which led to an increase in the engine operating mode to $\sim 90\%$ (in fact, corresponds to the nominal operating mode).

The use of brakes also proved ineffective, since at the initial At this stage, braking was actually carried out only by the wheels of the left chassis support. According to the recorded information, when the brake pedals were pressed, the pressure in the brakes of the wheels of the left (pressed) chassis support was 30...50 kg/cm², pressure in brakes of the wheels of the right (uncompressed) chassis support did not exceed 1...6 kg/cm² (at During normal braking, the brake pressure with the pedals fully depressed is 100±10 kg/cm² in this case the maximum pressure value installed in accordance with the operating algorithms of the anti-lock braking system).

4 seconds after pressing the brake pedals, the appearance of one-time command "Failure of one pair of brakes of the main braking subsystem", and also After 1 second, the captain released the brake pedals.

Since the wheel braking was ineffective and both engines were running at direct thrust at nominal mode, then instead of braking, the aircraft began to accelerate. Longitudinal overload increased to 0.15...0.25. A report was registered at 12:31:46 2P: *"(Something) went. Are they taking off or something?"* The RUR continued to remain in position of maximum reverse for about 8 seconds, after which they were transferred to off position.

After switching the RUR to the off position, at the time 12:31:49 Almost complete compression of the KVS brake pedals to 60 mm was recorded (Fig. 12) At this moment the aircraft was at a distance of approximately 1300 m from the exit end Runway 19 (Fig. 13), the pitch angle decreased to -1.1°, the bank angle, after decreasing to ~ -0.5°, increased to -4.4° (left bank). During the process of squeezing the brake pedals, the feed there was no pressure applied to the brakes of the main landing gear, and when the pedals were fully depressed The occurrence of a one-time command "Failure of the main braking subsystem" was registered and almost immediately - "Enabling the backup braking subsystem".

¹³ This means "more" in absolute value (modulus).

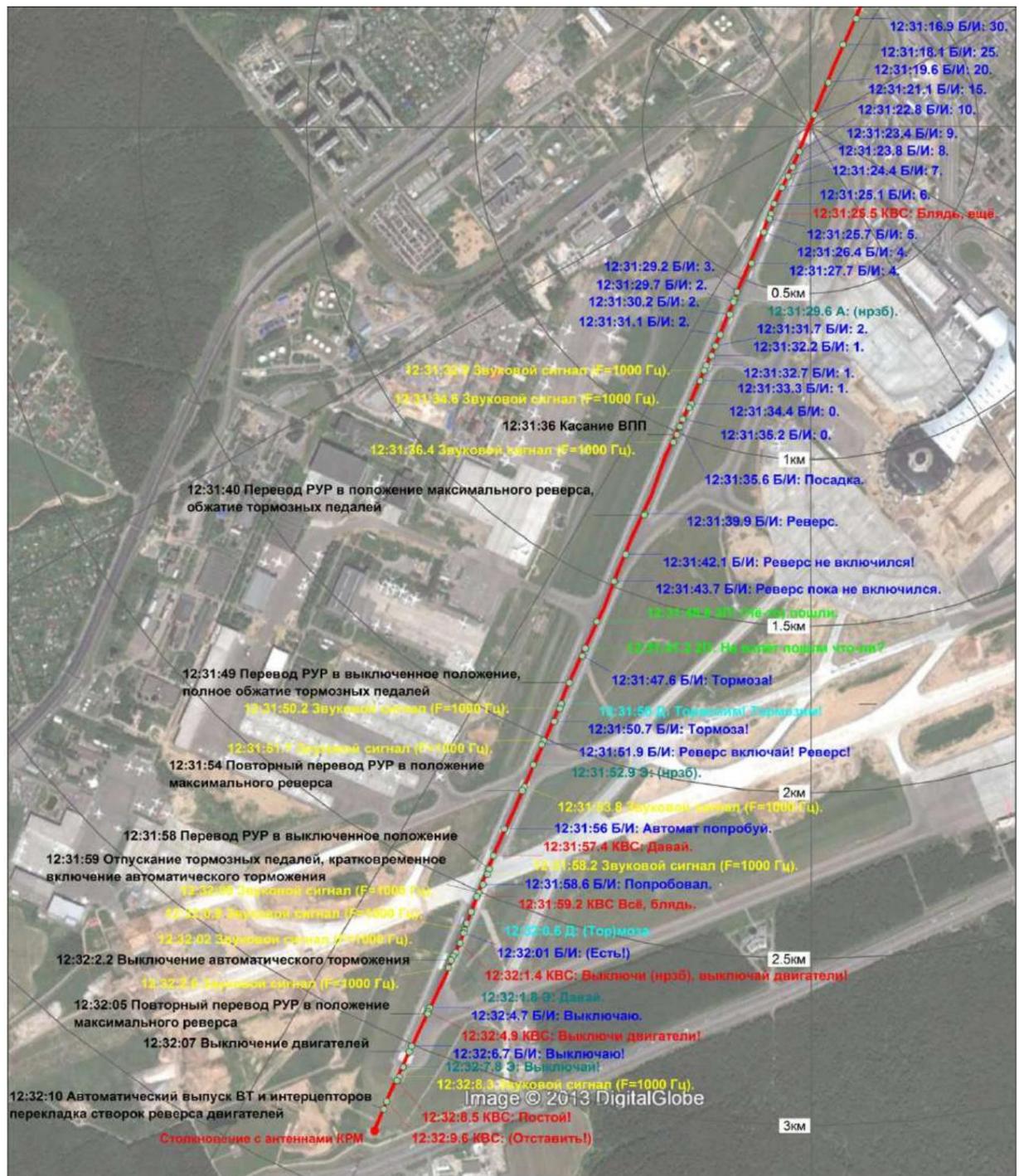


Fig. 13. Trajectory of the Tu-204-100B RA-64047 aircraft on runway 19 at Vnukovo Airport 29.12.2012.

As a result of the engines operating on direct thrust, by the time the RUR is transferred to off position, the airspeed increased to 240 km/h. Up to this point the plane was moving along the runway on the left and front landing gear. Increase in instrument speed, as well as the control actions of the crew to maintain direction movements, led to additional "unloading" of the chassis supports. In the process of further movements with oscillations in the roll from -4.4° to $+2.5^{\circ}$ there was a compression of the left, then right landing gear, in some areas the aircraft was almost completely separated from

Runway (Fig. 12). Simultaneous compression of both landing gear supports still did not occur, The interceptors and air brakes remained in the retracted position.

Despite the brake pedals being almost completely compressed, braking wheels remained ineffective: pressure was supplied to the wheel brakes only when compression of the chassis supports and spinning of the corresponding wheels (when slowing down rotation of any of the wheels in a pair causes the pressure in that pair of wheels to be released the moment these wheels started spinning), so there was a short-term braking of the wheels of the left and right landing gear, with the maximum pressure in the wheel brakes being 25...30 kg/cm². The appearance of signals of compression of the main landing gear chassis (and, accordingly, the supply of pressure to the brakes of the corresponding pairs of wheels when (compression of the brake pedals) corresponded to the change in the aircraft's roll.

Starting from the time 12:31:52, compression was also registered brake pedals 2P up to full travel.

5 seconds after the reverser was turned off, at 12:31:54, on the flight engineer's command "*Turn on reverse! Reverse!*", the RUR was re-set to position -37°, corresponding to the maximum reverse. As with the first attempt, turning on the reverse did not occur (there was no simultaneous compression of the main landing gear), both The engines again reached a higher mode when operating on direct thrust (up to N_Y~84%). The aircraft still did not slow down, the indicated airspeed was 230..240 km/h. After 4 seconds, the power steering was switched to the off position. at the moment the RUR was switched to the off position the aircraft was at a distance 650...700 m from the exit end of runway 19 (Fig. 13).

For the next 6 seconds the RURs were in the off position, in At this time the crew attempted to activate automatic braking, which the cockpit communications indicate: B/I: "*Try the automatic*", PIC: "*Go ahead*", B/I: "*Tried*" and short-term appearance of one-time commands: "Automatic "braking on" for the main and backup subsystems (Fig. 12). Before switching on automatic braking, the captain and 2P released the brake pedals, but then compression of the right brake pedal 2P to a value of 20...30 mm was recorded. According to the flight manual of the Tu-204-100V aircraft, when the brake pedals are pressed, the automatic the braking mode is switched off, and when the pedals are released, the system goes into mode automatic braking does not return. Thus, as a result of compression brake pedals 2P, the automatic braking mode was turned off. After attempts to use automatic braking, wheel braking crew

I hardly used it (except for short squeezes of the right pedal with the second one) pilot). The plane continued to move at a speed of about 230 km/h.

At 12:32:04 the crew again attempted to engage the reverser – The RURs were again moved to the maximum reverse position. After moving to maximum reverse position, the RUR movement to the intermediate position was registered position (small reverser). At this time, the aircraft was in the area of the exit end IVPP-19 (Fig. 13). As in the two previous cases, the repositioning of the reverser flaps is not happened, and moving the power steering gear to the maximum reverse position led to short-term increase in engine operation to $N_{j\ddot{y}} \sim 71\%$. In the process of transferring the RUR The on-board tape recorder recorded the captain's command: *"Turn off the engine... turn off engines!"* At this moment, the plane was about 200 m from the exit runway 19, the indicated airspeed was about 230 km/h.

The plane rolled off the runway at around 12:32:08, almost its axis, at an instrument airspeed of about 215 km/h. During the rolling process, on command from the PIC, B/I turned off the engines using the stop valves.

The further movement of the aircraft took place practically along the extended axis Runway. After turning off the engines, when the aircraft is moving on snow cover beyond the runway there was a decrease in speed, which, together with the collision with uneven surfaces, resulted in the simultaneous compression of the left and right chassis supports, as evidenced by simultaneous registration of the corresponding one-time commands by the MSRP system. Compression the main landing gear resulted in the automatic release of the air brakes and interceptors, as well as to the relocation of the flaps and the inclusion of the engine reverser (RUR engines continued to remain in the low reverse position).

The plane collided with the slope of a ravine at ground speed. 180...190 km/h. By this point the engines were turned off, the engine reverser doors were in the reverse thrust position, the air brakes were in the -50° position (fully extended), interceptors - -50° (fully extended). Directly Before the collision, movement of the flap control handle was recorded- slats to the 20° position and start retracting the flaps.

During the collision with obstacles and the slope of the ravine, destruction of the plane. The plane came to a stop at a distance of 330 m from the end of the concrete runway 19 pavement and a lateral deviation of approximately 20 m to the right of the extended runway 19 axis.

2.3 Analysis of the operation of aviation equipment

Before departure to Vnukovo, the crew had no complaints about the aircraft equipment presented.

During takeoff, climb and flight at the flight level, one-time commands and analog parameters indicating abnormal operation or failures aviation equipment, not registered.

When performing a control check chart before reducing comments on The crew also had no experience in operating the aircraft equipment.

During the descent to flight level 200, when the throttle lever is moved to the idle position a drop in air consumption in SVC 2 to 1270 kg/h was recorded (flow rate air in SCU 1 remained at the level of 2360...2380 kg/h). Air in SCU 1 comes from left engine, in SCS 2 - from the right. When the throttle lever is moved to the idle position the air intake in the SVC should switch from the 7th to the 13th stage of the HPC corresponding engine.

Note: *Air is bled from the engines from the 7th and 13th stages.*

high-pressure compressor (HPC) in all operating modes

engine. Air is taken mainly from the 7th stage

high-pressure compressor. Switching to air extraction from

The 13th stage is carried out according to the signal of the small limit switch

gas installed on the throttle lever (Airplane Manual for the Tu-204-100V aircraft, clause 8.11.1).

Analysis of the recorded information showed that switching to selection air from the 13th stage of the HPC occurred only on engine 1. The reason failure to switch to air intake from the 13th stage of the engine 2 high-pressure booster and, accordingly, The sharp drop in air flow in the SVC 2 was caused by a failure of the excess pressure regulator 6709 engine 2, as evidenced by the appearance of the corresponding one-time command. With the previous transfer of the throttle to the idle position (beginning of descent from the flight level) Switching to air bleeding from the 13th stage of the high-pressure booster occurred on both engines.

45 seconds after the drop in air flow in SVC 2, its switching off, and further reduction was carried out only with the operating SCR 1, and the SVC 1 did not switch to the maximum air flow mode. This failure had no influence on the occurrence and development of a special situation in flight.

During the flight, the B/I monitors the operation of the SVC. There are no reports from it. the parties about the drop in air flow in the SVC 2, as well as about its shutdown, are not registered, i.e. the pilot did not inform the crew of his actions.

Note: *On the previous flight at Pardubice Airport, there was a regulator failure. excess pressure 6709 engine 2 also occurred. In this case, When the flow rate in the SVC 2 dropped, the crew increased the operating mode engine 2. The flight was carried out with a difference in the position of throttle 1 and throttle 2 about 10°, after 6.5 minutes the crew turned off the SVC 2, however the situation RUD and, accordingly, the difference in the engine operating mode remained almost until the end of the flight. Such actions increase in air flow rate of the SVC RLE of the Tu-204-100V aircraft provided. After starting the APU, the crew turned on the SVC 2 and the selection From that moment on, air for SKV 1 and SKV 2 was supplied from the APU.*

In violation of the established requirements, the record of the discovery in flight malfunctions (accompanied by triggering (the corresponding signaling) was not made in the logbook.

Unit malfunction 6709 is included in the list of minimum composition equipment (PMO) (RPP) - clause 21.10-5 category "A" (elimination no later than one flight day from the moment of detection refusal). This refusal requires a special procedure. technical maintenance (established by part 3 of the PMO (GPMO)) and availability of information about inoperative equipment in the on-board computer airplane log.

The analysis showed that the drop in air consumption of the SKB 2 after switching the engine throttle 2 to idle mode, it also occurred in previous flights, and in some flights the crews, trying to maintain the required air flow, engine 2 was switched to increased operating mode, allowing for multi-mode operation engines. At least for the last month before the accident, the aircraft was flying Tu-204-100B RA-64047 were operated with the noted failure.

Thus, the specified requirements of the PMO (GPMO) during have not been completed for a long period of time, which indicates that insufficient quality of technical operation of aircraft in airlines and ineffective flight control according to data from flight recorders.

At an altitude of 2760 m, the APU was launched, which was accompanied by the appearance of RK "Otkaz VSU Refusal". Despite the appearance of the RK "Otkaz VSU Refusal", during the launch the Armed Forces of Ukraine reached

operating mode N_{yy}=100% and then worked normally (upon reaching a stable mode the one-time command "AFU failure" was lost during operation. The reason for the occurrence This one-time command is not clearly defined. The values of the APU rotor speed and the temperature of the gases behind the APU turbine during startup does not reach the maximum permissible values exceeded the values of the operating parameters of the APU, requiring the termination of its operation According to the flight manual, it was not registered. On the previous flight, the appearance of a one-time command No "APU failure" has been registered. Meanwhile, an analysis of the Tu-204-100V's flight RA-64047 from December 2012 revealed multiple occurrences of the one-time command "Refusal "VSU". There are no corresponding entries in the aircraft's logbook.

The appearance of the "APU failure" signal during its start-up did not create any problems for the crew, this event influences the occurrence and development of a special situation in an emergency

there was no effect on the flight.

2.3.1. Operation of the automatic flight control system during landing approach

When the crew switched on the "Landing" mode on the PU-56M, the aircraft approached fourth turn and was located at a distance of about 15 km from the end of runway 19, the height The flight altitude was 400 m, the indicated airspeed was 300 km/h. The angle of approach to the equisignal course line was ~26°, the deviation from the equisignal zone course ~0.32 RGM (more than 2 points on the KPI). The specified course angle was equal to landing and was 194°. By the time the "Landing" mode was activated, the onboard the MSRP system consistently registered a one-time command "Prepared control by the course zone in the lateral channel in the "Landing" mode, which indicates that the automatic landing approach system is ready.

Immediately after the Landing mode was activated, the execution of the right (on landing course) turn with a bank angle of up to 15°. According to the approach pattern up to There were still about 3 km left to complete the fourth turn. 7 seconds after the start turn, the PIC turned off the airborne power supply and switched to manual piloting. At the moment After the VSUP was turned off, the aircraft's gyromagnetic heading was 185°, and the approach angle was 19°. After switching to manual control, a left turn was registered roll of up to 12° and exit to a magnetic course of ~180°, i.e. taking into account a drift of about 10° (due to (Due to a strong crosswind from the right), the flight continued according to the approach pattern.

Automatic landing approach on a Tu-204-100V aircraft is carried out in two stages: Stage 1 - "Entry into the course zone" and Stage 2 - "Control along the course zone."

The exit to the course line is carried out by a signal of deviation from the equal signal zone of the KRM (Ek), received from the RTS, as well as according to the signal of the specified runway course and according to the course angle signal received from the SINS.

If the Landing mode is activated in a non-linear area of action localizer (more than 0.18 RGM), and the aircraft has an approach angle to the localizer lines other than 28°, then according to the algorithm of the VSUP operation, a turn is performed aircraft to an approach angle of 28°, which is maintained until entering the linear zone (less 0.18 RGM) of the course beacon.

When the "Landing" mode is turned on in the linear zone (less than 0.18 RGM) of the course beacon at any value of the approach angle, the algorithm begins to perform a turn with current angle towards the runway.

Turning on the 'Current Area Control' function indicates that the aircraft almost reached the course line.

In an emergency flight, when the "Landing" mode is activated in the non-linear zone of the control center with the value of $E_k=0.32$ RGM, instead of maintaining a constant approach angle of 28°, the VSUP immediately began to put the plane on a course close to the landing course, which is possible, was the reason for the crew to turn off the airborne pressure regulator.

The developer of the Tu-204-100V aircraft's air defense system, JSC MIEA, carried out Checking the BVUP-1-2 units from the Tu-204-100V RA-64047 aircraft. Check performed showed that all units are operational and comply with the technical specifications. In addition, the correctness of the implementation of the system block control algorithms was checked VSUP-85-3 in the "Landing" mode on the single-channel static stand of MIEA.

Testing the operation of the BVUP-1-2 units with the VSUP-85-3 software version on the OSS-1 stand IVUK.VSUP-85-3.00004-01 in the "Landing" mode in the "Entering the course zone" phase showed that when setting input parameters corresponding to the MSRP records, the values of the control signals to the input of the ASHU-204 for all blocks are identical and correspond to the logic embedded in the algorithms of the "Landing" mode. The obtained the results do not match the output values recorded in the alarm flight of the Tu-204-100B RA-64047 aircraft by means of objective control.

materials submitted by the International Institute of Economics and Management to establish the cause of the discrepancy It is necessary to evaluate the operation of interacting systems of the entire control loop.

As part of the investigation, the AP Commission analyzed previous landing approaches of the Tu-204-100B RA-64047 aircraft, carried out in different airports. The incorrect operation of the airborne control system (bringing the aircraft to a course close to landing when in the nonlinear zone of the KRM with Ek values greater than 0.18 RGM)

repeatedly appeared when the "Landing" mode was turned on. It should also be noted, that such work of the VSUP was of an inconsistent nature, in other flights the system automatic landing approach worked normally (i.e. when the mode was turned on "Landing" in the non-linear zone of action of the localizer radio beacon was carried out the aircraft at a constant approach angle close to 28° , which was maintained until the values $E_k = 0.18$ RGM. When the "Landing" mode is turned on in the linear area of the course No indication of incorrect operation of the VSUP radio beacon was noted.

In addition, it was found that the same nature of the work of the VSUP is also manifested on the Tu-204-100V RA-64049 aircraft (this aircraft is equipped with the VSUP-85-3, similar to that installed on the Tu-204-100V RA-64047 aircraft).

The analysis of the flights showed that in the event of non-intervention of the pilot in control in case of incorrect operation of the VSUP at the initial stage when the mode is turned on "Landing", the system eventually brought the aircraft into the equal-signal zone of the CRM and in subsequently maintained the landing course precisely.

It should be noted that incorrect operation of the air suspension system during an emergency flight of the aircraft Tu-204-100B RA-64047 12/29/2012 influence on the emergence and development of a special the situation did not affect the situation, since the crew had initially planned to make an approach to director mode.

To identify the causes of incorrect operation of the VSUP, detected during investigation of the accident involving the Tu-204-100B RA-64047 aircraft, an investigation is required special additional studies.

2.3.2. Operation of aircraft equipment after landing

To analyze the performance of aircraft equipment after landing It is necessary to understand the logic of the aircraft systems (thrust reverser, interceptors, etc.) air brakes, wheel brakes), which ensure its braking after landing, and also the logic of the operation of the limit switches of the main landing gear, which form ground-to-air signal for the above systems.

According to the aircraft developer, JSC Tupolev, for the coefficient 0.5 clutch and minimum landing distance braking efficiency distributed as follows: brakes – 75%, reverser + interceptors and air brakes – 25%, while for a higher coefficient of adhesion the share braking system increases up to 80%. At the same time, for effective using the braking system, reliable grip of the wheels is necessary surface of the runway, which at the initial stage of the run should be ensured by the release interceptors and air brakes.

2.3.2.1. Limit switches

To determine the fact that the aircraft is on the ground (landing), at each
The main landing gear is equipped with two limit switches. The limit switch is activated
switch (the appearance of a ground signal) occurs when it is released. According to the information
JSC Tupolev, the stroke of the shock absorber rod before the end valve is triggered (unclamped)
The switch diameter should be 9-12 mm, the load on the rack should be ~5.5 tons.
The adjustment of the tripping threshold of the switches is carried out during the manufacture of the aircraft,
when replacing switches and in response to crew complaints about their normal functioning.
the crew has the ability to control the operation of each limit switch on
IM No. 1, frame UPR. Control of the operation of limit switches by the crew before
each flight is prescribed by the RLE (paragraph 8.9.3.(1)). Failure of any limit switch does not
is part of the master minimum equipment list and is subject to elimination before
first flight. Signals from the limit switches are sent in analog form to
various aircraft systems (see below).

As noted above, during the landing run, when the aircraft is in
within the runway, the simultaneous generation of signals for compressing the main landing gear is not
occurred, while the minimum indicated air speed was 200-205 km/h at an angle
pitch ~0° and bank 1...1.5° to the left. Limit switch studies conducted at the GC
The BT BPs demonstrated their serviceability. Tupolev JSC conducted mathematical modeling.
emergency flight to determine the actual compression value of the shock absorbers of each
chassis supports (provided that they are charged normally) and determining the correct adjustment and
operation of limit switches. Based on the simulation results, it was established that the limit switches
The switches worked normally throughout the entire run, under the actual parameters
aircraft movements (speed, overload, roll, pitch) signal of simultaneous compression
The main landing gear should not be formed. In the event that the crew deploys the interceptors
in manual mode, as prescribed by the flight manual, the aircraft's speed would have been reduced, which
would lead to the formation of a signal for the simultaneous compression of the left and right chassis supports.

Similar operation of limit switches was recorded on the aircraft.
Tu-204-100B RA-64049, which landed at Vnukovo Airport on the same heading
approximately an hour before the disaster. At the moment of the first contact with vertical overload
~1.3g and a right bank of ~1°, a short-term compression of both main supports occurred
chassis. After the aircraft separated from the runway and landed again with the left
with a roll of ~1° and an overload of ~1.1g, the on-board recorder recorded a compression signal
only the left main landing gear. The aircraft's further movement along the runway continued
with a left bank of up to 4° without compression of the right main support. Activation of the end

switches and the appearance of a signal of compression of the right main landing gear occurred only at a speed of about 130 km/h with a bank of $\sim 2.5^\circ$ to the left.

Failure of limit switches for various reasons also had place on 20.12.2012 on the Tu-204-100B RA-64049 aircraft upon landing at Tolmachevo Airport (ended with rolling off the runway) and on December 23, 2012 on a Tu-204-100V aircraft RA-64047 upon landing at Vnukovo Airport (without consequences).

Thus, in just 10 days (from December 20 to 29), two aircraft were found to be infected. four cases of limit switches not operating for various reasons. Facts Limit switch failures were also identified during a random analysis flights conducted by the State Center for BP VT. The Commission believes that since in the formation of logic earth/air only limit switches are involved, and from timely the formation of this signal to one degree or another depends on the logic of the operation of all systems, providing aircraft braking after landing (see below), JSC It would be advisable for Tupolev to consider the issue of changing the logic of signal generation ground/air to ensure its reliable operation under all expected conditions operation (low landing weights, landings with low vertical values speeds (vertical overloads), maximum crosswind, etc.) and/or logic operation of systems that ensure aircraft braking after landing.

2.3.2.2. Engine thrust reverser

The crew controls the engine thrust reverser using the RUR. The movement of the RUR is impossible without installing the RUR of the corresponding engine in idle position. After setting the engine throttle to idle mode, possible movement of the RUR. The effort that the pilot must apply to the movement of the RUR in the normal case is no more than 4 kgf, while the additional the force on the intermediate stop (position "small reverse") is 2.8 ± 0.3 kgf.

When moving the RUR to the intermediate stop, the pointer on the pump limb- the regulator passes through the switching platform of the distribution valve (Fig. 14), after which, in 2...3 seconds, the reversing device flaps are repositioned Reverse thrust mode. To prevent the engine from engaging in reverse in the air the release of the engine reversing devices is blocked in the hydraulic control system reverser in the absence of a signal for simultaneous compression of the main landing gear supports. Signal compression of the main landing gear for the thrust reverser system is formed when at least one of the two limit switches on each support was triggered.

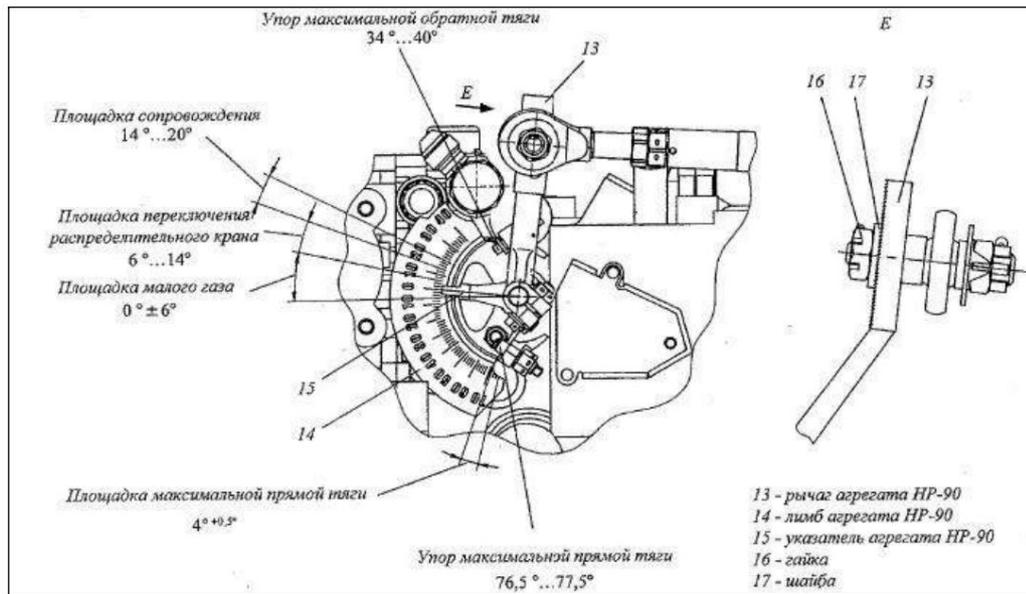


Fig. 14.

The engine design provides for blocking further movement of the power steering system. (above the intermediate stop) and, accordingly, blocking further movement an indicator on the dial of the regulator pump, the position of which determines the operating mode engine. Design and operating procedure of the control and locking mechanism (CLM) The reversing device at various stages is shown in Fig. 15 and Fig. 16.

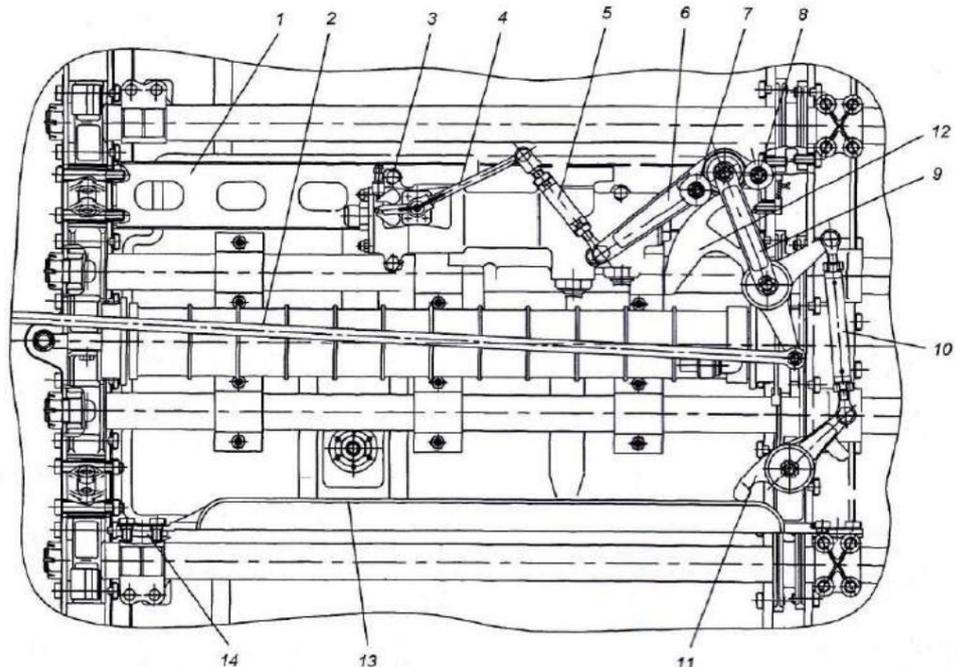


Рис. 7.7. Механизм управления и блокировки РУ двигателя ПС-90А
1 - кронштейн; 2, 5, 10 - тяга; 3 - кран КР-90; 4 - рычаг; 6 - переключатель; 7, 8 - ролики; 9 - перемычка; 11 - кулачок блокировки; 12 - кулачок управления; 13 - направляющая; 14 - кронштейн промежуточный

Fig. 15.

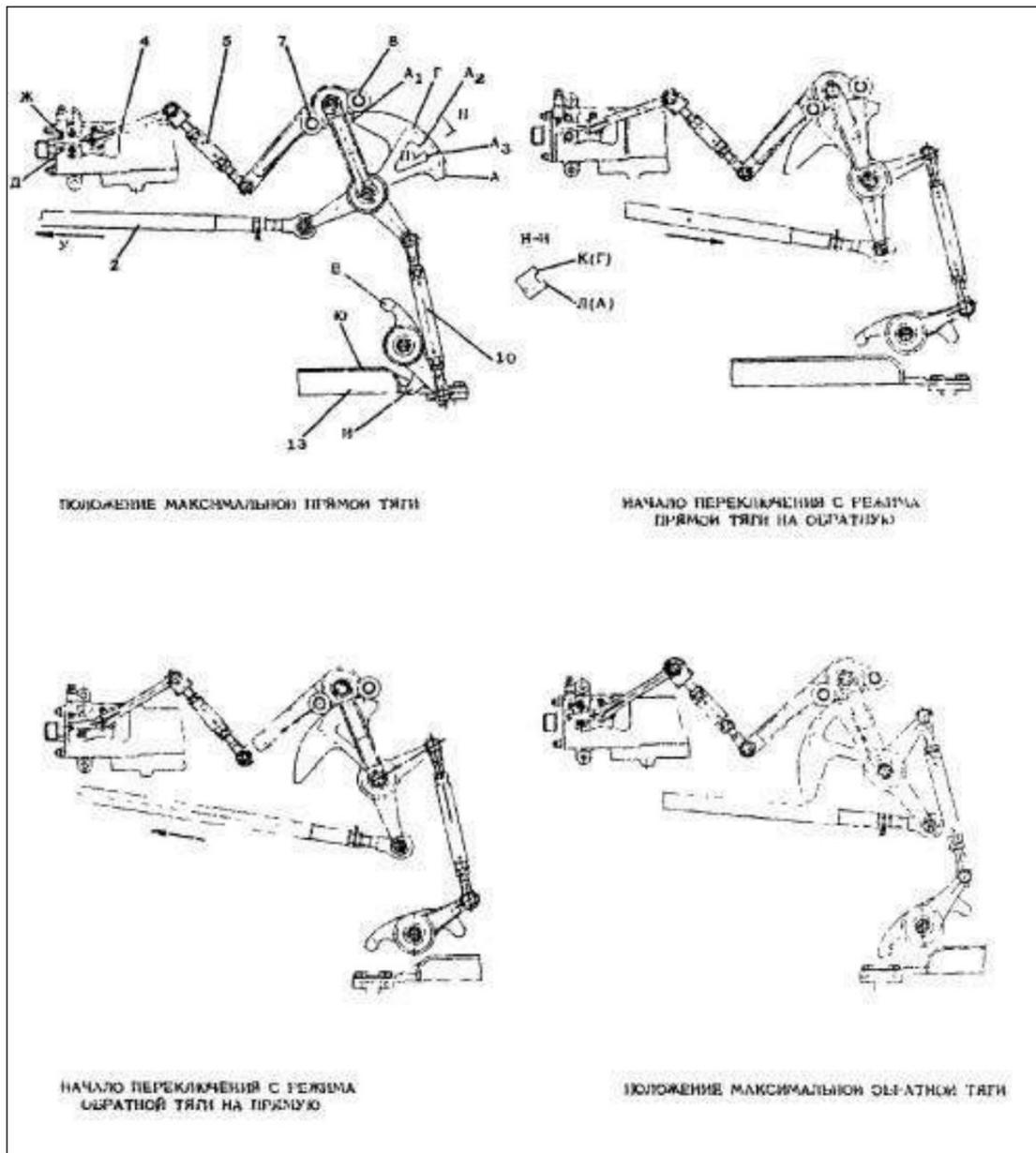


Fig. 16.

According to the logic of the MUB operation, when the reverse valves are in the straight position the traction, the locking cam, resting against the guide, should not allow movement RUR and, accordingly, the indicator on the limb of the pump-regulator further from the platform accompaniment (Fig. 14.).

Note:

During normal operation, the engine modes are set RED. When controlled from the power steering, the engine operating mode is increased occurs in stages (Fig. 17), upon reaching a position more -32° (for example, -33°) according to the indicator on the dial of the regulator pump (Fig. 14), until this value is reached, the operating mode is maintained engine "low throttle".

At the same time, in case of failure of the electronic control system and switching to the backup automatic change of engine operating mode when controlled from The RUR will occur proportionally to the deviation of the pointer on limb of the regulator pump, starting from the support platform (Fig. 17).

In the RLE, in section 8.1.1.2(2) there is information: "Meaning reverse thrust is determined by the magnitude of the upward deflection of the RUR similar to the throttle deflection when controlling direct thrust." This the position of the flight manual is valid only for engine operation at backup automation, when operating from the RED (main mode) this the situation does not correspond to reality and requires adjustments. Also in the Flight Manual, in section 6.7.3.2 "Crew actions during failure to release the main landing gear", paragraph 18 prescribes application of maximum reverse, which, as noted above, it is impossible because there will be no signal simultaneous compression of both main landing gear supports. This point also requires adjustment.

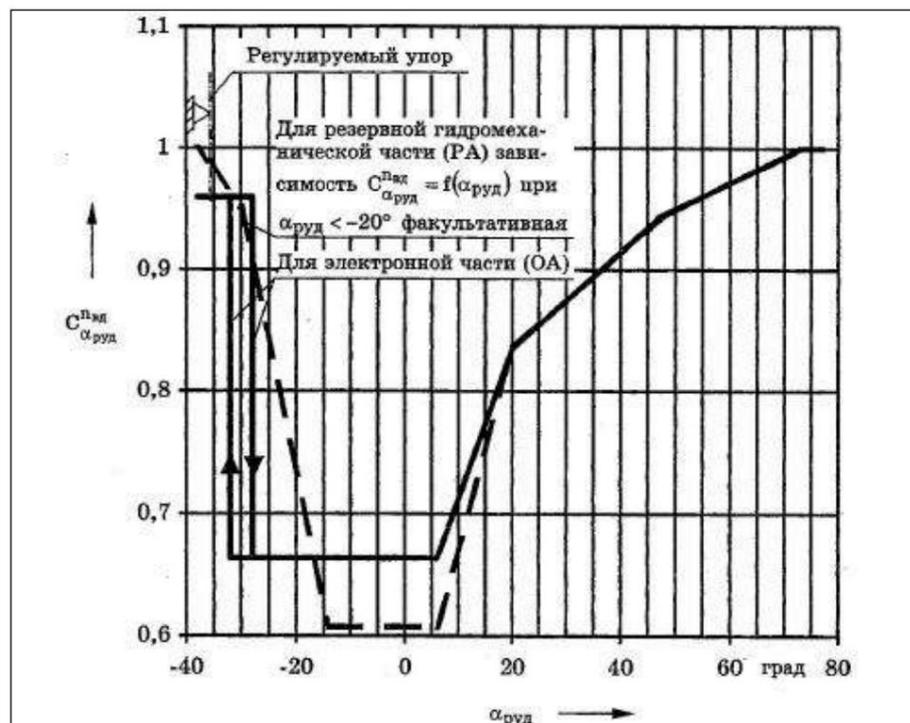


Fig. 17.

After the release of the reversing device, the guide moves and the blocking of further movement of the RUR and, consequently, increase is removed engine operating mode.

The release of the reversing device is controlled by the crew light signal panel located on the pilot's instrument panel:

- text REVERSE LOCK in yellow;
- text REVERSE ON in green.

In addition, information about the operation of the reversing device (shifting sashes) is issued to IM No. 2 in the DV/SIGN frame (DV OSN DV OBSH):

- when opening the reverse lock – ZMK (yellow);
- when reverse is engaged – REV (green).

In an emergency flight, after setting the throttle to the "low throttle" position, landing and the use of thrust reverser by the crew, repositioning of the thrust reverser doors devices did not occur due to the lack of a signal for the simultaneous compression of the main landing gear supports¹⁴, that is, the doors were not repositioned normally, in accordance with the programmed the logic of the operation of the reverse thrust blocking system in the air. When simultaneous compression of both main landing gear legs after the aircraft leaves the runway, when position of the RUR on the intermediate stop (in the "small reverse" position), the sash The reverse thrust devices were switched to reverse thrust mode as standard.

At the same time, the planned blocking of the increase in the operating mode engine above "idle" with the reverser flaps not shifted did not work. The RUR of both engines were moved by the crew in one movement in position ~ -37°, and the position of the pointers on the limbs of the HP-90 was ~ -33°, which exceeded threshold value (-32°) and normally led to an increase in the operating modes of both engines up to the nominal value. Analysis of the causes that led to failure locking mechanism, showed the following.

The control and locking mechanism of the reversing device is mechanical system (Fig. 15), which, through a system of levers and rods, provides communication reverser control valve KR-90 with RUR, as well as with the pump throttle valve lever-regulator HP-90. The control and locking mechanism provides, among other things, switching of the KR-90 crane, as well as blocking the RUR from possible switching reversing device, bypassing the "Low Gas" platform on the pump-regulator (this function and was not performed in the accident flight).

Based on the given data on the design and functions of the control mechanism and blocking, it is obvious that it was intended as a rigid system. This is the same This is also confirmed by the analysis of the engine's operating instructions. Thus, according to paragraph 7 of section 073.21.00,

¹⁴ The operation of limit switches is analyzed above in the text.

pp. 501-510 "Adjusting the control system", maximum permissible total backlash in the system, including clearances in the axes of the traction rollers from the engine drive roller to the control and locking mechanism should be no more than 0.7 mm. When adjusting control and locking mechanism (engine manual, 073.21.00, Checking and adjustment control and locking mechanism, pp. 205-208) it is envisaged that when with the KR-90 reverser control valve fixed in the "Reverse thrust" position, the gap between the locking cam and the guide should be 1.4...1.6 mm, which must ensure that the reverse control valve opens when the power steering is set to intermediate stop. It was assumed that in the absence of clearance, situations could occur, when the locking cam hits the guide before it is fully open reverse control valve, which will disrupt the normal operation of the system. It is also necessary It should be noted that the logic of the engine thrust reverser operation when switching to reserve automation (see note above) implies the impossibility moving the pointer on the limb of the pump-regulator beyond the tracking platform without re-positioning the reversing device.

However, the work carried out by the Commission, as well as the analysis of the results of the work on engine adjustments carried out after the accident with the Tu-204-100V RA-64047 aircraft in within the framework of the implementation of airworthiness directives and ETU, showed that when applied to the reverse control lever has a force of about 15 kg, it is possible to shift the pointer to the limb of the pump-regulator (when the locking cam rests against the guide) up to values $\sim 10^\circ$ (the exact values depend on the state of the control wiring of each specific engine, with an increase in engine operating time after repair data values are likely to increase). The shift becomes possible due to deformations and displacements of a number of structural elements of the propulsion part of the system engine control, including control and locking mechanism elements (Fig. 18 and Fig. 19). It should be noted that, according to the engine manual, the total wiring play control from the drive roller to the control cam should not exceed 0.7 mm, in this case, the total play of the rest of the MUB, including the locking cam and guide, not standardized. After the accident with the Tu-204-100V aircraft RA-64047 the rigidity of the structure was increased by installing a number of additional elements (Fig. 20 and Fig. 21, additional elements are shown with red arrows).

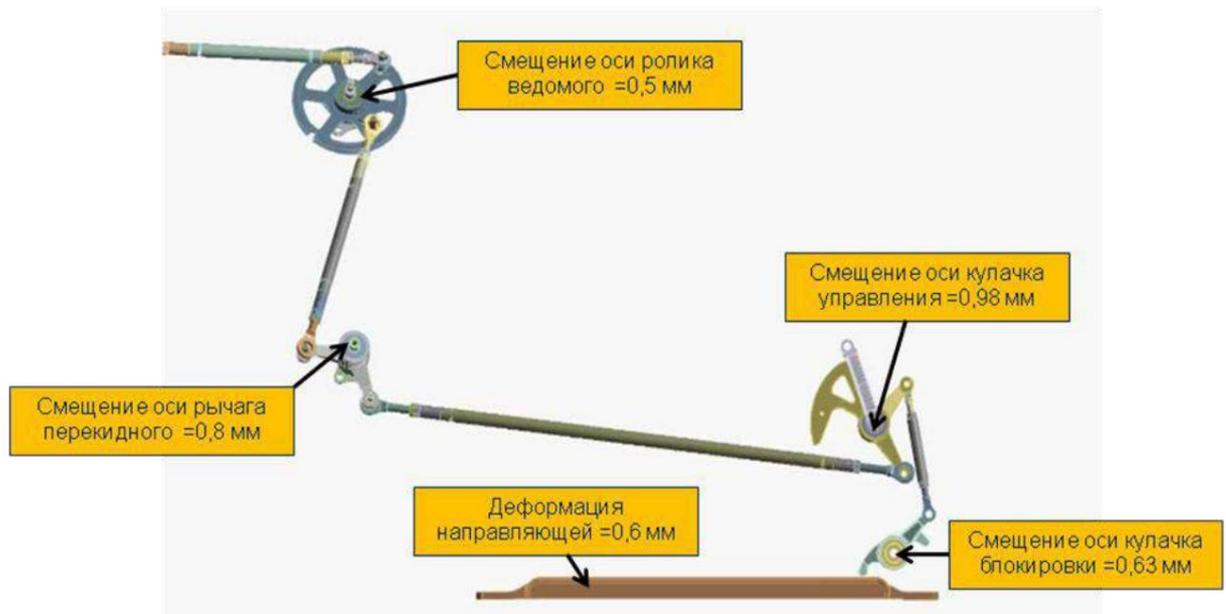


Fig. 18.

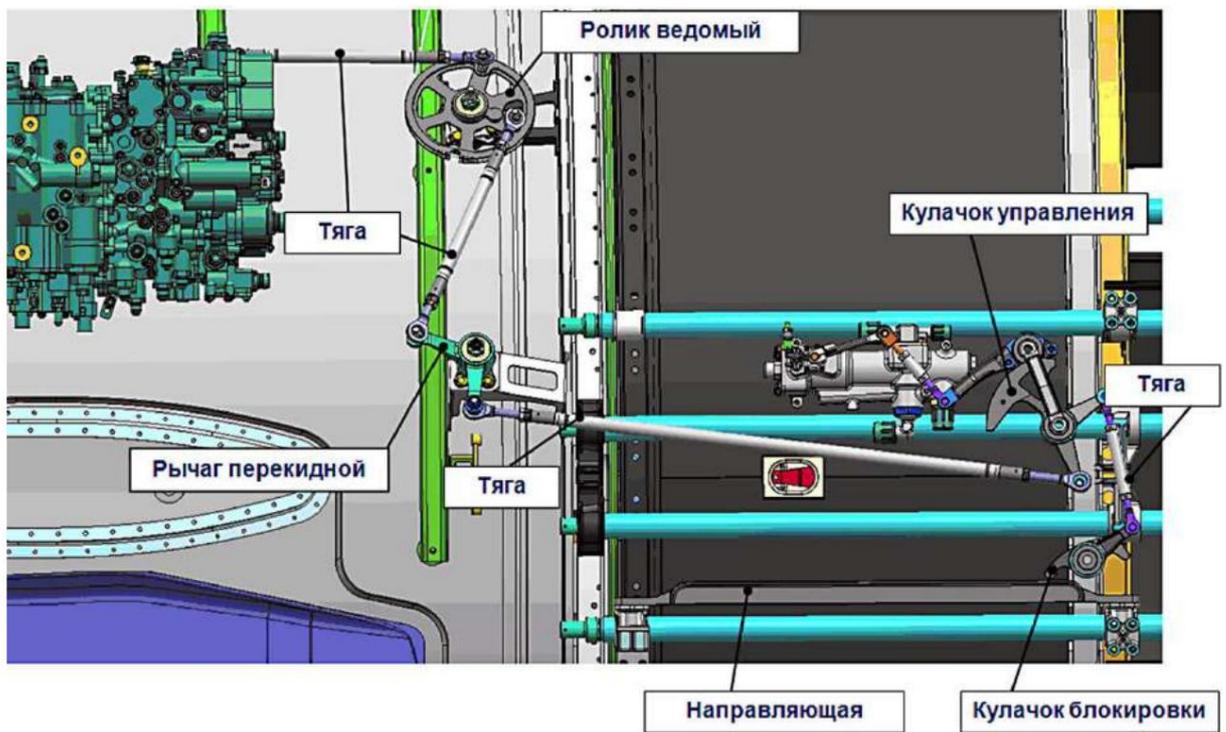


Fig. 19.

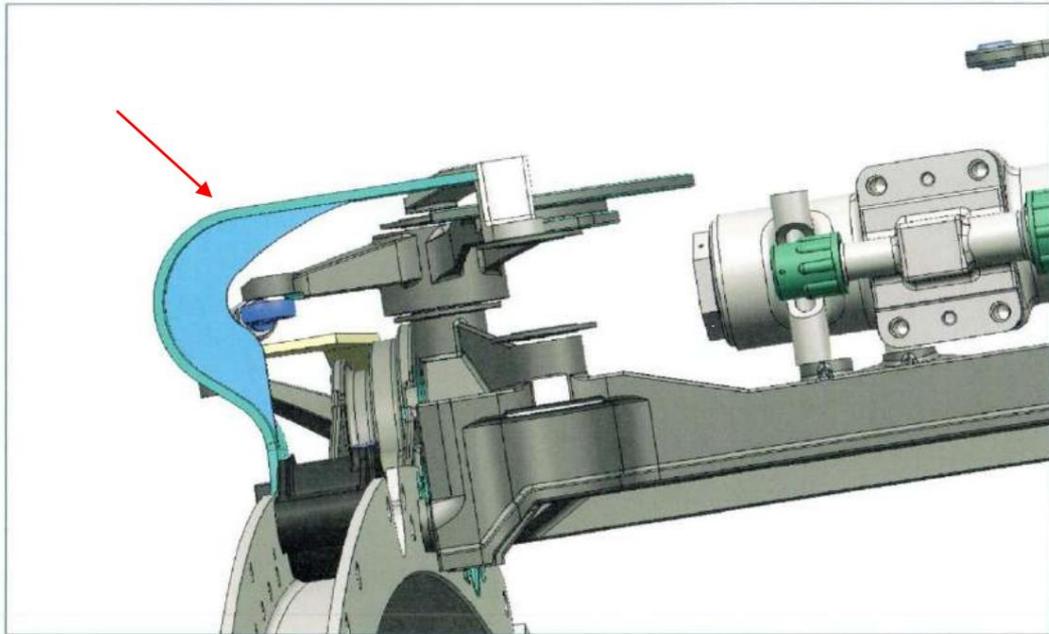


Fig. 20.



Fig. 21.

Additional movement of the pointer on the dial of the pump regulator is possible also if there is a gap between the locking cam and the guide when in position RUR on the intermediate stop. In addition to the rigidity characteristics of the control cable a specific engine, the amount of force that must be applied to the RUR for them movement until the engine thrust increases with the doors not repositioned reverse, depends significantly on the amount of adjustment of the gap between the cam locking and guide. The larger this gap, the easier it is for the pilot to apply

some effort to the RUR, move them (and along with this the entire system of rods and rockers) to a position in which a command is sent to the pump regulator to increase the mode engine operation (more than -32° on the HP limb). As the ground experiment showed, conducted on the Tu-204-100B RA-64050 aircraft, the maximum efforts that the pilot can really be used to hold the steering wheel in the upper position when not shifted reverser flaps, are about 25...30 kg (for both RURs), while the actual the position of the power steering in the cockpit and the position of the indicator on the dial of the regulator pump the engine do not match, the discrepancy can be up to $\sim 10^\circ$. In an emergency in flight, this discrepancy did not exceed 4° , that is, most likely, the gap between the locking cam and the guide when the RUR is positioned on the intermediate stop was is large enough, and the amount of effort required by the pilot to overcome the blockage, was relatively insignificant (according to the test pilot's estimates, about 10 kg). Measure the gap between the locking cam and the guide when the power steering gear is in the intermediate position It was not possible to support the Tu-204-100B RA-64047 aircraft due to the destruction and deformations of the wiring of the engine operating mode control system due to collisions of the aircraft with obstacles and thermal effects from the fire.

At certain values of clearance between the locking cam and the guide, position of the RUR on the intermediate stop (when conducting an experiment on an airplane Tu-204-100V RA-64050 obtained values: 4 mm for an engine with more operating time and 6 mm for an engine with less operating time) further movement of the RUR is possible and indicator on the dial of the pump regulator without any additional effort.

Further analysis showed that with the existing design of the MUB, its reliability response (with a margin of about 2° according to the position of the pointer on the dial of the pump regulator) when setting engine operating modes from the RED (stepwise increase in thrust) is ensured provided that when the indicator position on the limb is no more than -20° (on support platform) the locking cam "with force" rests against the guide.

The engine is supplied from the manufacturer (repair plant) completely adjusted in accordance with the technical specifications. On an engine adjusted during production (repair) in accordance with the technical specifications, the position of the risk on the unit control lever indicator HP-90 with the reverse valve fully open and the locking cam resting against the guide can be in the range of -14° ... -20° degrees, including extreme values.

In the aircraft's manual (sections: 71-00-00, TC No. 403 Dismantling and installation of the engine, pp. 413-431/432; 76-11-00, TC No. 203 Checking the control system adjustment engine operating mode, pp. 209-212; 76-11-00, TC No. 204 System adjustment control of the engine operating mode, pp. 213-222) contains an indication that when

When installing the engine on an aircraft, it is necessary to ensure that when the power steering is in the on position at the intermediate stop (small reverse), the indicator on the dial of the pump-regulator is in position $20 \pm 2^\circ$. Control of the position of the aircraft's electronic control locking cam is not provided. The experiment conducted by the Commission on the Tu-204-100V aircraft RA-64022 showed that when fulfilling these requirements of the aircraft's operating instructions on one of the engines, the engine speed increases when moderate efforts are applied to the RUR (the measured value of the backlash in the control system corresponded to the specifications). Thus, the implementation of the provisions of the aircraft's operating manual with the existing design of the MUB is not guarantees reliable operation of the lock.

Technological maps of the aircraft's operating instructions, which determine the order of engine installation on aircraft, as well as the procedure for checking and, if necessary, adjusting the system control of the engine operating mode after its installation, do not contain references (in part the procedure for checking and, if necessary, adjusting the control system) on technological maps of the engine manual.

At the same time, in accordance with the engine operating instructions, it is the main document for its maintenance. In case of violation of the provisions of the engine's operating manual, The engine manufacturer does not guarantee the normal operation of the engine. The engine operating manual requires a full adjustment. systems according to the aircraft's operating instructions after connecting the aircraft's propeller shaft to the drive roller of the engine control system.

The engine manual contained a list of works that must be carried out when installation of the engine on the aircraft. In particular, the engine manual (section 073-21-00, Inspection and control system check, pp. 601-606 (clause 2.7)) at the time of the AP contained a requirement about checking the position of the pointer on the dial of the pump regulator (should be in range of $14 \dots 20^\circ$) and the locking cam (must touch the guide) when moving the power steering "to the stop". What is meant by "stop" (intermediate stop, physical emphasis), at the time of the AP, the RE was not specified. In case of discrepancy The specified values of the engine manual provided for adjustment of the control system. The specified adjustment of the control system is carried out on the engine, disconnected from the aircraft control linkage. Thus, direct adjustment the position of the risk on the indicator of the control lever of the HP-90 unit in the range minus 14 ... minus 20 when the power steering is positioned on the intermediate stop is not provided. The specified range must be met automatically based on engine design when performing the adjustments provided in the engine manual, when There are no requirements for a specific value within the specified range.

Operations to adjust the engine control system and mechanism

The controls and interlocks provided by the engine manual are designed to ensure that the engine complies with the technical specifications established for it. Provided performing engine adjustments at the manufacturer's plant (repair plant) in accordance with the specifications for additional adjustments when installing the engine on an aircraft should not be required. Thus, when the control system adjustments are released the engine beyond the range established by the engine operating instructions during engine installation on the aircraft (due to a wider (plus two degrees) tolerance in the aircraft's operating instructions) adjust the complete engine control system (aircraft and engine part) is only possible using the aircraft part adjustment power plant control systems.

It is also important to note the following:

- all adjustments of the motor part of the control wiring (section 073-21-00, Adjustment of the control system (pp. 501-510) is carried out with the system disconnected aircraft wiring and begin with the combination of two low-gas risks (p. 4.2): on the indicator and on the end of the drive roller (the first element of the drive parts of the control wiring). In the future, all wiring adjustments controls are performed while maintaining the given initial position. At the same time at the same time, when installing the engine on the aircraft (when connecting the aircraft wiring) requirements to ensure compliance with the specified risks of small there is no gas. The aircraft's operating instructions only require ensuring the position indicator on the regulator pump dial in the range of $0 \pm 2^\circ$ with the throttle position on at low throttle. Thus, when installing the adjusted engine on airplane idle throttle adjustment, and therefore other modes, including reversible, can shift up to 2° both upwards and downwards and in the direction of decreasing the reserve before increasing the direct thrust of the engine;
- with the aircraft engine control wiring disconnected, all efforts, which are applied when performing adjustment work for movement of the elements of the motor part of the wiring (to the drive roller or to control cam), much smaller than those that can be applied in operation. An experiment on the Tu-204-100B RA-64022 aircraft showed that when fixing the pointer on the dial of the pump regulator in any position in the range 2.5° (in the experiment from minus 20° to minus 22.5°) possible by hand move the locking cam until it touches the guide, while

measured total backlash of the control wiring of this engine was 0.4 mm, which did not exceed the limit (no more than 0.7 mm).

All the above mentioned deficiencies were identified only after the aviation incidents during the investigation and work on adjusting the control mechanism and reverser locks on other engines. The specified adjustments, with using the documentation available at the time of the AP, were carried out during a long period of time and, in some cases, were not allowed the first time adjust the engines even with the participation of the developer's representatives in the adjustments aircraft and engine, and not just operating organizations and organizations, having permission to replace the engine. The documentation available at the time of the accident was not took into account the actual rigidity of the control and locking mechanism, not provided for a final check of the system under load (with the application of force to RUR), contained a number of discrepancies in the required values of the regulated and controlled parameters and, in general, did not allow for operational implementation necessary engine adjustments.

The results of the adjustments depended largely on experience, qualifications and production discipline of specific performers and conditions of work (illumination, ambient temperature, hangar/apron, etc.).

At the same time, according to the information provided, before the accident with the plane Tu-204-100B RA-64047, for the entire period of operation of the Tu-204/214 family of aircraft, complaints from operators and organizations that carried out engine replacements about difficulties in carrying out adjustments and an ambiguous understanding of the documentation by developers aircraft and engines were not received. These requests began to arrive only when performing checks and adjustments after an accident with the Tu-204-100V RA-64047 aircraft. According to the operational reports that were filled out during the last replacement engines (the left one – by the Red Wings airline in March 2012, the right one – in January 2011, by the efforts of the Tupolev Center for Technical Support LLC, the provisions of all the above-mentioned process maps. Absence in the operational statements specific values of regulated and controlled parameters do not allow to clearly assess the completeness of the implementation of the specified maps. At the same time, taking into account the contradictions in the content of these maps, as well as the above analysis possible development of an emergency situation, the Commission believes that the implementation of a number of The process maps were carried out formally, without any actual work being carried out. Thus, for example, if the organizations that carried out the engine replacement were verbatim (literally, completely) paragraph 2.7 of section 073-21-00, Inspection and testing of the system has been completed

control, pp. 601-606 of the engine manual, that is, the RUR would be moved to the stop (physical), while the position of the pointer on the pump limb is checked regulator in position 14...20° and the cam fits against the guide, then increases direct thrust in an accident flight would most likely not have occurred.

Taking into account the above, the following conclusion seems most likely: after installing the engines on the aircraft and conducting a check according to the Technological Map No. 203 "Checking the adjustment of the engine operating mode control system" p. 209-212 of section 76-11-00 of the aircraft operating manual, all parameters were in the TU (provision indicator on the NR-90 limb when the RUR is positioned at the intermediate stop within $20\pm 2^\circ$, checking the gap between the locking cam and the guide is not required), while all The remaining Technological Maps were written formally, without any work being carried out. This assumption is confirmed by the results of the research (section 1.16.1), which showed that the adjustments of both the engine and aircraft parts of the wiring engine control, were not performed in operation. Considering that after the release the plane had three different engines installed on it, both in the left and in the composition of the right power plant, while after repairs the left engine was installed on different aircraft twice (the first time on a different aircraft)¹⁵ , The failure to carry out adjustments confirms the conclusion presented above.

Thus, the increase in the forward thrust of both engines in an emergency flight at unshifted reverse valves, most likely due to misalignment control and locking mechanism. This misalignment was the result of:

- actual data not taken into account when drawing up operational documentation rigidity of the design of the control and locking mechanism;
- inconsistencies and contradictions in the operating documentation aircraft and engine, determining the order of checks and adjustments of the system engine control when replacing it during operation;
- formal approach over a long period of time to implementation inspections by the organizations that carried out the engine replacement, which is not allowed for feedback from the aircraft and engine developers and promptly eliminate existing deficiencies in the electronic document.

The manifestation of the above mentioned deficiencies (misalignment of the MUB) became possible only if the crew fails to comply with the requirements of the flight manual, which provide a two-stage procedure for using reverse thrust during landing with mandatory

¹⁵ The right engine, after repair, was immediately installed on the Tu-204-100B RA-64047 aircraft.

control of the released position of the reversing device flaps (more detailed (The analysis of the crew's actions is given below in the text).

2.3.2.3. Interceptors and air brakes

The aircraft is equipped with automatic release of interceptors and air brakes after landing. Automatic release of interceptors and air the brakes are applied by simultaneously actuating all four end switches on both main landing gear. On landing, when not released interceptors and air brakes in automatic mode, the RLE prescribes The flight engineer should release the interceptors manually. Releasing the interceptors in manual mode does not depend on the state of the limit switches. Air brakes in are not released in manual mode.

In an emergency flight, after landing, automatic release of interceptors and the air brakes did not occur, since there was no signal at the same time activation of four limit switches of the main landing gear. Manual release the crew did not apply interceptors. Interceptors and air brakes in in automatic mode, they were released normally after the aircraft rolled out of the limits runway and the operation of four limit switches. Thus, there are no failures and No malfunctions in the operation of this system were identified.

2.3.2.4. Brake system

The aircraft braking system consists of two independent subsystems: the main and backup, as well as the parking brake channel. The effectiveness of the main and backup subsystems are the same. During normal operation, braking is performed from the main subsystems. Switching to the backup subsystem occurs automatically in the event of a failure. main subsystem or manually when selected by the crew. There are also two braking mode: from pedals and automatic. The condition for applying pressure to The braking subsystem is activated by two limit switches on one of the main landing gear legs. When this condition is met, the brake is released after 5+1 seconds. locking for pressure supply to all pairs of wheels on both main landing gear supports. When the limit switch signal disappears, the 5-second cycle will restarted after the trigger signal appeared.

Even if there is no signal from the limit switches, the supply pressure in the corresponding pair of wheels occurs when both wheels spin on the same axles to a speed of at least 150 km/h. The pressure is maintained until the wheel speed reaches 30-20 km/h.

During automatic braking, there are two additional locks: ground speed (braking is possible at speeds below 250 km/h) and compression front support.

Anti-skid automatic (anti-lock braking system) in main and backup subsystems that work to slow down and reduce wheel slip relative to the runway, ensures skid-free braking at all values of the tire adhesion coefficient runway surface. The parking brake channel does not have automatic anti-skid control.

Analysis of the braking system showed that after landing, when compressed brake pedals by the crew, pressure was supplied to the brakes of the wheels of that support chassis that was compressed, while the pressure in the brakes of the wheels of the uncompressed chassis support was absent. Pressure was supplied from the main subsystem. insufficient grip of the tires of the compressed (left) landing gear support with the runway (due to high speed of movement and non-release of interceptors and air brakes) worked normally Anti-skid automatic: when the brake pedals were almost completely depressed, the pressure value (up to 40 kgf/m²) was significantly less than normal (100±10 kgf/m²).

4 seconds after pressing the brake pedals, a one-time command appeared "Failure of one pair of brakes of the main braking subsystem." During operation Anti-lock braking system signal "Failure of one pair of main brakes "braking subsystem" is formed if the rotation speed of one wheel in a pair exceeds 30 km/h, and the second wheel does not rotate for 1.5 seconds. probably during the movement of the aircraft (due to a slight change in the bank to the right side), there was contact between one of the inner wheels of the right main landing gear with the runway surface. Spinning only the inner wheel of the right main chassis support could lead to the appearance of the signal "Failure of one pair of brakes main braking subsystem." At the same time, according to the operating algorithm anti-lock braking system, spinning only one wheel does not lead to applying pressure to the brakes of this pair of wheels.

After another 5 seconds, a one-time command appeared: "Main subsystem failure" braking" with simultaneous switching to the backup braking subsystem. This one-time command was registered for 6 seconds, registration stopped recorded simultaneously with the termination of the registration of the one-time command "Refusal one pair of brakes of the main braking subsystem." Signal "Failure of the main "braking subsystem" is formed in the event of failure of the brakes of two or more pairs of wheels. By this time, the one-time command "Failure of one pair of brakes of the main subsystem "braking" was recorded for 5 seconds. An increase in the instrument airspeed and

the aircraft's roll and pitch oscillations led to a decrease in the contact of the landing gear wheels with runway, to uneven spinning of wheels of individual pairs and, as a consequence, to the formation signal of failure of another pair of wheels. In this case, when the brake pedals are depressed, A failure of the main braking subsystem may be diagnosed. Judging by the small time elapsed since the occurrence of the main subsystem failure alarm braking until the backup subsystem is activated, transition to the backup subsystem braking occurred automatically (the crew has the option of manual switching to the backup braking subsystem).

After switching, the aircraft's braking system was operated by reserve subsystem until the end of the recording, the crew does not apply parking braking used. Analog parameters or one-time commands indicating No abnormal operation of the backup braking subsystem was recorded.

When operating from the backup system, the maximum pressure in the brakes at full compression of the brake pedals did not exceed 50 kgf/m² which is explained by the work anti-skid automatics.

25 seconds after landing, the crew briefly applied the mode automatic braking, which turned off after pressing the brake pedals the second pilot, which corresponds to the logic of the system's operation. When the pedals are released in The system does not automatically return to automatic braking mode.

Thus, the braking system worked as intended. logic. In the absence of reliable simultaneous grip of all wheels on the runway braking was ineffective.

2.4 Analysis of the level of professional training, condition and actions of crew members

All crew members had valid aviation licenses. specialists. Detailed information on the professional training of crew members, including deviations from regulatory documents allowed during preparation, is given in section 1.5. This section analyzes only those aspects of preparation that which are directly related to the implementation of emergency and previous flights. Analysis of specific deficiencies and their possible impact on the outcome of the flight is given below in the text.

All flight crew members had valid medical certificates. The causes of the aviation accident are not related to the health of the crew members.

When conducting radio communications in English (when flying to Pardubice) the second the pilot was clearly having difficulty and kept asking again

information transmitted by the dispatcher, distracting the PIC from performing his duties. This situation could not help but irritate the captain, but his manner of communication with 2P: in a rude manner, with a lot of obscene expressions (*"Fuck, how shitty you are speak English", "Fourth level ..."*), led to quite a tense the atmosphere and nervousness in the cockpit, especially since the crew in this composition performed a flight for the first time.

Note: *As the Investigation Commission established, the available protocol and certificate of completion of the co-pilot test for determination the level of language proficiency according to the ICAO scale was falsified.*

When landing in Pardubice, the PIC allowed after the first touchdown separation of the aircraft from the runway, with repeated landing and lowering of the front The landing gear was significantly overloaded. After the plane stopped Crew members' conversations were recorded, indicating the captain's dissatisfaction completed landing: *"Look at the overload, how we screwed it up."*

In this case, the PIC, without understanding the situation, blamed another crew member for everything, the most probably B/I: *"It's all your fault."* As noted above, the consequence of such The tense emotional situation in the crew became the cause of the captain's behavior. Thus, During the flight to Pardubice Airport, a conflict may have arisen within the crew situation. This fact most likely contributed to the lack of normal interactions between crew members during an emergency flight.

Note: *As a result of the analysis of psychological testing results According to the SMIL methodology, psychologists have found that for The personality profile of the KVS is characterized, among other things, by an overestimated self-esteem, ease of decision-making and unceremoniousness, also the desire for freedom in expressing feelings and statements.*

Based on the analysis of the landing at Pardubice Airport, it can be noted the following piloting style of the PIC: descent at high speeds and smooth touchdown of the runway with a small vertical acceleration.

It should also be noted that the aircraft alignment was initiated by the PIC. relatively high, at a height of 12...15 meters. In accordance with the Flight Manual (paragraph 4.7.1.2(1)) leveling must begin from a height of 10...6 meters, without allowing for sustaining and take-off. At the same time, the analysis showed (section 1.16.2) that the crews of all without

exceptions for airlines operating flights on Tu-204/214 family aircraft, begin alignment at altitudes greater than those recommended by the Flight Manual. According to The Commission requires further joint study of this issue by the Federal Air Transport Agency, JSC Tupolev, test pilots and airline pilots.

The crew made a well-founded decision to fly to Vnukovo Airport.

Takeoff, climb and flight at altitude proceeded without any special features. approaching the point of the beginning of the descent, the crew received information from the dispatcher about the working strip, but did not specify the arrival route. This fact subsequently led to certain difficulties in programming the flight route and additional nervousness in the crew.

At the moment of the PIC's command to begin pre-landing preparations, 2P was engaged in calculation of the aircraft's center of gravity and mass. Judging by the recorded in-cabin data negotiations, this procedure caused him considerable difficulties. In fact, all 2P calculations were carried out under the guidance of the B/I. Instead of listening to ATIS information and preparations for the descent from the flight level, 2P continued to make calculations and Only after the captain repeated the request: "Are you ready to start?", did he begin to search navigation schemes. At the same time, 2P began to ask again which lane it would be on landing is in progress (although the crew received this information from the dispatcher in advance), which clearly irritated the captain.

Note: When performing pre-landing preparation, the RLE establishes

the following responsibilities for 2P:

- Clarifies the actual weather at the destination and alternate aerodrome, reports the captain.
- Reports readiness for descent and landing approach.
- Reports to the PIC about the descent and landing approach pattern.
- Enters the landing approach program into the VSS and the necessary data into the control center RTS.
- Enters the VPR or MVS value into the SEI PU No. 2.
- Checks the settings of radio equipment at the RTS No. 2 control center (aircraft flight manual) Tu-204-100V, p. 4.4.1.1).

During the pre-landing preparations, 2P continued to search for the necessary schemes, interrupting the captain several times and clearly not listening to the information. Thus, The crew's interaction was insufficient. 2P reported readiness. only 7 minutes after the PIC's command to carry out pre-landing preparations.

Analysis of the recorded information indicates that the crew planned to perform an ILS approach in director mode, The set ILS frequency corresponded to the approach pattern. Active piloting was supposed to be the captain, control and maintenance of radio communications - 2P, planned glide path speed – 230 km/h, flap position – 37°. After landing it was planned to use intermediate ("*small*") and maximum ("*large*") reverser. The distribution of responsibilities that the PIC determined during pre-landing preparation, complied with the provisions of the airline's operating procedures.

According to the flight manual, with a landing weight of 67.5 tons, the glide path speed is with flaps at 37° is 210 km/h. In the presence of turbulence, the flight manual recommends increase the approach speed by 10 km/h (paragraph 4.6.1(9)), and if there are signs icing – by another 10 km/h (section 4.6.6(2)).

It can be noted that during the pre-landing preparation the crew did not I listened to the ATIS information for the landing airfield in full. Partially listened to ATIS information could not allow the crew to receive information during pre-landing preparations to fully assess the meteorological conditions at the landing airfield.

Only after the descent from the flight level began, the crew listened to the ATIS information in full. Taking into account the gusts, the crosswind component (11.4 m/s) is almost corresponded to the maximum permissible for landing (according to the flight manual Tu-204-100V p. 2.2.3.(3) for a friction coefficient of 0.5, the maximum permissible lateral The wind component is 11.7 m/s). The crew did not discuss this information.

Note: *According to the RPP, the crew is obliged to take into account the values of wind gusts when production of takeoff and landing of aircraft.*

When performing the reduction, significant discrepancies are observed between set and recorded instrument speeds (up to 65 km/h) when the AT is operating (VSUT) in the "V Stabilization" mode. The indicated airspeed set by the crew was 440..408 km/h. When descending in the specified vertical speed mode, the AT (VSUT) does not can withstand such an indicated airspeed. The normal operation of the AT is evidenced by transfer of engine throttle to the flight idle position (minimum possible engine thrust when the VSUTS is operating) and the appearance of one-time commands "Stop sign "VSUT testing at the lower limit."

Note: *A survey of the airline's flight crew showed that it was most likely setting low values of the specified instrument airspeed was performed by the crew in order to descend from a given altitude*

vertical speed to "force" the autothrottle to move the throttle lever engines to idle mode.

It should be noted that during the entire flight, the modes set by the crew the work of the VSUP and VSUT were not announced, reports on the established tasks the values of altitudes and speeds were also missing, cross-check was practically not implemented. Thus, we can talk about significant deficiencies in crew resource management.

At an altitude of about 6,300 m, after receiving information about the arrival route Ivanovskoye 19 Alpha, the crew began changing the flight plan Analysis in-cabin conversations indicate that 2P was having difficulties, which may indicate insufficient skills in working with on-board computing system (VSS-95) installed on the Tu-204-100V. According to available information, the main The second pilot's flight experience on Tu-204 family aircraft was on the VSS-85, which has certain differences compared to the VSS-95. The captain himself was partially involved in it. When entering the route, he constantly corrected 2P, using rude and obscene language. The nervousness in the crew led to the fact that, judging by further negotiations, at this point At this stage of the flight, the crew mistakenly entered the arrival pattern of Ivanovskoye 19 Bravo.

Note: *Based on the results of a survey of flight crews, it was established that*

the error in question could also have been facilitated by the fact that the crews Airlines used arrival routes relatively rarely via the point "Ivanovskoye".

After receiving information about the arrival scheme from the dispatcher again Ivanovskoye 19 Alpha, the crew detected an error, registered within the crew next dialogue:

2P: *"This is our Alpha, you scored Bravo, I think."*

KVS: *"This is Bravo, damn it."*

2P: *"This is Bravo."*

KVS: *"Fuck, bitch!"*

2P: *"Maybe through Ivanovskoye? But that's..."*

KVS: *"This di ... through Ivanovo, through Ivanovo, fuck."*

KVS: *"There can't be any other fucking way, there's fucking ... "He's fucking lying."*

PIC: *"And what kind of landing gear, fuck your mother, if it's Alpha, then, fucking hell, this is fucking it."*

The need to adjust the approach pattern has again caused tensions to rise in cockpit. Despite the fact that the crew had already received several warnings from the dispatcher arrival diagram, at 12:18:44 the PIC again asked the dispatcher: *"Probably 19... Uniform Romeo16 19 Bravo, didn't you give us Alpha?"*, the dispatcher confirmed: *"Nine.... Romeo 92-68, Ivanovskoye, Uniform Mike 19 Alpha."* This request confused the dispatcher: *"Red Wings 92-68, are you familiar with this scheme: Ivanovskoye 19 Alpha?"*, the PIC confirmed: *"Yes, yes,"* although the crew still couldn't decide on the arrival plan. Judging by the negotiations, in During this time, the PIC was trying to find the right landing pattern, and the 2P was monitoring the descent aircraft, reporting approach to the assigned altitude. Only at an altitude of 2500 meters, the PIC finally decided on the arrival plan: *"We know each other!" ... "Of course we know each other, fuck!" ... "And There's also Alpha, fucking the best one, fuck your mother!"*

At an altitude of 2760 m, the launch of the APU was registered. According to the flight manual, the launch of the APU and its operation is controlled by the B/I on command from the PIC. There are no PIC commands on The launch of the APU was not registered. After the launch and the APU entering the operating mode The activation of SVC 2 and switching of air intake to SVC from engines was registered

to the Armed Forces of Ukraine (there were no reports from the B/I on the launch of the Armed Forces of Ukraine and the operation of the SCV).

While flying at flight level 70, the crew listened to the Hotel ATIS information. Taking into account gusts of the crosswind component (14.6 m/s) with the transmitted coefficient runway adhesion (0.5) exceeded the maximum permissible for landing (11.7 m/s). The crew did not react to this information.

During the rest of the flight, the situation in the cabin remained quite tense. The PIC, fearing that he would not have time to release the flaps into the landing position, was constantly nervous and hurried the second pilot. Such actions led to the second pilot acting in a state of haste, making mistakes even when communicating with the dispatcher via radio.

After transitioning to airfield pressure, the crew performed the appropriate control check map. During the execution of the map, it was confirmed once again estimated approach speed (230 km/h). At the same time, the above-mentioned There were also elements of haste in the execution of this map. Thus, the captain gave the command to release the flaps to the 18° position between the execution of the map points, not waiting for it to complete.

At a distance of 25...20 km from the end of the runway, the crew must complete the map control check of the control wheel. This requirement of the Flight Manual was not carried out, control of the control wheel by the crew was not performed.

¹⁶ The correct name for the Ivanovskoye 19A arrival plan is UM 19A, which stands for Uniform Mike, not Uniform. Romeo.

The landing gear was released by the crew prematurely, before the fourth mission was completed. turn. In accordance with the provisions of the RPP, the chassis must be extended when entering glide path.

In accordance with the RPP, at this stage of the flight the crew had to withstand speed $V_{zp}+40$, that is, at a landing approach speed determined by the PIC of 230 km/h, The maintained speed was supposed to be 270 km/h. In fact, the crew the speed of 300 km/h was maintained.

Analysis of the recorded information shows that the "Landing" mode was included in advance, according to the approach pattern, there was time left before the fourth turn was completed about 3 more km.

Seven seconds after the Landing mode was engaged, the autopilot was disengaged. It is most likely that the PIC was not satisfied with the maneuver he was performing. autopilot (see section 2.3.1). After disengaging the autopilot, the PIC performed a left turn to bring the aircraft onto the approach pattern. The crew's actions at this lack of proper interaction is observed at this stage of the flight. After disconnection The VSUP and the transition to manual piloting were recorded by the onboard tape recorder B/I report: "Chassis down, autothrottle off, autopilot on." How it was It was noted that the automatic control system (ACS) was switched off, but the automatic throttle (ACS) continued to operate. Automatic mode. Neither the captain nor the second pilot paid attention to the incorrect report.

The flaps were released to position 37 by the crew prematurely, during turn to landing course. According to the RPP, this action is performed after entering glide path. After the B/I report on the release of the flaps, the onboard tape recorder The completion of the "Before Landing" checklist has been recorded. The checklist Only 2P and B/I were carried out. Judging by the negotiations, the PIC was in check and control parameters were practically not involved. Apart from controlling the landing configuration aircraft (chassis, flaps, interceptors), the map provides control of the mode descent along the glide path (speed, angle of attack), so it must be carried out directly on the glide path. This map is executed during the aircraft's turn on the landing course indicates that the crew members followed the map formally, without taking into account the physical meaning of the checkpoints being performed.

Before performing the turn to the landing course, the crew reduced the set indicated airspeed to 249 km/h. After completing the fourth turn, in the process following to TVG, the following crew reports were recorded: B/I: "240", 2P: "Speed increasing," N/A: "250." This information provoked a violent reaction from the PIC: "Fuck, I'm sick of it, fuck off," after which the shutdown of the VSU (AT) was registered.

3 seconds later the B/I reported: *"Autothrottle off."* Analysis recorded information showed that none of the crew members checked the set instrument airspeed, which was still equal to 249 km/h. The airspeed control system operated normally, maintaining the specified indicated airspeed. A slight decrease in the indicated airspeed to 240 km/h was due to the transfer the aircraft began to climb with a vertical speed of about 5 m/s. At the moment of shutdown AT indicated airspeed corresponded to the assigned one. The further flight was carried out in director mode with the autothrottle off. Conducting an approach with the disconnected autothrottle increased the workload on the PIC and could contribute to failure to maintain the calculated speed during flight along the glide path.

After the VSUT was switched off, the throttles were immediately switched to the idle position. Such abrupt and impulsive management clearly indicates a high degree tension and irritation of the PIC. Since the flight in this section was carried out without a reduction, the reduction in engine thrust led to a rapid loss of speed, which 2P and B/I immediately drew attention:

B/I: *"220".*

KVS: *"Well, shut up, bitch."*

B/I: *"(illegible) speed!"*

B/I: *"230 speed".*

2P: *"Well, more speed (inaudible)."*

B/I: *"220, 220 speed."*

In an effort to maintain speed, the PIC constantly moved the throttle levers from the position idle throttle to 40...50° (Fig. 11). This type of throttle control was maintained almost to leveling off. In response to the crew's reports, the captain responded rudely B/I: *"If you scream again, Igor, don't make me lose my temper."*

Upon entering the glide path, the controller transmitted meteorological information to the crew, emphasizing Pay attention to the wind strength and direction and the runway conditions. Crosswind component near the ground (~14.5 m/s) clearly exceeded the maximum permissible for landing meanings. Answer 2P: *"Understood, 92-68"* was formal in nature. The crew I ignored the information from the dispatcher and continued the approach.

The descent along the glide path was initiated by the crew from the calculated distance. It is necessary It should be noted that the glide path entry altitude is 400 meters, while up to the altitude 300 meters the crew, according to the work technology, must create a landing configuration, perform a checklist, and select the operating mode engines and stabilize the approach speed. This situation creates a certain

lack of time, especially when flying in director mode with the automatic transmission disabled thrust, perhaps that is why in an emergency flight the actions to release the chassis and The crew had previously set the flaps to the landing position.

The descent along the glide path was carried out in the director mode with the engine off. autothrottle. Piloting was carried out with disproportionate, long movements steering wheel in the longitudinal channel with significant changes in the engine operating mode. At the same time, the normal glide load varied on average in the range of 1.2g...0.8g. The maximum values of overload change reached 1.4g...0.7g.

At the initial stage of descent along the glide path, the indicated airspeed was close to the planned speed of the PIC was 230 km/h, but later it increased to 250 km/h and even up to ~275 km/h, that is, it was 20-45 km/h higher than the calculated one. In accordance with the flight manual (p. 4.6.3.2) and RPP when the speed increases by more than 20 km/h, the second pilot is obliged was to report: "The speed is high," but no such report followed. Also The second pilot had to control the required angle of attack values (5...7°). The actual values of the angles of attack did not exceed 2°, but the corresponding There was no report from the second pilot.

The commission found that the estimated approach speed was exceeded was a typical practice for the PIC. A selective analysis of flights (total 31) revealed that, on average, the landing approach speed was exceeded by the PIC by ~30 km/h.

Note: *Exceeding the recommended approach speeds was a common practice at Red Wings Airlines. In the overwhelming majority most flights performed by different crews, the realized approach airspeed exceeded recommended by the RLE, the average excess was 20...25 km/h.*

On September 5, 2012, the PIC completed the annual qualification check with the pilot-instructor. The flight was carried out on the route Vnukovo - Hurghada - Vnukovo in simple meteorological conditions. According to objective monitoring data, when landing in In Hurghada and Vnukovo, glide path speeds were exceeded by ~30 km/h. According to the RPP, the accuracy of maintaining speed for a rating of "three" is plus 20 minus 10 km/h. Despite this, the flight instructor gave the captain a rating of "five."

The airline's express flight information analysis program allowed to detect excess of recommended speeds on the glide path. Fact excess of flight speed on the glide path was detected and, based on the processing results, qualification flight to Hurghada (upon landing at Vnukovo the event is not

formed due to malfunctions in the operation of the MSRP). However, this fact was not addressed by the airline due attention was not paid, a comprehensive decoding and analysis of the flights was carried out were not. In accordance with the RPP, all qualification checks of the flight commander, flight instructors and commanders of the Armed Forces are accompanied by a comprehensive decoding of flight data carriers. Results of decoding of carriers
Flight information is stored in the specialist's flight file for two years. Also, when
When conducting checks on a flight crew member, a corresponding card is filled out
qualification check. According to the information provided, the last time such a
The card for the aircraft's pilot was filled out when it was put into operation in 2008.

It should also be noted that FAP-128 (clause 5.7) and the airline's RPP require when conducting qualification checks of the direction of these objective means control to the authorized body entrusted with the functions of issuing certificates (licenses) of aviation personnel of civil aviation, as well as in in established cases, their suspension, limitation of action and cancellation, then is in the MTU VT CR FAVT. Any specification of what information means
There is no objective control and in what volume it should be directed. In turn, the MTU
The Central Committee of the Federal Aviation Administration did not request data from the airline's objective control systems regarding conducting a qualification check of the aircraft commander. Thus, the extension of the pilot's license certificate 01.06.2012 KVS conducted by MTU VT CR with deviations from the provisions paragraph 5.7. FAP - 128. The control provided for by FAP-128 by
The authorized body in this case was not effective.

Thus, the PIC systematically exceeds the approach speeds became possible due to an objective assessment of the professional level of the captain, performed by the pilot-instructor, as well as the lack of proper control on the part of the airline's flight service and aviation authorities. In accordance with paragraph 2.22 FAP-147, the PIC should not have performed flights as he had not passed (with (with a satisfactory assessment) a qualification check with a pilot instructor.

Initially, the aircraft was below the glide path (within one point), which the recording of the MSRP and the second pilot's report testify to this. The aircraft's exit to The equisignal zone along the glide path was completed at an altitude of ~270 meters.

It should be noted that in Part B, Section 2.4 "Flight Operation", Subsection 2.4.7 The company's "Approach to Landing" RPP provides control of a stabilized approach to landing. For a precision approach, this control is performed at an altitude of 300 meters. The following criteria are given for "stabilization" of entry into the RPP:

- The aircraft is on the calculated trajectory in vertical and horizontal planes (by instruments or by visual references)¹⁷;
- The aircraft is in landing configuration;
- All sections of the checklists and pre-boarding briefing have been completed.

At the same time, the following are not specified as criteria for the “stabilization” of the approach: maintaining the calculated speed (angle of attack) and the selected engine operating mode. However, these criteria are given in Part A, section 25.1 “Stabilized approach for landing”, subsection 25.1.3 “Definition of a stabilized approach”.

Thus, in accordance with the provisions of Part B, the crew had the right to continue landing approach, and the company's RPP requires approval of sections.

When issuing permission to land, the dispatcher once again informed the crew about the direction and strength of the wind (270 degrees 7, gusts 15). This wind is not allowed landing to be carried out, since the lateral component exceeded the limit acceptable values for the Tu-204-100V aircraft. The crew again ignored this information and instead of going around, continued the landing approach.

Systematic ignoring of the values of the lateral wind component, exceeding the maximum permissible values, indicates either the crew's ignorance the magnitude of the restrictions, or the desire to land at a particular airfield.

After the flight engineer reported an altitude of 100 meters, the PIC made a decision to landing, which the crew was informed about. Comparison of records barometric and geometric height, as well as analysis of the underlying relief the surface showed that the flight engineer reported an altitude of 100 meters radio altimeter, the actual height above the runway threshold was ~70 meters. This fact constitutes a violation of the crew's work procedures. During the landing approach It is prescribed that the flight altitude be determined at altitudes of 60 m and more using barometric altimeter, at altitudes less than 60 m – by radio altimeter; decision height 60 m and more determined by a barometric altimeter with control by a radio altimeter, less than 60 m (ICAO category II) to determine by radio altimeter (RLE Tu-204-100B, p. 4.6.2 (5)). In the accident flight, at this point in time, visual contact with the runway, meaning the flight engineer's error did not affect the outcome of the flight.

The runway entry threshold was passed at the specified altitude (~15 m) and significantly increased speed (~260 km/h). Upon crossing the runway threshold, the alignment began aircraft (increase in pitch angle), however, due to the increased flight speed, the aircraft

¹⁷ This criterion is given without specifying the quantitative values of permissible deviations.

switched to holding mode. The plane landed at a distance 950...1000 m from the threshold, that is, with an overflight. It should be noted that when performing the last qualification check landing at Vnukovo was also carried out with flight of about 1000 m. Despite this, as noted above, the pilot-instructor rated the actions of the captain as a "five".

The flight manual for the Tu-204-100V aircraft (section 4.7.1.3) provides for the following distribution responsibilities for the crew when performing landing:

KVS:

- At a height of 7...6 m¹⁸ begins alignment.
- After creating the landing position, move the throttle to IDLE.
- At the moment of contact: moves the steering wheel to the INTERMEDIATE STOP position.
- Lowers the front support.
- Having ensured the correct position of the aircraft relative to the runway axis: moves the power steering gear to the MAXIMUM REVERSE position.
- Compresses the brake pedals (when braking from the pedals or when not engaged) automatic braking).
- Maintains a direction parallel to the runway axis during the run.

2P:

- Controls altitude, vertical rate of descent, flight speed, the amount of roll.
- Controls the deactivation of the SPEED mode.
- When reaching a speed of 140 km/h: "SPEED 140 km/h".

B/I:

- Keeps track of the radio altitude every 2...1 m according to the checkpoint.
- "SMALL REVERSE ON."
- Controls the automatic release of spoilers and air brakes (in case of non-release, release the INTERCEPTORS with the handle).
- "INTERCEPTORS, AIRBRAKES RELEASED."
- When the speed $V_{put} \geq 250$ km/h is reached, it controls the inclusion automatic braking (if used).
- When automatic braking is activated, "AUTOMATIC BRAKING".
- After the engines have entered the "MAXIMUM REVERSE" mode.

¹⁸ In accordance with section 4.7.1.2, alignment should begin at a height of 10...6 meters.

Thus, the main load during landing falls on the PIC and the pilot-in-command. It should be noted that for the Tu-204-100 aircraft, the distribution of crew responsibilities is of a different nature: on command from the captain, the throttle lever is switched to idle mode, RUR in the position of small and maximum reverse, as well as control of the mode activation automatic braking is carried out by 2P. Similar differences in distribution duties of crew members for aircraft of the same type, but different modifications, may lead to confusion and incorrect actions when performing flights by one and the same by the same crews on Tu-204-100 and Tu-204-100V aircraft.

Note: *At the time of the accident, Red Wings Airlines was operating 5 Tu-204-100V and 4 Tu-204-100 aircraft. Flight survey the composition showed that the crews used one or another order turning on the reverser in a specific flight based on the decision of the PIC.*

According to the requirements of the Tu-204-100V aircraft flight manual, the inclusion of engine reverser on landing must be carried out in two stages after touching down on the main landing gear: first move the power steering to the intermediate stop (small reverse) and, only after making sure the correct position of the aircraft relative to the runway axis and the inclusion of the reverser (shifting sashes) upon activation of the corresponding alarm, move the RUR to the position maximum reverser. At the same time, during a rejected takeoff, the flight manual allows for switching RUR to maximum reverse mode with one movement. From the point of view of the systems operation aircraft involved in braking, landings and rejected takeoffs The only difference is that during an aborted takeoff the limit switches will be guaranteed to be compressed, meaning there will be no delay in repositioning the reverse valves. explanation from the aircraft developer, given the existing design of the aircraft and engines unify the procedure for turning on the engine thrust reverser on landing and an interrupted takeoff without deteriorating the aircraft's performance characteristics seems possible.

Note: *The flight manual prescribes to engage the reverser after the aircraft has landed without details of the characteristics by which the moment is determined landing. Features of the operation of limit switches of the compressed positions of the chassis supports (generation of ground-to-air signal) on the Tu-204-100V aircraft are discussed above. Theoretically, the crew can control the compression of all limit switches in the frame The control panel for IM No. 1, which is displayed on the screen during landing. The aircraft's flight manual does not directly prescribe such actions, however,*

*Note in paragraph 8.1.3(18) there is information for the crew that
The thrust reverser is activated only after the main landing gear is compressed.*

During the emergency flight, the PIC moved the power steering to the maximum reverse position. in one movement, without making sure that the valves are repositioned (relevant report the flight engineer's call was not heard). Most likely, the captain, knowing about the significant flight, tried to accelerate the aircraft's braking as much as possible. When landing in At Pardubice Airport, the reverse gear was switched on during the run in two stages.

Note: *In the RLE (section 8.1.3 (18)) it is recommended not to use the maximum reverse at friction coefficient greater than 0.45, airfield altitude less than 500 m, outside air temperature less than 30° and strip length more than 2500 m (corresponds to landing conditions in an emergency flight).*

As part of the AP investigation, an analysis of the Tu-204-100V aircraft's flights was conducted. RA-64047 for December 2012 (75 flights). None of the previous transfer flights RUR to the maximum reverse position, bypassing the intermediate position, when The run was not registered. However, it can be noted that in On some flights, the crews moved the RUR from an intermediate position to a position maximum reverse when the reverse lock opening alarm is triggered (Yellow REVERSE LOCK) without waiting for the reverse to be engaged (alarm "REVERSE ON" in green). Analysis of the PIC flights performed during the period from 01.11.2012 to 29.12.2012, showed that the transfer of the RUR immediately to the maximum position reverser (bypassing the intermediate position) was sufficient for the PIC common practice: out of 31 flights, 14 recorded the transfer of the RUR to one reception in the position of maximum reverse. In one movement, the maximum reverse was included and during the last qualification check (05.09.2012, flight Hurghada airport – Vnukovo Airport). As noted above, despite this and other deviations from According to the provisions of the flight manual, the PIC's flight was rated as a "five" by the flight instructor.

After landing, the interceptors and air brakes are automatically released. did not occur. According to the Flight Manual (sections 4.7.1.2 and 4.7.1.3), automatic release control air brakes and interceptors after landing, as well as control of inclusion reverse thrust, carries out B/I. If the automatic release of air brakes and there were no interceptors after landing, the B/I must release the interceptors manually. This requirement of the flight manual was not fulfilled by the flight engineer, the interceptors remained in the retracted position until the aircraft rolled off the runway.

Note: *Release of air brakes and spoilers after landing*

happens automatically. If there is no automatic release happened, release the interceptors completely by moving handles INTERCEPTORS in one movement (Aircraft Manual Tu-204-100V, clause 4.7.1.2 (4)).

On landing. Flight engineer.

In the automatic release of interceptors and air brakes on run through the frame of the UPR on IM No. 1 - make sure.

If the automatic release does not work, the handle INTERCEPTORS in the released position - install (RLE Tu-204-100V, p. 8.7.3 (9)).

Note: *On December 20, 2012, an airplane rolled out at Tolmachevo Airport.*

Tu-204-100B RA-64049 (section 1.18.5). The investigation established that that after landing the interceptors and air brakes in were not released automatically. Release of interceptors in The crew did not perform the manual operation. According to the airline, after this serious incident with the flight crew there were relevant analyses were carried out, at which the following was addressed: attention to the need to release the interceptors manually mode. The captain and flight engineer were present at the debriefing, the second pilot - no. 12/23/2012 (after analysis) on a Tu-204-100V aircraft RA-64047: No release occurred during landing at Vnukovo Airport interceptors and air brakes in automatic mode, the crew released the interceptors manually; at the same time on December 29, 2012, in the event of a similar event on a Tu-204-100V aircraft RA-64049, Manual interceptor release failed. According to available information, the airline is currently a procedure for the mandatory release of interceptors has been established manual mode at each landing.

Section 4.7.1.2 of the AFM lists (numbers) the operations that the crew must perform upon landing. Which crew member must perform the specified operations are detailed in section 4.7.1.3. In section 4.7.1.2, the operations for switching on and control of the inclusion of reverse (both small and large) precedes operations on control of the release of interceptors and air brakes. At the same time, according to

Section 4.7.1.3 actions to control the inclusion of small reverser and release the flight engineer must operate the interceptors and air brakes simultaneously, The control of the maximum reverser engagement is performed later. In this case, the RLE does not determines the flight engineer's actions in the event of failure to engage the reverser and the absence of signaling its failure.

Taking into account the above, as well as the fact that the available simulators did not allow practice the crew's actions when the limit switches fail to operate (that is, if the reverser flaps are not repositioned and the interceptors and air brakes are not released in automatic mode), and other types of training to practice these actions were not provided for, most likely, B/I switched all attention to control turning on the reverser and did not perform the subsequent actions (to control the release interceptors and air brakes), and the PIC, busy maintaining the direction aircraft run with a strong crosswind and the thrust reverser engaged, position air brakes and interceptors were also not checked. This is confirmed also negotiations and further actions of the crew members: after an unsuccessful attempt turning on the reverser, the crew made two more attempts, and the flight engineer several times reported that the reverser did not engage. None of the crew members tried analyze the reasons for the failure to engage reverse.

Note: *At the time of the accident, the flight manual of the Tu-204-100V aircraft did not contain recommended actions for the crew in case of failure to engage the reverser engines. According to paragraph 4.7.1.3. transferring the power steering control to the position for engagement The PIC performs the reversal, and the B/I monitors and reports about engaging the reverser. Instructions for the crew's actions in case of Engine reversing faults are contained in section 8.1.4, item 4.27 "Malfunctions." This refers to situations where: "BELL STROKE sound signal, LOCK display does not light up REVERSE and (or) REVERSE ON, KISS (DV/SIGNAL) text DV1 (2) REVERSER IS NOT FUNCTIONAL." In this case, the B/I is prescribed "Reverse DV1" (2) Do not use." In an emergency flight, the alarm will be triggered. There was no bell strike and no "REVERSE FAULTY" message. However, as it was It is noted above that during the landing process the B/I does not control the RUR and, accordingly, it cannot "use" or "not use" reverse. Prohibition of re-engaging the reverse when it There was no failure in the RLE.*

The analysis showed that, most likely, the failure to engage the reverse during the run and the lack of braking became the trigger for the emergence of the strongest psycho-emotional stress among all crew members, against which further The actions during the final stage of the run were impulsive and chaotic. The crew's interactions were completely disrupted. Personal issues came to the fore. factors. An analysis conducted by an aviation psychologist showed that the flight engineer in In a stressful situation, excessive, not always purposeful, behavior may manifest itself activity; in KVS – a narrowing of consciousness with a focus on one or two ideas; in the second pilot - uncertainty, passivity, with a tendency to stop reactions.

An analysis of the crew's subsequent actions confirms the psychologist's findings. After an unsuccessful attempt to engage the reverser and in the absence of aircraft braking, in further, almost all commands (for braking, re-engaging the reverse gear and even the use of automatic braking) came from the flight engineer, while he did not fulfilled his direct duties of monitoring the position and releasing the interceptors. It should be noted that the release of interceptors in manual mode even after the first attempt the use of reverse could have prevented further development of the special situation. The remaining The runway length allowed for the safe completion of the runway. The flight analysis conducted by JSC Tupolev 12.02.13 on the Tu-204SM aircraft, with initial data similar to emergency flight (weight, center of gravity, landing speed), showed that if the crew in emergency flight even after the first unsuccessful attempt to engage the reverser and the current at a speed of 250 km/h, I released the interceptors manually, with the engines running in mode "low throttle" he would have been guaranteed to be able to stop the plane within the runway.

The captain actually lost control of the situation and focused on turning on reverser (two more attempts were made) and the flight engineer's commands were carried out. The second the pilot was outside the control loop, did not participate in the crew's work and did not understand, what's going on . This is evidenced by his question: *"Are they taking off or something?"* increasing speed, as well as squeezing the brake pedals when attempting to take off the aircraft and flight engineer to apply automatic braking.

Conversations inside the cockpit indicate that the captain and flight engineer are present internal psychological attitude (dominant) aimed at inhibition (stopping) the aircraft, even when the remaining length of the runway would clearly not be enough to stop the aircraft safely. Analysis shows that having sufficient speed 220...240 km/h, which the plane had during the last 10 seconds before rolling out, was quite sufficient to perform a takeoff with flaps extended to 37° (such maneuver is not provided for by the RLE). However, due to a lack of understanding of the current situation, as well as

due to the psychological unpreparedness of the crew, primarily the captain, in the current situation. In an emergency situation, this possibility was not discussed and was not implemented.

It should be noted that this feature cannot and should not be used by crews as a "normal" means of eliminating the consequences of unstabilized approaches to landing. In case of an unstabilized approach to landing, it is imperative to perform a go-around with established flight altitude.

Only immediately before the aircraft rolls out of the runway, the PIC abandoned attempts to engage the reverser and gave the command to the flight engineer to turn it off engines. This was a smart move under the circumstances and, perhaps, made it possible to prevent a large-scale fire on the plane.

As a general conclusion on the assessment of the crew's actions, it can be noted that throughout the flight the PIC was unable to properly organize the work in crew, crew resource management was at an unsatisfactory level, which, along with the noted shortcomings in professional training and stress psychological situation created by the communication style of the captain, and predetermined erroneous actions of the crew in the emergency flight and their inability to counter the situation that arose after the failure to turn on the reversing devices and the increase direct thrust of engines.

3. Conclusion ¹⁹

The cause of the crash of the Tu-204-100B RA-64047 aircraft was a misalignment control and blocking mechanism of the reversing device of both engines and incorrect (not in accordance with the provisions of the flight manual) actions of the crew during the run after landing, while controlling the interceptors and thrust reverser, which led to lack of effective braking of the aircraft, rolling off the runway, collision with an obstacle at high speed (~190 km/h), destruction of the aircraft and loss of life.

Contributing factors to the disaster were:

- not taken into account in the operating documentation determining the inspection procedure and adjustments to the engine management system when replacing it during operation, actual rigidity of the control and locking mechanism design reversing device. This factor can only manifest itself when crew control of thrust reverser in violation of the provisions of the flight manual;
- inconsistencies and contradictions in the technical documentation for the aircraft and engine and a formal approach over a long period of time to execution checks of the engine control system adjustment (including the mechanism control and blocking of the reversing device) by organizations, replacing engines, which did not allow for the return contact with the aircraft and engine developers and promptly resolve existing shortcomings;
- unstabilized landing approach and significant (up to 45 km/h) excess the crew of the estimated flight speed along the glide path, which led to a long maintaining the aircraft before landing, significantly lengthening landing distance and landing of the aircraft with an overflight (~950 m);
- failure to release interceptors and air brakes after landing automatic mode due to the lack of a signal for simultaneous compression of the left and the right main landing gear, which was the result of the advanced "soft" (vertical overload 1.12g) landing of the aircraft on the left main landing gear with a side wind component from the right of the limit values (~11.5 m/s);

¹⁹ In accordance with the ICAO Manual of Aircraft Accident and Incident Investigation (DOC 9756 AN/965), the causes and factors are presented in a logical order, without an assessment of priority.

- lack of control by crew members over automatic release interceptors and air brakes after landing and failure to release interceptors in manual mode;
- violation by the crew of the technology for using the reverser as provided in the flight manual thrust on landing, expressed in the application of maximum thrust reverser "by one movement", without setting the RUR to the intermediate stop (small reverser) and without control of the position (relocation) of the reversing device flaps, which, when the above-mentioned shortcomings of the control mechanism and the reversing lock devices, led to an increase in the direct thrust of the engine;
- absence of a simultaneous compression signal during the entire runway run main landing gear due to the design features of the limit switches²⁰ compressed position of the main landing gear (for operation the switch requires a load on the rack of ~5.5 t) and failure by the crew provisions of the flight manual for the release of interceptors in manual mode, which normally led to failure to switch the reversing device flaps to the reverse thrust mode;
- poor crew resource management by the PIC during the entire flight, which, during the landing approach, led to a lack of control over stabilization of the approach, and at the run stage – to "fixation" on the operation turning on reverse in the absence of control over the operation of other systems;
- failure to take timely preventive measures during the investigation serious incident that occurred on December 20, 2012 at Tolmachevo Airport with by Tu-204-100B RA-64049 aircraft of Red Wings Airlines;
- unsatisfactory level of organization of flight operations and incapacity airline safety management systems, as well as formal attitude towards the performance of the qualification check of the aircraft commander assigned to this goal of the pilot instructor and the lack of proper control in the airline qualification checks and flight operations by means of objective control, which did not allow for timely identification and elimination systematic deficiencies in the piloting technique of the aircraft commander in terms of maintaining increased speeds when flying along the glide path, as well as the technology of use thrust reverser during landing rollout. As stipulated by FAP-128 (p. 5.7) control over the conduct of qualification tests was not carried out;

²⁰ There were no failures in the operation of limit switches.

- the absence of training in the periodic training programs for crew members actions in situations related to the failure of limit switches main landing gear and, as a consequence, with the failure of the interceptors and air brakes in manual mode. The technical capabilities of the existing simulators are not allow you to work through this situation.

4. Deficiencies identified during the investigation

The deficiencies are listed in the text of the report.

5. Recommendations for improving flight safety

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5.1 To the aviation authorities of Russia

5.1.1 Information on the results of the investigation of the aviation accident

communicate this to flight and engineering personnel of airlines.

In the analysis, flight crews should pay special attention to:

- the PIC's responsibility to stop the descent and carry out the interrupted landing approach (go-around) in the cases specified in paragraph 3.90. FAP-128, as well as to comply with the requirements of the RLE and Instructions for interaction and technology of work of crew members (standard operational procedures) when performing landing;
- to clarify the differences in procedures for engaging engine thrust reverser during landing and rejected takeoff.

5.1.2 Together with JSC Tupolev, test pilots and line

airline pilots to analyze the reasons for the current situation

exploitation of the practice of early (at higher altitude) start of leveling

compared to the recommendations of the RLE. Based on the results of the analysis, accept the corresponding decision.

5.1.3 Taking into account the provisions of the ICAO Aircraft Oversight Manual

to develop and implement instructions to ensure flight safety

material on methods for assessing the compliance of civil organizations aviation requirements in force.

5.1.4 In the framework of the implementation of the Federal Law of December 25, 2012 No. 260-FZ

continue work on implementation in airlines, airports, and maintenance centers

and repair of aircraft flight safety management systems, including in this

system of all divisions of airlines, airports and maintenance centers and

repairs. Eliminate formalism in the approval of airline SMS.

5.1.5 Taking into account the provisions of Amendment 101 to ICAO Annex 8 and Annex 19

to come up with an initiative to introduce amendments to the regulatory legal acts on

issues of implementation of the BPMS at enterprises responsible for standard

design and manufacture of aircraft.

5.1.6 Implement recommendations on the content of flight data analysis programs,

provided for in paragraph 5.7 of the FAP "Preparation and execution of flights in

²¹ The aviation authorities of other States Parties to the Agreement shall consider the applicability of these recommendations taking into account the actual state of affairs in states.

civil aviation of the Russian Federation”, with the aim of providing methodological assisting airlines in identifying deviations in operating rules aviation equipment according to objective control data. Establish the order and volume of information provided by the operator to the authorized body for conducting pilot qualification tests, as well as the procedure its consideration, analysis and adoption of corrective measures.

5.1.7 Conduct a one-time test of the “Obzor” video surveillance system

Tu-204 aircraft for its operability, including testing registered video information. Together with the developer the aircraft's flight manual should be supplemented with provisions for the use of the system CCTV "Obzor".

5.1.8 Ensure improvement of simulator training of flight personnel,

operating Tu-204/214 family aircraft. For this purpose:

- determine the procedure and frequency of assessing the suitability of the training equipment complex (simulator, including software, including mathematical model of an aircraft; methodological classes and manuals; simulator instructors) to perform training tasks flight crews in the declared volume, for which purpose a comprehensive a group of specialists with the involvement of representatives of the developer and aircraft operators, as well as test pilots;
- speed up edition Federal aviation rules, regulating the use of training devices for training and advanced training of flight personnel; before publication FAP to develop a temporary procedure for assessing the conformity of training equipment or conduct such an assessment in accordance with the NG AOS and the document ICAO 9625, third edition – 2009;
- consider the need to revise flight training programs composition on Tu-204/214 aircraft and their modifications, taking into account the actual condition of the simulators. If it is impossible to practice certain situations due to deficiencies in hardware and software develop and implement alternative measures to provide simulators confirmation of compliance with the level of training of aviation personnel personnel in accordance with current regulatory documents;
- evaluate the applicability of this recommendation to other exercise machines types of domestically produced aircraft.

5.1.9 Mandatory involvement in the investigation of incidents

aircraft, engine and component development specialists
(including developers from other countries) if possible
technical faults. If necessary, ensure the development and
implementation of operational preventive measures before completion
investigation of aviation incidents.

5.1.10 Conduct events by conjugation automated

meteorological measuring system "AMIS-RF" with the system
unified time of the Vnukovo Center of Internal Affairs of the branch of the "MC AUVD" of the Federal State Unitary Enterprise
State Corporation for Air Traffic Management.

5.1.11 Conduct activities for automatic dissemination of information

about the ATIS index directly from the ATIS operator to workplaces
dispatchers of the branch "MC AUVD" of the Federal State Unitary Enterprise "State ATM Corporation".

5.1.12 Issue a directive to operating enterprises on

the contents of the operational statement for the installation of PS-90A engines on
aircraft, providing for the inclusion of positions in them that provide for
registration of parameters (numerical values) of system adjustments
engine control, the requirements for which are established in
corresponding technological maps.

5.1.13 Improve the quality of licensing and certification of organizations,

performing maintenance of aircraft and engines.
coordination, involve representatives in the performance of these works
developer and manufacturer of aircraft and engines.

5.1.14 Taking into account the non-decreasing percentage of aviation

incidents related to the manifestation of human factors in flight and
technical operation of aircraft, develop a target
a comprehensive program on all aspects of human factors
on flight safety.

5.1.15 Together with the Ministry of Industry and Trade of Russia, develop an interdepartmental

Regulations on the procedure for the development and approval of measures for
the results of investigations of incidents and aviation accidents, their
accounting, control over implementation and timely communication to aviation authorities
enterprises, organizations and bodies that conducted the investigation, as well as
ensuring funding for necessary work, including research
aviation equipment.

- 5.1.16 Recommend that airlines conduct voluntary self-monitoring based on the results of each air travel season on the main issues affecting on flight safety, with the preparation of a plan of necessary measures.
- 5.1.17 Conduct a flight and technical conference to summarize the experience operation of Tu-204, Tu-214 aircraft and their modifications with engines PS-90A with an analysis of the circumstances of the aviation events that took place, and as well as techniques and skills for safe piloting.

5.2. Rosaviatsia together with Aviadvigatel OJSC

- 5.2.1 In accordance with Article 37 (paragraphs 4 and 6) of the Air Code Russian Federation, together with JSC Tupolev and others developers of aircraft on which PS-90A engines are installed, to evaluate sufficiency of all measures taken to ensure further safety operation of aircraft with PS-90A engines. Contribute (if (if necessary) additional changes to the aircraft and engine operating documentation.

5.3. JSC Aviadvigatel

- 5.3.1 Together with JSC Tupolev and other aircraft developers, on which PS-90A and PS-90A2 engines are installed, consider the feasibility introduction of an additional electronic blocking of the increase in the mode engine operation with the reverser not released.

5.4. JSC Tupolev

- 5.4.1 Analyze the operating instructions of other types of aircraft, in relation to which JSC Tupolev is the holder of the Type Certificate for the subject the presence of deficiencies identified during this investigation. the need to take corrective measures.
- 5.4.2 Conduct an analysis of the operational reliability of the types used limit switches, taking into account the measures taken to reduce intervals for their periodic lubrication. Based on the results of the analysis, give specific recommendations on the advisability of replacing them with more reliable.
- 5.4.3 Taking into account the results of the implementation of the previous recommendation, consider the feasibility of changing the logic of ground/air signal generation to ensure its reliable formation in all expected conditions operating conditions (low landing weights, landings with small values of vertical speeds (vertical overloads),

maximum crosswind, etc.) and/or the logic of the systems' operation, providing braking of the aircraft after landing.

- 5.4.4 Consider the feasibility of making changes to the RLE and GPMO in terms of permission to land without using reverse thrust engines, and also determine the order of using the thrust reverser engines in case of RED failure (operation on backup automation).
- 5.4.5 Consider the feasibility of making changes to the flight manuals of various modifications of the Tu-204/214 family of aircraft in terms of unification the order of control of engine thrust reverser on landing (controlled by the PIC or co-pilot). Eliminate other deficiencies and inaccuracies in the Tu-204-100B, identified during this investigation (items 6.7.3.2(18), 8.1.1.2(2), 8.1.4(4.27)); analyze the RLE of other modifications of the Tu-204/214 family for the presence of the specified deficiencies.
- 5.4.6 Based on the example of the world's leading manufacturers of aviation equipment develop and implement standard crew training programs (such as Flight Crew Training Manual, FCTM).
- 5.4.7 Analyze the operation of the VSUP together with the autopilot developers during the landing approach in the emergency flight. Based on the analysis results make an appropriate decision.
- 5.4.8 Together with test pilots and air line pilots airlines to analyze the operating experience of Tu-204/214 aircraft after the introduction of temporary amendment No. 33 to the Flight Manual (in terms of changes (procedure for the crew's actions during landing). Based on the results of the analysis, adopt the corresponding decision.

5.5. For aircraft developers

- 5.5.1. Ensure compliance with the International Organization Standards civil aviation for maintaining airworthiness, ensuring and extension of flight resources, taking measures for prompt elimination failures identified during operation, ensuring the system after-sales service throughout the entire life cycle aircraft, taking into account the experience of leading aircraft manufacturers corporations.

5.5.2. When writing the operating instructions for the main product, ensure the approval of the operating instructions components (purchased) products as components of the RE the main product, in accordance with the provisions of GOST 18675-79.

5.6. To airline executives

5.6.1 Review the recommendations issued by Red Airlines

Wings", to analyze the situation with the organization of flight work, personnel training, quality control of performance flights and risks, as well as the effectiveness of the existing airlines flight safety management systems and, when necessary, take corrective actions aimed at improvement of the above mentioned processes.

5.6.2 To implement the developer's responsibilities for maintaining flight the suitability of the park, immediately submit to the developers aircraft, engines and components (including foreign developers) complete and objective information in the field of flight suitability, including a description of incidents that occurred during the process operation due to failures and malfunctions of aircraft techniques.

5.7. Airlines operating Tu-204/214

5.7.1 In agreement with the Federal Air Transport Agency and JSC Tupolev, supplement express analysis algorithms for action monitoring messages crews when turning on the engine thrust reverser, as well as work limit switches for the compressed position of the chassis supports.

5.8. Red Wings Airlines

5.8.1 Improve the airline's flight safety management system taking into account the shortcomings identified during the investigation. Special pay attention to the regular holding of events identification of hazardous factors affecting flight safety, and also updating the risk map and measures for their control and mitigation.

5.8.2 Within the framework of the airline's flight safety management system assign the responsibility to the command flight, instructor and the inspectorate staff shall constantly monitor the implementation flights using objective control means. Special attention pay attention to maintaining approach speeds and order using engine thrust reverser. Please note

instructor staff to be personally responsible for objective assessment of the qualifications of the inspected persons of the aviation staff.

5.8.3 Ensure the effective functioning of the voluntary system

messages about shortcomings and errors made during execution flights, with the aim of discussing them with other crews and taking measures to correct them warning.

5.8.4 Take measures to prevent the formal implementation of technical

by the personnel of the technological maps during the technical aircraft maintenance.

5.8.5 Correct other deficiencies identified during the investigation

aviation accident.

5.9. JSC "II"

5.9.1. Consider the need to make additions to the relevant

sections of the flight manual for aircraft with PS-90A engines developed by JSC "II" in terms of the order of turning on the engine thrust reverser for unification of the provisions of the flight manual with the provisions of the engine manual.

**Dissenting opinion of a member of the commission investigating the disaster
Tu-204-100B RA-64047 aircraft, which occurred on December 29, 2012**

1. In section 1.6 "Information about the aircraft" (subsection "Work on replacing engines on the aircraft") it is rightly noted that only during the investigation of the aircraft an explanation was received from the engine developer that under "stop" (mentioned in paragraph 2.7 of the process map "Inspection and testing of the control system" (073.21.00, pp. 601...606), concerning the checking and adjustment of the control and locking mechanism (CLM)) should be understood as the intermediate stop of the RUR ("small reverser").

It should be noted, however, that PS-90A engines are used not only on Tu-204-type aircraft, but also on Il-96 aircraft, where the concept of "small reverser" was introduced only in 2009 (Il-96 Aircraft Flight Manual Amendment No. 187, dated September 30, 2009). On the Il-96, engaging maximum reverser without stopping the power steering at the intermediate stop is the primary method of using the thrust reverser during landing.

Moreover, modifying the Il-96 aircraft to accommodate the use of a small thrust reverser is not mandatory. Furthermore, the PS-90A engine manual does not contain any specific provisions that take into account the specifics of the Il-96 engine control system. Consequently, the engine developer's clarification cannot be fully utilized.

I propose supplementing the final report with information on the operating characteristics of PS-90A engines on the Il-96 aircraft.

2. In section 1.16.3 "Natural ground-based modeling of the operation of the blocking system and "reverse control" (subsection "Experiment on the Tu-204-100V RA-64022 aircraft") is done the conclusion that the failure of operating organizations to comply with the requirements of the engine operating manual The PS-90A was one of the factors that led to the aviation accident.

The investigation revealed no direct or indirect evidence that the operating organizations violated the aircraft or engine manual requirements during the engine replacement. A comparison of the data recorded in the engine repair files with the data from the Tu-204-100V RA-64047 aircraft data recorder during flights performed after the engine replacement did not confirm the possibility of "misalignment" of the engine control system to values outside the tolerances of the aircraft and engine manuals.

The final report contains information indicating that the Tu-204-100V aircraft manual and the PS-90A engine manual contain contradictions. Given the inconsistency in the interpretation of the term "thrust" noted in paragraph 1 of this dissenting opinion, this indicates that the aircraft and engine developers failed to ensure the required operational manufacturability—the instructions and recommendations set forth in the operating documentation were not clearly formulated and allowed for ambiguous interpretation.

3. In section 1.18.1 "Exercise Equipment" (subsection "General Provisions") there are references to some points of the regulations of the Federal Air Transport Agency concerning use of simulators that were in operation at the time of the disaster, but during the period investigations have undergone significant changes or have been cancelled by the relevant decrees of the Government of the Russian Federation. Taking into account the decisions taken The Government of the Russian Federation, in relation to the functions of Rosaviatsia, proposes eliminate or completely revise references in the final report to Regulations on the Federal Air Transport Agency.

It is necessary to exclude the reference to the document entitled "Administrative Regulations of the Federal Air Transport Agency for the provision of public services for issuing permits for the use of integrated flight simulators for

training of aviation personnel", since such a document was not approved by the regulatory legal acts of the Russian Federation.

The subsection "Tu-204 KTS Simulator (serial number 0101)" concludes that "the subjective (flight) testing of the simulator was performed only by the operator crews without the involvement of specialists from the State Research Institute of Civil Aviation or the flight test center." However, it fails to take into account that, according to paragraph 6.1.4 of the Standards for the Suitability of Flight Simulators for the Training of Air Transport Personnel, approved by the Federal Antimonopoly Service of Russia on May 15, 1998, individuals with "sufficient flight experience on the relevant aircraft type" may be involved in the subjective flight evaluation as experts. Furthermore, these standards do not require the issuance of an order or other regulatory legal act confirming the authority of the experts involved.

Taking this into account, it is proposed to make appropriate changes to section 1.18.1
final report.

4. In section 1.18.2 "Flight evaluation" (subsection "Analysis of the actions of the aircraft crew Tu-204-100B RA-64047 landing at Vnukovo Airport on 12/29/2012") is made unambiguous the conclusion about the "increased clearance" between the camshaft and the guide, which is not confirmed objective data (see point 2 of this dissenting opinion).

However, during the investigation it was not possible to determine what efforts the aircraft commander could have applied to the RUR to move them to full speed when the reversing device was in the "forward thrust" position.

It is necessary to exclude or comment on the conclusion about the "increased gap" and its influence on the actions of the aircraft crew.

In the subsection "Comparative analysis of the recommendations of the Tu-204-100V aircraft flight manual for landing procedures with similar sections of the FCOM/QRH for individual Western-made aircraft," a comparison is made with Boeing 747/757/767/777, A-318/319/320/321, Falcon 7X, and CRJ-900 aircraft. However, the final report does not mention or analyze the crew work techniques of the Il-96 (see paragraph 1 of this report) and Tu-214, which differ from the technology proposed in the Tu-204-100V flight manual.

The crew work techniques for the Tu-204 and Tu-214 aircraft are considered in the final report to be identical, although the recommended FLE for the distribution of duties within the crew during landing has a number of fundamental differences, with the FLE for the Tu-214 aircraft providing for a more rational (compared to the Tu-204-100V) distribution of duties between the PIC and the second pilot during landing and the post-landing run.

It is proposed to supplement the final report with an analysis of the flight manuals of not only foreign but also domestic types of aircraft.

5. It is proposed to exclude section 1.18.3 "SAFA" of the final report (SAFA - local (regional) program of the European Union), since it has no connection with the circumstances, the cause of the event under investigation and the recommendations proposed in this regard.

6. During the investigation of the aviation accident involving the Tu-204-100B RA-64047 aircraft In addition to the shortcomings in the activities of Red Wings CJSC, shortcomings and omissions were identified in activities of aircraft and engine developers.

However, the final report only presents section 1.18.4, "Flight Safety Management System at Red Wings Airlines." The final report does not include a section on the deficiencies in the aircraft and engine developers' SMS, or the negative safety consequences of the developers' failure to implement the SMS.

the plane and the engine.

It is proposed to supplement the final report with a section describing the SMS aircraft and engine developer.

7. In section 1.18.6 "Serious incident on 20.12.2012 at Tolmachevo Airport" it is necessary state the reason for the serious incident with the Tu-204-100B RA-64049 aircraft in the version in which it is given in the conclusion of the investigation commission.

8. The main concept of Section 2 "Analysis" of the final report is based on the fact that in During operation, the engine control system became out of adjustment. Taking into account this leads to the conclusion that ensuring the fit of the MUB cam to the guide would allow to avoid the engines reaching a higher mode before the reversing gears are repositioned devices in the "reverse thrust" position.

During the investigation it was shown that when adjusting the engine to the lower limit (airspeed minus 22°, EO of the Tu-204-100V aircraft), it is possible for the RED-90 to be triggered, issuing a control command to increase the engine operating mode without first repositioning the reverser.

The automatic engine control system has a main and a backup Automatic control. Transitioning to engine control from the backup automatic control is not a special case in flight. The investigation showed that, with the guaranteed absence of "misalignment" (upper limit adjustment - arur minus 14°, PS-90A engine manual) and When the engine is operating on backup automatic mode, even after the design changes implemented during the investigation aimed at increasing the rigidity of the control wiring, when moving the RUR, the engine operating mode will increase without first moving the reversing device to the "reverse thrust" position.

These features indicate a design error in the implementation of the requirement for automatic limitation of the engine operating mode in the event of failure to engage the reverser, which is one of the factors in the aviation accident.

The lack of a clear understanding between the aircraft and engine developers regarding the method for implementing this requirement is evidenced, for example, by the contradiction between Sections 4 and 8 of the Tu-204-100 Flight Manual (a complete analogue of the Tu-204-100V) regarding the use of the thrust reverser. Section 8.1.3 (21) of the Tu-204-100 Flight Manual allows for the possibility of engaging the thrust reverser in a single step—setting the throttle to idle and moving the power steering to maximum thrust reverser within 1-2 seconds.

I believe that, in the case of Tu-204-100V RA-64047, the Tu-204-100V flight manual's requirement that maximum thrust reverser cannot be engaged without first engaging the low thrust reverser cannot be considered as a requirement for automatically limiting engine performance if the thrust reverser is not engaged. These requirements must be met through appropriate design solutions.

Therefore, I consider the conclusion contained in Section 2 "Analysis" that the manifestation of design defects in the aircraft and engine was a consequence of violations by the crew of the Tu-204-100V RA-64047 aircraft and the misalignment of the engines during their operation to be biased.

9. Taking into account the provisions set out in paragraphs 1–8 of this dissenting opinion, I propose to amend Section 3 "Conclusion" (consists of 12 paragraphs) contains the following changes:

the first paragraph shall be stated as follows: "The cause of the crash of the Tu-204-100B RA-64047 aircraft was the failure of the control mechanism and the interlock of the thrust reverser of both engines and incorrect (not in accordance with the provisions of the flight manual) actions of the crew during landing and during the landing roll, which led to the lack of effective braking of the aircraft, rolling off the runway, collision with an obstacle at high speed (-190 km/h), destruction of the aircraft and loss of life";

the second paragraph shall be stated as follows: "a design error in the implementation of the requirement for automatic limitation of the engine operating mode in the event of failure to engage the reversing device, which, taking into account the rigidity of the engine control system, led to an increase in the engine operating mode above idle without first shifting the reversing devices to the "reverse thrust" position;

delete the third paragraph;

the seventh paragraph shall be stated as follows: "the crew's forced deviation from the technology for using thrust reverser on landing, as stipulated by the flight manual, which resulted in the use of maximum thrust reverser "in one movement", without setting the RSL to the intermediate stop (small reverser) and without monitoring the position (shifting) of the reverser device flaps, which, given the above-mentioned design errors in the control mechanism and the reverser device lock, led to an increase in the forward thrust of the engine before the reverser device was engaged";

The tenth paragraph should be excluded, since the time interval (9 days) between the serious incident with the Tu-204-100B RA-64049 aircraft and the crash of the Tu-204-100B aircraft RA-64047 did not allow (as the results of the investigation into the accident showed) the aircraft and engine developers to implement the required design solutions, or indicate the absence of a state (interdepartmental) mechanism for making decisions on the introduction of restrictions (prohibitions) on the operation of an aircraft type in such situations;

Supplement the thirteenth paragraph with the following content: "the failure of the technology for crew members to work during landing proposed in the Tu-204-100V aircraft flight manual, which led to an incorrect distribution of duties within the crew and, as a consequence, an increase in the workload on the aircraft commander and the actual removal of the second pilot from the control loop in a difficult situation caused by the failure to engage the thrust reversers of two engines."

10. Section 5 "Recommendations for improving flight safety":

paragraphs 5.1.3, 5.1.10 - 5.1.12, 5.1.14, 5.1.15, 5.1.17, 5.6.2 are not substantiated in the final report, in connection with which it is proposed to exclude them;

paragraphs 5.1.4 and 5.1.5 shall be extended not only to civil aviation organizations, but also to aviation industry organizations;

I propose to exclude paragraph 5.1.6, as it is not justified in the final report;

paragraph 5.2 - replace the word "Rosaviatsia" with the words "IAC Aviation Register", add the words "and JSC Tupolev".

December 17, 2013

Response to the dissenting opinion of a member of the commission investigating the crash of Tu-204-100B RA-64047, which occurred on December 29, 2012

Regarding point 1:

The Commission notes that in subsection 8.1.3.2(N) of the flight manual for the Il-96 aircraft, determining the order of using the engine thrust reverser, contains requirement to first transfer the RUR to the intermediate stop. Transfer of the RUR the maximum reverse mode is performed only after the shift reverse valves and the activation of the corresponding alarm. Such thus, there are no contradictions with the provisions of the flight manual of the aircraft of the family The Tu-204/214 is not included in this section. At the same time, in section 4.7, which defines the crew's procedure for landing is really not clear requirements for transferring the engine RUR first to the intermediate stop, however, there is also a requirement for the crew to control the inclusion thrust reverser and the production of the corresponding report.

Thus, taking into account the position of the engine manual (section 072.80.00, p. 4, paragraph 3.2), that the translation of the reversing device to position reverse thrust is achieved by moving the RUR to the pass stop position, The Commission, following its consideration of point 1 of the dissenting opinion, decided supplement the Recommendations section of the Final Report with the relevant recommendation of JSC II.

Regarding point 2:

Information obtained during the work of the Commission of Inquiry shows that after making adjustments in accordance with engine documentation (ER), in particular, when ensuring the cam stop locking the control mechanism and locking the reversing device in guide when the RUR is positioned on the intermediate stop and position risks on the indicator of the control lever of the HP-90 unit in the minus range 14...minus 20 degrees, application of significant efforts (three times exceeding normal operating conditions) did not lead to movement of the risk on the indicator of the control lever of the HP-90 unit in

the position is more (in absolute value) minus 32°, that is, to an increase engine thrust when the RED-90 is running.

Thus, the fact of increase in direct thrust in an emergency flight both engines with the reverser flaps not shifted indicates, which is most likely the control and reverse locking mechanisms of both engines were misaligned, which is indicated in the Final report.

In accordance with the engine operating instructions, it is the main document for its technical maintenance. In case of violation of the provisions of the RE engine, the engine manufacturer does not guarantee normal operation engine operation. Checking these adjustments is provided for installation of engines on an aircraft. Analysis of possible reasons for non-detection misalignment of the control and locking mechanism, if present The list of the noted deficiencies in the technical documentation for the aircraft and engine is given in pages 151-156 of the Final Report.

Thus, following the consideration of paragraph 2 of the Dissenting Opinion The Commission decided not to amend the Final Report.

Regarding point 3:

The Commission notes that it is primarily analyzing the content of regulatory and legal documents in force at the time aviation accident or at the time of the event in question.

Resolution of the Government of the Russian Federation No. 521 "On amendments to the Regulation on the Ministry of Transport of the Russian Federation and the Regulation on the Federal Air Transport Agency", referred to in the Dissenting Opinion, was adopted in June 2013, therefore cannot be used to evaluate the events that took place, for example, in 2010, when the head of the Flight Operations Department Rosaviatsia was issued the final permit to conduct training flight crew members on a simulator in St. Petersburg.

The Commission agrees that the current draft Administrative Regulations of the Federal Air Transport Agency for the provision of public service for issuing permits for use integrated flight simulators for aviation training

The Ministry of Transport of Russia has not approved the personnel, the corresponding changes included in the Final Report.

In the standards of fitness of flight simulators for training aviation personnel of air transport, approved by the FAS Russia 05/15/1998, in section 6.1 the "Principles of Standardization" are indicated, one of which is the conduct of a subjective flight assessment by flight personnel, having sufficient experience of flying the relevant type of aircraft.

Section 6.3 specifies the "Criteria for subjective flight evaluation of the KTS", where it is stated that: "...subjective flight assessment is carried out by pilots-test crews (test crews) with sufficient experience in flights the aircraft in all assessed flight modes, including emergency situations and special flight cases..." In the certificates of subjective checks The simulators indicate crews that do not have pilot qualifications. test crews (test crews).

Regarding point 4:

The Commission notes that in the Final Report on page 151 the grounds (including data from objective control means) are indicated, according to which the Commission concluded that, most likely, in an emergency flight on both engines with the RUR position at the intermediate stop there was a fairly large gap between the locking cam and guide of the control mechanism and reverse lock. Possible the effort that the pilot could apply to move the RUR into position, providing an increase in engine thrust, assessed by the pilot-tester during a ground experiment.

The Commission agrees that the provisions of the flight manuals of the aircraft of the family Tu-204/214 have differences in the order of engaging the reverser on landing

(Tu-204-100V - piloted, Tu-204-100 and Tu-214 unmanned pilot on command of the pilot), while the provisions of the Tu-204-100V flight manual comply with the provisions of similar documents of the majority modern aircraft. The Final Report contains a recommendation JSC Tupolev on unification (controlled by a pilot or unmanned pilot) of the order of control of the engine thrust reverser on landing for Tu-204/214 family aircraft.

Thus, following the consideration of paragraph 4 of the Dissenting Opinion The Commission decided not to amend the Final Report.

Regarding point 5:

The Commission took into account the content of this paragraph of the Dissenting Opinion. Section from The final report has been excluded.

Regarding point 6:

The Commission notes that the text of the Final Report, including The Conclusion section reflects the shortcomings in the developers' activities aircraft and engine, in particular, shortcomings in the preparation of the operational documentation. At the same time time, since at the time of the aviation accident in Russia Federation of the regulatory framework for the implementation of management systems flight safety at organizations responsible for standard design, did not exist (taking into account the content of Amendment 101 to Appendix 8 at the time of the AP did not contain these requirements and in the documents ICAO), then the specified systems at JSC Tupolev and JSC Aviadvigatel were not implemented.

Thus, following the consideration of paragraph 6 of the Dissenting Opinion The Commission decided not to amend the Final Report.

Regarding point 7:

The Commission notes that the relevant section of the Final report on the results of the investigation into the Tu-204-100B crash RA-64047 the circumstances and provisions of the section have been included as close to the text as possible Conclusion from the Final Report on the results of the conducted

the commission of the West Siberian MTU VT FAVT investigation of a serious incident with the Tu-204-100B RA-64049 aircraft that occurred on December 20, 2012 in Tolmachevo Airport. At the same time, since the tasks of the Technical The IAC Commission is not responsible for revising the results of the investigation conducted commission of the West Siberian MTU VT FAVT, and some provisions The Conclusion section of this report contradicts the findings of the results investigation of the crash of the Tu-204-100B aircraft RA-64047, Technical The IAC Commission decided to include these provisions in the Final Report. include them and do not comment on them.

Thus, following the consideration of paragraph 7 of the Dissenting Opinion The Commission decided not to amend the Final Report.

Regarding point 8:

The Commission notes that many of the provisions of this paragraph of the Special opinions duplicate the provisions of the previous points, the answers to which are given above. What is fundamentally new is the indication of "a design error in the implementation of the requirement for automatic limiting the engine operating mode in case of failure to engage the reverse gear devices, which is one of the factors in the aviation accident." as evidence of this position, the fact is given that the existing system does not provide blocking of the increase in the operating mode engine with the reverser flaps not shifted and the RED-90 faulty, then exists when the engine is running on backup automatics (hydromechanics).

From the explanation received by the commission of inquiry from aircraft developer JSC Tupolev and engine developer JSC "Aviadvigatel", it follows that the existing requirement for the system reversal that each such system must have the means, which, in the event of malfunctions in it, would prevent the development engine thrust greater than at idle mode refers to malfunctions in the thrust reversal system itself. There are no other requirements for means of preventing the engine from developing thrust greater than "small"

gas", no. During the investigation, the Commission found that the failure to include
The reversal did not occur due to a malfunction of the reversing system.

Thus, the stated requirement applies to the system
reversing the thrust of a serviceable engine with a normally functioning
the main control system is the electronic control system. In particular, protection against overshooting
direct thrust, high idle thrust, in case of system malfunctions
reversal is ensured by the algorithm of the RED operation. In case
failure of the electronic engine, hydromechanics can no longer provide such protection due to
algorithm of the RED operation, however, when the crew performs the intended
Aircraft flight manual for the procedure for engaging the reverser with mandatory tracking
alarms on the KISS screen, output to direct thrust, large thrust of small
gas, is impossible, since the crew must signal in the cabin
make sure that when the low reverse mode is turned on, the gear shift occurs
reverse valves, and only then turn on maximum reverse.

Thus, from the above, as well as the fact that the refusal
There was no RED-90 in the accident flight, and, as already indicated above in this
document, on all engines in operation the mechanism
control and reverse lock, adjusted in accordance with the ETD,
ensured blocking of increase in engine operating mode when
the commission decided based on the results of the unshifted reverse valves
consideration of paragraph 8 of the dissenting opinion The Final Report shall not be amended.

Regarding point 9:

Taking into account the above responses to points 1-8 of the Dissenting Opinion
The Commission decided not to amend the Conclusion section of the Final Report.

Regarding point 10:

Following the review, the Commission decided:

- recommendations 5.1.10, 5.1.14, 5.1.15, 5.1.17 are sufficient justified;
- recommendations 5.1.3, 5.1.6, 5.1.11, 5.1.12 have been removed;
- Recommendations 5.1.4 and 5.1.5 apply to organizations aviation industry;

Recommendation 5.2 should be left unchanged, as it is in line with the provisions of the Russian Air Code