

**NATIONAL BUREAU
OF AIR ACCIDENTS AND INCIDENTS INVESTIGATION
WITH CIVIL AIRCRAFT**

SERIOUS INCIDENT

FINAL REPORT

OCCURRENCE No 3.2.11 – 390, 29.11.2014

**SMOKE IN THE PASSENGER CABIN
DURING TAXIING**

AC OPERATOR:	«TYROLEAN AIRWAYS» AVIATION COMPANY (AUSTRIA)
AC TYPE:	Fokker F28 Mark 0070
REGISTRATION NUMBER:	OE-LFJ
SITE OF OCCURRENCE:	DNEPROPETROVSK INTERNATIONAL AIRPORT (UKRAINE)
STATE OF OCCURRENCE:	UKRAINE
DATE OF OCCURRENCE:	29.11.2014r.

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**BRIEF DESCRIPTION
OF THE SERIOUS INCIDENT**

Occurrence №: 3.2.11 – 390, 29.11.2014г.

AC Operator: «TYROLEAN AIRWAYS» AVIATION
COMPANY (АВСТРИЯ)

AC type and registration number: Fokker F28 Mark 0070, OE-LFJ

Number and type of engines: 2, RR TAY 620-15, jet

Date and time of occurrence: 29.11.2014г., 15:48 UTC

In accordance with the standards and recommendations of the International Civil Aviation Organization, the report issued for the sole purpose of preventing accidents in the future.

The investigation which was conducted within this report is not intended to establish the proportion of someone's guilt or responsibility.

This report and investigation materials may not be used by administrative, service, prosecutors, courts, agencies, insurers to establish a blame or a liability (in accordance with the Article 119 of the Air Code of Ukraine).

List of abbreviations used in the report

TWR – aerodrome control tower;
RWY – runway;
AC – aircraft;
PIC – pilot-in-command;
S – stand;
OM – operations manager;
M – maintenance;
ATC – air traffic control;
CVR – cockpit voice recorder;
FDR – flight data recorder;
S/N – serial number;
P/N – part number;
UTC – coordinated universal time;

1. Actual information

1.1. Flight history

On November 29, 2014 the crew consisting of PIC, a co-pilot and two flight attendants was performing a scheduled passenger flight AUA 676 en route Dnepropetrovsk (Ukraine) – Vienna (Austria) on Fokker F28 Mark 0070 AC, registration number OE-LFJ (Austria).

At 15:48 (hereinafter UTC is used) during the AC taxiing from PL No 6 to the location of the AC processing with anti-icing liquid (point D1 in the beginning of TWY No 6) the cabin crew noticed a smoke in the passenger cabin and reported to the AC captain about it. The PIC ordered the co-pilot to assess the situation and simultaneously increased the engines rate causing greater smoke in the passenger cabin and triggering “Lavatory smoke detector” alarm.

The PIC took a decision to carry out an emergency evacuation, declared an emergency situation announcing “MAYDAY” signal, he performed operations as per the on-ground emergency checklist shut down the engines and cut the electric supply of the aircraft.

At 15:52 TWR operations manager announced “ALARM” signal.

At 15:53 they started the evacuation of the passengers through emergency exits to the left and right wings surfaces and the main left exit by the fixed ladder. At 16:02 the evacuation was completed, 64 passengers and 4 crew members were evacuated. During the evacuation one passenger was insignificantly injured (injuries of the coccyx and right ankle), he was provided with first aid. The passenger refused from the hospitalization.

During the AC inspection by the rescue team unit the smoke source was not found. After the AC ventilation and the situation check the AC was towed to PL No 18.

At 18:10 OM announced a cancellation of the “ALARM” signal. The AC suffered no damages during the operations of the rescue team unit.

1.2. Injuries

Injuries	Crew	Passengers	Total on the aircraft	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Insignificant	0	1	0	0
None	0	0	0	0
TOTAL	0	1	0	0

1.3. Aircraft damages

During the passengers evacuation through the emergency exits onto the wings there were made 9 (nine) dents of the left half-wing interceptors 1, 2, 3 panels and 2 (two) dents of the right half-wing interceptors 1, 2 panels. As per SRM 51-10-02 the damages were classified as No 2, their troubleshooting can be delayed by 300 flying hours.

1.4. Other damages

None.

1.5. Personnel information

Position	Aircraft captain
Sex	Male
Age	39 years
Pilot's license	ATPL – air transport pilot's license AT.FCL 10581, issued by Civil Aviation Authorities of Austria on 27.05.2014r., no expiration date
Qualification/Ratings	F70/100 (valid until 30.06.2015) SEP (land) (valid until 31.12.2015) Flight instructor (valid until 12.11.2015r.)
Medical Certificate	Class 1, valid until 12.11.2015r.
Last qualification check:	
Proficiency Check	13.05.2014 valid until 30.06.2015
Line Check	30.06.2014 valid until 31.08.2015
Emergency Training	15.04.2014 valid until 30.04.2015
Logged operation time, total flying time on all types	8827 hours
Total flying time on Fokker F28 Mark 0070 AC type	1033 hours
Logged flying time for the last month	39 hours 28 minutes
Recent flight on Fokker F28 Mark 0070 AC	3 hours 02 minutes
Rest time before the flight	More than 24 hours

Position	Co-pilot
Sex	Male
Age	32 years
Pilot's license	CPL – commercial pilot license AT.FCL 17176, issued by Civil Aviation Authorities of Austria on 27.10.2014r., no expiration
Qualification/Ratings	F70/100 (valid until 31.12.2014r.)
Medical Certificate	Class 1, valid until 23.07.2015r.
Last qualification check:	
Proficiency Check	07.11.2013 valid until 31.12.2014

Line Check	11.12.2013 valid until 28.02.2015
Emergency Training	10.04.2014 valid until 30.04.2015
Logged operation time, total flying time on all types	5340 hours
Total flying time on Fokker F28 Mark 0070 AC type	1888 hours
Recent flight on Fokker F28 Mark 0070 AC	3 hours 02 minutes
Rest time before the flight	12 hours

1.6. Aircraft information

AC type	Fokker F28 Mark 0070
State registration number	OE-LFJ
AC manufacturer	Fokker Aircraft B. V., Netherlands
Engines type	RR TAY620-15
Engines manufacturer	Rolls-Royce, Great Britain
Registration Certificate	№ 3328, issued on 15.03.2010
Airworthiness Certificate	№ 3328, issued on 24.06.2010
Airworthiness Revision Certificate	№ AR1-LFJ0114-0003, issued on 13.02.2014, valid until 04.03.2015
Ownership	Tyrolean Airways Tiroler Luftfahrt GmbH
Operator	Tyrolean Airways Tiroler Luftfahrt GmbH
Airframe	
Serial number	11532
Date of manufacture	1995
Time since new	51600 hours
Cycles since new	37986
Last M check:	
Line M:	S-90-001 Check, 29.11.2014
Base check	
Time since operation	3 hours
Cycles since operation	1
Base M:	23.09.2014
Time since operation	496 hours

Cycles since operation	374
Maintenance station	Austrian Airlines Technik Bratislava

Engines information:

Engine type	Serial number	Date of manufacture	Time since new	Cycles since new
Eng. #1 RR TAY 620-15	17158	01.03.1996	42782 hours	31833
Eng. #2 RR TAY 620-15	17092	01.11.1994	40389 hours	32425

During troubleshooting and the identification of the smoke cause in the passenger cabin, the following works were carried out and the AC units (components) were replaced:

- 1) check of the inner AC tail section;
- 2) check of the air condition system;
- 3) PACK No 2 of the air condition system is switched off in compliance with MEL 21-51-1 (Cat. C);
- 4) check and maintenance of No 1 and No 2 hydraulic system;
- 5) replacement of No 2 hydraulic system pressure valve;
- 6) replacement of No 2 hydraulic system control valves;
- 7) air circulation unit serviceability check (left and right).

1.7 Meteorological information

Actual weather of Dnepropetrovsk aerodrome on 29.11.14 at 15.00.

Wind 060° 5m/s, visibility 450m, RWY visibility from 1300m to 1500m tendency increase, heavy snow, vertical visibility 0m, temperature minus 1°, dew point temperature minus 2°, pressure (QNH) 1023, RWY08 condition friction coefficient 0,15.

Forecast for landing: at times visibility 300m, heavy snow, overcooled fog.

1.8. Navigational aids

Not applicable to the serious incident.

1.9. Communication

Communication means is not applicable to the serious incident.

Corresponding readouts of the communications are attached; the information is described in Chapter 2 of the Report.

1.10. Aerodrome information

Not applicable to the serious incident.

1.11. Flight data recorders

The AC is equipped with the following register devices:

FDR: P/N 980-4700-003; S/N 1433

CVR: P/N 2100-1020-00; S/N 000656485

Readout and transcript of flight data recorders were performed by the technical service of "Tyrolean Airways" Aviation Company in the presence of the accredited representative of flight safety investigation authority of the CAA of Austria.



Fig.1. FDR data readout procedure.

1.12. Information about impact and wreckage

Unavailable.

1.13. Medical and pathological data

During the evacuation one passenger was insignificantly injured (injuries of the coccyx and right ankle), he was provided with first aid. The passenger refused from the hospitalization.

1.14. Fire

Signal "LAVATORY SMOKE DETECTOR" alarmed about the operation of the smoke detector in the lavatory cabin in the AC tail section. The crew applied the fire extinguishing system of the engines and APU. After the AC inspection no signs of fire (ignition points) were found. Three fire extinguishers cylinders of engines No 1 and No 2 engines and APU firefighting system were replaced.

1.15. Survival factors

Not applicable to the serious incident.

1.16. Examinations and tests

The maintenance department of the engineering and technical service of "Austrian Airlines" aviation company carries out an examination of the de-installed air supply control valves.

1.17. Information about organizations and administration

Not applicable to the serious incident.

1.18. Additional information

Unavailable.

1.19. Useful or effective investigation techniques

Not applied.

2. Analysis

Being based upon the study of the information which was obtained as a result of the investigation (the crew explanatory notes, analysis of the flight data transcript, the crew and the airport ground services communications recordings, AC condition protocol, Engineering Investigation Report prepared by the Maintenance department of Engineering and Aviation Service of "Austrian Airlines" Aviation Company), the Commission determined the following course of the occurrence development.

On November 29, 2014 the crew of Fokker F28 Mark 0070 AC, registration number OE-LFJ (Austria) after performing AUA 675 scheduled flight en route Vienna (Austria) – Dnepropetrovsk (Ukraine) fulfilled a pre-flight preparation for the return flight AUA 676 en route Dnepropetrovsk (Ukraine) – Vienna (Austria). During the previous flight and the pre-flight preparation there were no remarks. For weather conditions the flight delay was announced from 15:00 till 15:30.

At 15:30 the crew requested for a start-up and anti-icing procedures, received a clearance from the controller and new estimated departure time of 15:40.

At 15:41 the crew requested for a start-up and at 15:46 for taxiing to D1 point to perform the anti-icing procedure. While taxiing the senior flight attendant noticed a smoke in the back part of the passenger cabin. The smoke was white, acid and scratchy. The senior flight attendant immediately reported to the captain about the smoke through the passenger address system. PIC ordered the co-pilot to open the door, to look into the passenger cabin and to assess the situation. The co-pilot noticed a thick smoke. PIC increased the air supply from the air conditioning system (PACK No 1 and No 2) for the ventilation of the passenger cabin, and, as this did not improve the situation, PIC increased the engines rate, which, as to the senior flight attendant, resulted in the smoke intensity. At that moment, the smoke detector triggered in the lavatory room, «LAVATORY SMOKE DETECTOR» was on in the cockpit and a aural smoke alarm operated.

At 15:52 PIC took a decision to carry out an emergency evacuation, declared "MAYDAY" signal, reported to the controller about presence of smoke in the cabin and requested immediate full assistance.

At 15:52 Tower Operations Manager announced "ALERT" signal.

At 15:53 the crew started the passengers' evacuation and performing on-ground emergency operations checklist. The co-pilot as per PIC's command proceeded to the passenger cabin to provide assistance to the cabin crew in the passengers' evacuation. After the engines shutdown and the AC electricity supply disconnection the situation improved a little bit (due to opening of all doors and emergency exits, as well as to cutting air supply from the air condition system).

For the crowd of people on the wing surfaces and snow on them (*as to the co-pilot's words* – the thickness of the snow layer was about 30 cm), and for the decrease of the smoke in the cabin, the crew slowed down the evacuation procedure and sent some passengers back to the cabin to be evacuated through the main exit. The co-pilot left the AC to check out the number of the passengers and gave a command to the ground personnel to direct the passengers to the bus to deliver them to the airport terminal. After that the co-pilot returned onboard of the AC and joined the crew which was completing the evacuation.



Fig.2. Use of emergency evacuation means.

Simultaneously with the start of the evacuation, a unit of the fire brigade embarked the AC with a fire hose barrel ГПЦ-200 from the fire truck, which insignificantly delayed the evacuation of the passengers. The fire brigade unit inspected the AC and searched for the source of the smoke.

At 16:02 the evacuation of the crew and the passengers was completed.

At 16:04 the fire brigade unit finished the AC inspection and the search for the smoke source. No fire locations or smoke sources were found.

At 16:15 the AC ventilation was completed and a control inspection was carried out.

After the luggage was unloaded, the AC was towed to the stand No 18.

At 18:10 there was announced a rebound of "ALERT" signal.

Defaults identification.

In order to determine the causes of smoke in the passenger cabin and to maintain the AC for further operations release, on 30.11.2014, the Investigation Commission granted access to the AC for an engineering and technical team of "Austrian Technik" company.

During the AC maintenance at "Dnepropetrovsk" airport the engineering and technical team of "Austrian Technik" company carried out works as to finding and troubleshooting defaults in compliance with the AC Maintenance Manual (Fokker 70/100 AMM 0100), a Protocol of Works Performed was composed, the Aircraft Maintenance Logbook was drawn up (pages No No 1616061-1616067) with filling out "Release to Operation Section" on the ground of card-orders No No 3568550-3568558.

Proceeding from the works performed the technical staff determined a preliminary cause of the smoke in the passenger cabin, and the hydraulic liquid infiltration into the air distribution system unit (PACK No 2) due to:

- a hydraulic liquid tank overflow of the No 2 hydraulic system;
- No 2 hydraulic system pressure valve failure;
- No 2 hydraulic system check valves failure.

In order to release the AC to a ferry flight over to the base aerodrome the air distribution system unit (PACK No 2) was de-activated in compliance with MEL 9.21.1-4-51-1 p. of the Minimum Equipment List and a Deferred Item of Category "C" for 10 days MEL 21-51-1 (Cat. C). was opened.

On the basis of the letter of the Deputy of Airworthiness Department, Operators and Maintenance Organizations (“Airworthiness, Operations and Technical Organizations” of the civil aviation authorities of Austria “Austro Control GmbH” dtd 02.12.2014, and in accordance with s.p. 3.6.4 Part II Annex 8 to the Convention on International Civil Aviation, by the decision of the Investigator-in-Charge, the aircraft was released to perform a ferry over flight before the end of the investigation.

After the AC arrival to the base airport the Technical Department of Engineering and Aviation Service of “Austrian Airlines” Aviation Company carried out an engineering analysis and drafted additional measures for determination of causes of the smoke in the passenger cabin. As a result of the carried engineering investigation, it was determined how the air pressure regulator operated, and in particular, a failure of the air supply check valve between No 2 hydraulic system and the system of preliminary pressurization was identified, including the check valve of air supply to the system of preliminary pressurization.

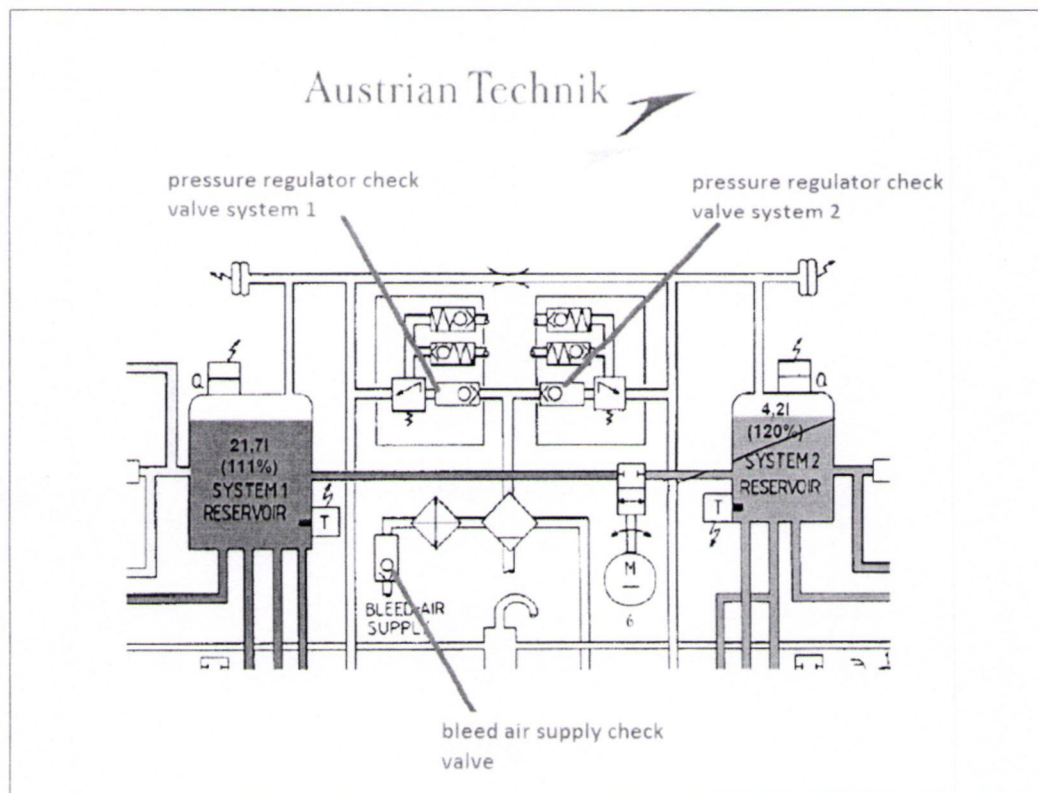


Fig.3. Layout of preliminary pressurization of №1 и №2 hydraulic system.

The valves failure allowed the vapors/fumes of the hydraulic fluid to infiltrate from the overflown hydraulic fluid tank of No hydraulic system (the fluid level made 4,2 liters – 120%) into the air distribution system, which is finally connected to the AC cabin through the air condition system (Engineering Investigation Report of 16.12.2014, Fig. 3 and 4). As per the conclusions of the engineering analysis that became the cause of the smoke emergence.

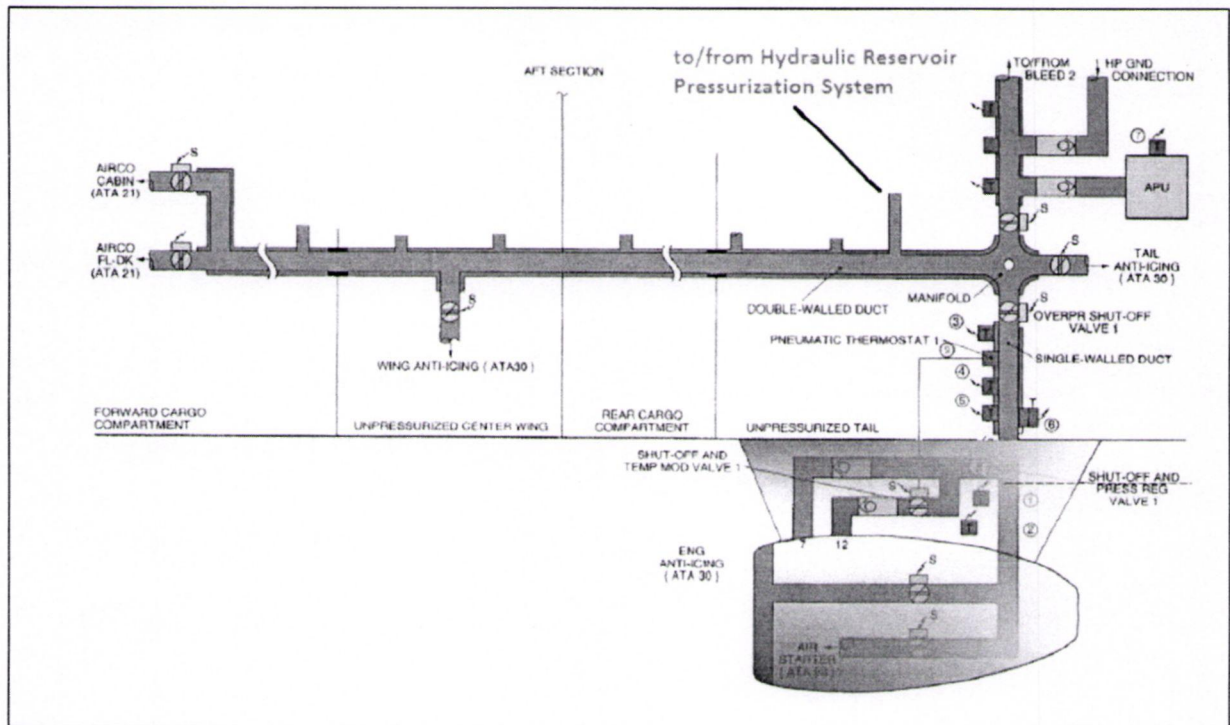


Fig.4. Layout of air distribution and induct system.

To eliminate the consequences of hydraulic fluid vapors/fumes infiltration into the air distribution and induct system (the right part) and probable contamination of the air distribution system unit (PACK No 2) and its components by hydraulic fluid, as well as in the connection with an abnormal noise in PACK No 2, there was carried out a replacement of the appropriate components as per Work Order No 7432110.

By the results of the engineering investigation the Technical Department of the Engineering and Aviation Service of "Austrian Airlines" Aviation Company took the following measures:

- "Fokker" was informed via mail on December 1, 2014
- Experience exchange was carried out with KLM (No of events and experience with new CV);
- investigation of failed part requested will be initiated accordingly;
- One Time replacement of the air supply check valve on the remaining FKR Fleet (Due Date 12.12.2014);
- OTI on the FKR Fleet to check the pressure regulator check valves (until 12.12.2014);
- OTI on FKR Fleet to check & correct Hydr Reservoir Oli level (until 12.12.2014);
- Review of inspection intervals for Check Valves, transfer system, oil level check on reservoirs;
- Special consideration of Hydr System Servicing in the Continuation training (info Screen).

As a result of the taken additional measures it was determined:

TO-FKR-29-0011 "OTI OF REGULATOR CHECK VALVES AND REPLACEMENT OF SUPPLY CHECK VALVE" performed on whole Fleet.

- One defect pressure regulator check valve was found and replaced.
- Investigation on removed supply check valves is ongoing.

TO-FKR-29-0012 "FUNCTIONAL (COMPARISON) CHECK OF RESERVOIR SIGHT GLASS/HYDRAULIC GROUND SERVICE PANEL" issued, 13 aircraft performed.

- Several findings on the Hydraulic Quantity Indication System.
- Replacements and adjustments on the Indication System performed.

MRA for SBF100-29-0044 "THE INTRODUCTION OF AN IMPROVED CHECK VALVE" issued and approval process initiated.

Taskcard 291300-00-01-XF-10 "VISUAL CHECK OF HYDRAULIC SYSTEM 1 AND 2 RESERVOIR FLUID LEVEL" revised in order to prevent Hydraulic System overflow.

Interval reduction of **Taskcard 293100-00-01-XF-46** "FUNCTIONAL (COMPARISON) CHECK OF RESERVOIR SIGHT GLASS WITH HYDRAULIC GROUND". SERVICING PANEL IND" initiated.

3. CONCLUSIONS:

Being based on the study of the investigation materials, Investigation Commission analyzed the circumstances of the event (the actions of the crew and of the airport ground services, operation of aircraft systems) and from the available evidences, it made the following conclusions and identified the causes and contributing factors that led to this incident and/or directly contributed to this incident, elimination, prevention or absence of which would reduce the likelihood of the incident or would weaken the severity of the consequences.

3.1. The crew members were licensed and they had the right to participate in the flight in accordance with existing requirements of the aviation authorities of Austria.

3.2. The aircraft was certified, equipped and maintained in accordance with existing requirements of the aviation authorities of Austria.

3.3. The plane had been airworthy at the time of the flight.

3.4. Performance of works during the AC preflight preparation revealed no evidence of existing structural or mechanical abnormalities in the operation of the aircraft components before departure, which could contribute to the incident.

3.5. The members of the flight crew when preparing the passenger cabin for the flight in accordance with paragraph 2.16.3 Operation Manual Part B (OM PART B, EXPANDED CHECKLIST / NORMAL CHECKLIST, 2.16.3 Expanded Flight Checklist) did not reveal any excess amount of hydraulic fluid in the reservoir of the

hydraulic system No 2, as well as short-term pressure drop in the hydraulic system № 2 after starting the engine (according to the transcript of the flight data parameters).

3.6. The quantity of hydraulic fluid in the hydraulic system No 2 reservoir exceeded the maximum quantity.

3.7. The pressure valve of hydraulic system № 2 did not operate due to a faulty check valve between the hydraulic pressure control system № 2 and preliminary pressurization system.

3.8. The check air supply valve of the preliminary pressurization system was not operating.

3.9. Vapors/fumes of hydraulic fluid from the reservoir of the hydraulic system № 2 got into the air distribution and bleed (the right part) system through the pressure valve and a return check valve of the hydraulic system № 2.

3.10. Formation of white, acrid smoke in the air distribution and bleed system occurred due to mixing hydraulic fluid vapor with hot air from the engine compressor and possible contamination of fumes/vapor on the heat exchanger of the air distribution system unit.

3.11. The emergence of smoke in the passenger cabin took place due to triggering the air conditioning system for heating.

3.12. Smoke in the cockpit was found by the cabin crew too late because of bad cabin lighting. Thus, effective preventive actions were taken by the crew with a delay.

3.13. Activation of the smoke detector in the toilet cabin (alarm «LAVATORY SMOKE DETECTOR») is associated with an increase in the air supply flow from the air distribution and bleed (right part) system and an increase by the PIC RPM of the engines operation, which led to even greater smoke.

3.14. Reports of the smoke and the evacuation by the cockpit crew were not clearly understood by the cabin crew from the first announcement without specifying. That is, the communication between the flight and cabin crew was not effective. Standard phraseology or emergency instructions were not applied in accordance with the procedure of evacuation.

3.15. The flight crew used the engines and APU firefighting system.

3.16. The aircraft had already been configured for the scheduled anti-icing (stabilizer, flaps ...). The flight crew was aware of the icy wing, in spite of this, passengers in addition to the emergency exits in front of the cab were evacuated through emergency exits on both half-wings.

3.17. To assess the situation with smoke was difficult both for the flight crew and the cabin crew. However, the decision to evacuate on icy wing can be questioned. In this particular case, the risk of injury to passengers really increased during the evacuation onto the icy wing surfaces.

3.18. After the AC inspection no signs of fire (fires) were found.

3.19. Any deviations and deficiencies in the actions of personnel of the rescue team and ground services to evacuate upon the announcement of "ALERT" signal were not found. The evacuation phase of the passengers from the aircraft made 10 minutes. As a result of actions of the rescue team unit, the AC did not suffer any damages.

3.20. During the evacuation through an emergency exit onto the wing one passenger suffered minor injuries (bruises tailbone and right ankle), he was provided with the first aid, the passenger refused from hospitalization.

3.21. The presence of snow on the wing (the thickness of snow cover was about 30 cm) contributed to the passenger's injury.

Causes.

As a result of the investigation of the serious incident, the Commission determined that smoke in the AC cabin had been caused by:

- an excess of hydraulic fluid level in the reservoir of the hydraulic system № 2;
- a malfunction of the hydraulic system №2 pressure valve due to a malfunction of the check pressure valve between the hydraulic system №2 and preliminary pressurization system;
- a malfunction of the check valve in the air supply system of pre-pressurization;
- infiltration of the vapors/fumes of hydraulic fluid in the air distribution and bleed (right part) system through the pressure valve and the return check valve of hydraulic system №2;
- mixing vapors/fumes of hydraulic fluid with the hot air from the engine compressor and their probable contact with the heat exchanger unit of the air distribution system;
- initiation of an air conditioning system for heating.

Contributing factors.

Increasing the air supply flow from the distribution and bleed (right part) system into the air conditioning system, as well as an increase of the engines rate by the PIC resulted in even greater smoke and triggered the smoke detector in the toilet cabin (alarm «LAVATORY SMOKE DETECTOR»).

4. RECOMMENDATIONS to «Tyrolean Airways» Aviation Company

4.1.1. Conduct an analysis of this serious incident by air crews as for the fulfillment of the procedures for preflight preparation during a transit stop in accordance with paragraph 2.16.3 of Operation Manual Part B.

4.1.2. Provide a training for the air crews as for the fulfillment of on-ground emergency evacuation procedures.

4.1.3. Make a replacement of the return valve of air distribution on the remaining aircraft of «Fokker» type within the AC fleet.

4.1.4. Perform one-time inspection of the fleet of «Fokker» aircraft to test the check valves of the pressure regulator in the hydraulic system.

4.1.5. Conduct relevant investigations of the failed components to determine the cause of failure.

4.1.6. Revise the inspection intervals for the transmission system check valves, for inspection of the level of hydraulic fluid in the hydraulic system reservoirs.

4.1.7. Include a special study of the hydraulic system maintenance into the continuous learning training program.