



Islamic Republic of IRAN

Civil Aviation Organization

Aircraft Accident Investigation Board

Final Investigation Report



State File Number: A961127EPFQF
Type of Occurrence: Accident
Date of Occurrence: 16 Feb 2018
Place of Occurrence: Mashhad Airport, I.R Iran
Aircraft Type: Fokker 100
Registration: EP-FQF
Operator: Qeshm Airlines

Date of Issue: 24 Dec 2018

“In the name of God”



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Foreword:

According to Aircraft Accident Investigation Act of Civil Aviation Organization of the Islamic Republic of Iran, accident investigation shall be used for prevention of similar occurrences and should be conducted without prejudice to any judicial or administrative action that may be taken to determine blame or liability.

Base on Annex 13 to the Convention on International Civil Aviation, Chapter 3, Paragraph 3.1, and Chapter 5, Paragraph 5.4.1; it is stipulated and recommended as follows;

The sole objective of the investigation of an incident or accident shall be the prevention of incidents and accidents. It is not the purpose of this activity to apportion blame or liability.

Abbreviations:

AAIB	Aircraft Accident Investigation Board
AD	Airworthiness Directive
AOC	Air operator Certificate
ASSY	Assembly
ATC	Air Traffic Control
ATPL	Air Transport Pilot License
CAM	Cockpit Area Microphone
CAO	Civil Aviation Organization
CPL	Commercial Pilot License
CSN	Cycle since New
CVR	Cockpit Voice Recorder
DSB	Dutch safety Board
FDM	Flight Data Monitoring
FH	Flight Hours
HDG	Heading
HYD	Hydraulic
IAF	Initial Approach Fix
ILS	Instrument Landing System
INTL	International
IRI	Islamic Republic of Iran
L/G	Landing Gear
LH	Left Hand
LMT	Local Mean Time
QAR	Quick Access Recorder
QRH	Quick Reference Handbook
RH	right Hand
RWY	Runway
SB	Service Bulletin
SSFDR	Solid State FDR
Trk	Track
TSN	Time since New
TWY	Taxiway
UK	United Kingdom
UTC	Universal Time Coordinated

Synopsis:

On Feb 16 2018, Qeshm Air scheduled the aircraft Fokker F100 with registration EP-FQF for scheduled passenger flight from Tehran to Mashhad back to Tehran. Aircraft with Flight No; QSM.1202 was scheduled to fly from Mehrabad Intl. Airport/Tehran to Shahid Hasheminejad Airport/ Mashhad on 15:40 Local time (12:10UTC). The aircraft has taken off with 2 cockpit crew, 5 cabin crew, carrying 97 passengers to the destination airport (MHD) on 16:38 LMT .No unusual occurrences were noticed during departure, en-route .

While approaching to the Mashhad Airport, the pilot tried to extend landing gears normally but he received red light for left L/G. He tried to extend landing gears several times based on the related check list So far, he could not extend LH landing gear successfully and finally called "MAYDAY" and declared emergency condition. The pilot made several holdings to consume fuel. Finally, he requested landing on RWY 31R with unsafe landing gear situation. Finally the aircraft involved Runway Excursion accident.

No injuries or fatalities were found as sequence of this accident but aircraft sustained substantial damages to underneath of the LH aircraft wing.
There were not any " Dangerous Goods" on board.

The investigation was conducted with IRI CAO Aircraft Accident Investigation Board as State of Occurrence. Based on Annex 13, notification was sent to Dutch Safety Board (DSB) / Netherlands as State of Design /Manufacture of aircraft and also to the Air Accident Investigation Board (AAIB) /UK as State of Design /Manufacture of Landing Gear and both states had Mutual cooperation.

In this respect, the investigation team has received a letter from Fokker Service Company via DSB that any technical supports from Manufacturer will not be done due to Sanction involved to Iranian Airline, so the Manufacturer did not participate on this investigation.

The draft of final report was sent to DSB/Netherland and AAIB /UK accordingly and some comments were received by DSB, AAIB and EASA as responsible agency for Type Certificate Approval.

The main cause of this accident was "*entering foreign contamination to hydraulic system by "maintenance activities during C Check "which caused blockage hydraulic flow in restrictor check valve to open left main landing gear.*

While recovering the aircraft from accident site, the damage on the aircraft wing was extended so the aircraft was beyond repair and written off in Mashhad airport located in the Northeast of IR of Iran.

1-FACTUAL INFORMATION:

1-1 History of the Flight:

On date Feb. 16th, 2018, the aircraft Fokker 28 Mark F100 with Registration EP-FQF belonged to QESHM Airline was scheduled for domestic passenger flight from Mehrabad international Airport to Mashhad INTL. Airport with flight No; QSM1202 on 12:10 UTC. The aircraft took off from RWY 29L Mehrabad Airport on 13:08 UTC and continued flight at cruise level FL.330 and became ready for approaching to Mashhad Airport.

The pilot attempted to make normal approach and landing in Mashhad INTL. airport, during approach 10 miles to touch down the aircraft experienced left hand landing gear unsafe light, and the pilot in command informed the tower and requested to do missed approach and asked permission to continue flight to the holding point in the vicinity of airport to do checklist to ensure safe extension of left hand landing gear. He tried to extend landing gears several times based on the related check list So far, he could not extend LH landing gear successfully .so he used alternate LG selection for lowering gears for last chance and problem was not solved and finally called "MAYDAY" and declared emergency condition. The pilot made several holdings to consume fuel. Finally, he requested landing on RWY 31R with unsafe landing gear situation at 16:01 UTC time.

During the landing, the pilot attempted to keep the aircraft within the Runway boundary as much as possible but finally the aircraft veered off to the left of the runway and came to stop between runway 31L and 31R.

1-2 Injuries to Persons:

Neither the 7 flight crew members nor the aircraft 97 passengers suffered injuries in this accident.

1-3 Damage to Aircraft:

The Aircraft was substantially damaged as a result of scratching to the ground. The damaged areas are summarized as:

- The right-hand landing gear wheels
- The left wing trailing edge, especially flap area was damaged.
- The lower surface of left wing by scratching on the ground
- LH main L/G wheel bay doors were damaged

During recovery of the wreckage and transferring from the accident site; the left wing structure was severely damaged during operation of weak crane and security belts.



Figure 1 -Accident Site



Figure 2 -Unsuccessful recover of Aircraft

1-4 Other Damage:

Due to location of aircraft final stop point (the outdoor area between the two runways, no entity or airport infrastructure suffered damage.

1-5 Personnel Information:

Both the pilots of the aircraft have valid certificates accordingly with valid medical issued by IR of Iran Civil Aviation Organization. Their qualifications were as:

	Pilot	Pilot monitoring
Gender, Age	Male, 48 Y	Male, 31 Y
License No;	ATPL;1995	CPL;3964
License Validity	22/06/2019	22/07/2018
Medical Validity	14/01/2019	05/07/2018
Total FH Experience	9642	2163 H

Both pilots were employees of Iran Air and temporarily had flight mission for Qeshm Air by Mutual agreement between two airlines.

1-6 Aircraft Information:

1-6-1 General information:

Type of Aircraft: FOKKER F28 Mark F100

Manufacture: FOKKER Company, Netherlands

Date of Manufacture: February 1993

Aircraft Serial No; 11444

The Aircraft was equipped with 2, Rolls- Royce TAY 650-15 engine type

Eng. 1: with Serial Number: 17351

Eng. 2: with Serial Number : 17250

The operator of the aircraft is "QESHM AIR".

The operator was A.O.C Holder (AOC # IR.AOC.118); valid until: 26.01.2019

The aircraft certificate of registration was issued in: 26.01.2014

The aircraft certificate of airworthiness was valid until 09.11.2018

The aircraft airworthiness review certificate was valid until: 09.11.2018

The aircraft radio station license was issued on 12 Mar 2016 (valid until: 09Nov, 2020)

The aircraft and third party and the pilot insurance was valid until 22 Oct, 2018

1-6-2 Aircraft Technical History:

The aircraft was maintained in accordance with approved AMP, and used maintenance data was Issue. 01 Rev. 1A Sep-2017 and its last heavy check (F100-C01+A09-1739 check) was performed on 14 Jan 2018 when aircraft accumulated about 48392 total flight hours and 37800 Cycles at Tehran 28 days before accident.

The aircraft check was in "FARSCO" maintenance base from 06 Nov 2017 up to 14 Jan 2018 with responsibility of Qeshm Air maintenance.

The aircraft had totally 48654 flight hours and 38040 Cycles on accident time.

1-6-3 The Engine information:

The Aircraft was equipped with two engines manufactured by Rolls- Royce, model: Tay650-15 .The operation history of the engines was:

Engine #1 TSN: 41061 F/H. CSN: 32760

Engine #2 TSN: 50217 F/H. CSN: 41816

1-6-4 Introduction to L/G system:

The configuration of the aircraft is cantilever wing, semi-monocoque structure, tail mounted engines and tricycle landing gear. The interval of landing gears is 12 years/20000 cycles. During this heavy check, the Landing Gears of the aircraft were removed from this aircraft on 07 Nov. 2017 and were installed on another operative F.100 of the airline with registration EP-FQG. Also un-usable Landing gears were available on the aircraft during maintenance work. While finishing the heavy check, again the landing gears were returned to the maintenance base and installed on the aircraft. The cannibalization tag document of left hand L/G shows the L/G assembly with P/N; 201072021 and S/N; DRG/8718/86 was installed on the aircraft on 09 Jan 2018. The condition of landing gears at end of "C Check" was:

- 1- NLG - P/N: 201071004 , S/N:DLG0012, Remaining life : 8.2 Y/14906 Cycles
- 2- RH MLG- P/N: 201072022 , S/N: DLG-0230 , Remaining life : 5.2 Y/6794 Cycles
- 3- LH MLG- P/N: 201072021, S/N: DRG/8718/86 , Remaining life : 3.4 Y/10165 Cycles

History of left landing gear installation was:

Date	Removed L/G	Installed L/G
07 Nov 2017	DRG-8718/86	DRG/7051/89
09 Jan 2018	DRG/7051/89	DRG-8718/86

1-7 Metrological Information:

The metrological information as reported by meteorological office was as following which had no effect on accident scenario:

Time		WIND		VISIBILITY	Clouds	TEMP	DEW	QNH
UTC	Local	Direction	Speed	-----	-----	-----	-----	-----
13.00	17.30	110	10	CAVOK	---	07	00	1029

1-8 Aids to Navigation:

The aircraft was equipped with navigation facilities based on international standards. Both navigational systems of the aircraft and Mashhad airport worked normally and had no effect on the accident.

1-9 Communication:

Communication system of aircraft was operating normal. No communications problems between the pilots and any of the air traffic controllers who handled the accident flight were reported.

1-10 Airport Information:

Mashhad Shahid Hasheminejad International airport (OIMM) with geographical coordination N36°14.05' / E59°38.70' is located at 6 kilometers away from Mashhad city with elevation of 3,266 ft. / 995 m.

The runways in use are 31/13 Left/Right. RWY 31R dimension is 3810 × 45. The airport is operated for VFR/IFR flights. The RWY31R is equipped with ILS, and at the date of accident all station systems were in operational condition except DVOR/DME awaiting for the maintenance.

1.11 Flight Recorders:

The airplane was equipped with a Solid State Flight Data Recorder (SSFDR) and a Cockpit Voice Recorder (CVR). The aircraft FDR / CVR were removed from the aircraft without any damages and delivered to IRI CAO AAIB for investigation. The FDR was analyzed by FDM software of the airline.

1.11.1 Digital flight data recorder (SSFDR):

The SSFDR-unit was manufactured by Honeywell and had the part number 980-4700-003 and the serial number 11877. A direct readout of raw data from the flight was performed by acquiring FDM (SAGEM) software of the airline. The conversion was made by using the airplane manufacturer's parameter list. Relevant tables are presented below.

Table.1 Takeoff Information

Time	13:08:54(UTC)	Gnd→Flt
Altitude(ft)	3507 ft	
Airspeed(CAS)kts	161 kts	
Magnetic HDG	286 Deg	
AOA(Deg)	10.0 Deg	
Pitch(Deg)	18 Deg up	
Roll(Deg)	0.8 Deg Left	
Vertical G	1.16 g	

Table 2.Gears Retraction sequences in Takeoff Phase

Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main UP/DOWN	Right Main D/L	Left Main UP/DOWN	Left Main D/L	LDG Warning
13:08:48	GND							No warning
13:08:50	Flt							No warning
13:08:54			D/L		D/L ↓ UP		D/L ↓ UP	No warning
13:08:58			UP					No warning
13:08:58		Open						No warning
13:09:02		Locked		Down ↓ up		Down ↓ up		No warning

❖ Note: the operation of Landing gears was normal.

Table 3.First attempt in gears extraction

PHASE	Approach							
Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main UP/DOWN	Right Main D/L	Left Main UP/DOWN	Left Main D/L	LDG Warning
EXTENTION PHASE(First attempt)								
14:07:36	Flt	Open		DOWN			----	No warning
14:07:40	Flt		D/L				----	No warning
14:07:48					D/L		----	No warning
14:08:08						DOWN	----	No warning
RETRACTION PHASE(First attempt)								
14:08:08			UP		Unlock		----	No warning
14:08:12				UP		UP	----	No warning
14:08:16		Locked					----	No warning

ELV 15000

❖ The Left Main Landing gear was not Down &Locked.

Table 4. Second attempt in gears extraction

PHASE	Approach							
Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main U/D	Right Main D/L	Left Main U/D	Left Main D/L	LDG Warning
EXTENTION PHASE(Second attempt)								
14:09:08	Flt	Open		DOWN			----	No warning
14:09:16	Flt		D/L				----	No warning
14:09:24					D/L		----	No warning
14:10:00						DOWN	■	No warning
RETRACTION PHASE(Second attempt)								
14:11:16					Unlock		----	No warning
14:11:20			UP			UP	----	No warning
14:11:24		Locked		UP			■	No warning

ELV12000

Table 5. Third attempt in gears extraction

PHASE	Approach							
Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main U/D	Right Main D/L	Left Main U/D	Left Main D/L	LDG Warning
EXTENTION PHASE(Third attempt)								
14:11:52	Flt	Open					----	No warning
14:11:56	Flt			DOWN		DOWN	----	No warning
14:12:00			D/L				----	No warning
14:12:12					D/L		■	No warning
RETRACTION PHASE(Third attempt)								
14:13:10					unlock		----	No warning
14:13:13			UP				----	No warning
14:12:18				up			----	No warning
14:13:19		LOCKED					----	No warning
14:13:20						UP	----	No warning
14:12:12							■	No warning

ELV7500

Table 6.Forth attempt in gears extraction

PHASE		Approach						
Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main U/D	Right Main D/L	Left Main U/D	Left Main D/L	LDG Warning
EXTENTION PHASE(Forth attempt)								
14:15:01	Flt	Open					----	No warning
14:15:03	Flt			DOWN			----	No warning
14:15:05			D/L				----	No warning
14:15:20					D/L		----	No warning
14:15:56						DOWN	----	No warning
RETRACTION PHASE(Forth attempt)								
14:17:56			UP				----	No warning
14:17:58					unlock		----	No warning
14:18:00		LOCKED				UP	----	No warning
14:18:02				UP			----	No warning
14:15:10							----	No warning
14:15:10							----	No warning

ELV7500

Table 7.Fifth attempt in gears extraction

PHASE		Approach						
Time (UTC)	GND/FLT	Nose Gear Door	Nose Gear	Right Main U/D	Right Main D/L	Left Main U/D	Left Main D/L	LDG Warning
EXTENTION PHASE(Fifth attempt)								
14:18:16	Flt	Open					----	No warning
14:18:18	Flt			DOWN			----	No warning
14:18:24			D/L				----	No warning
14:18:30					D/L		----	No warning
14:19:48						DOWN	----	
No RETRACTION PHASE(Fifth attempt)								
14:28:01	LDG warning							
↓	warning							
↓	warning							
14:29:03								

ELV7500

Table.8 Landing Information

Phase	Landing				
Time(UTC)	14:59:03	14:59:07	14:59:26	14:59:29	14:59:56
Altitude(ft)	2792 ft	---	----	----	End of Recording
Airspeed(CAS)kts	122 kts	111	55 kt	0 kt	
Magnetic HDG	310 Deg	312	300	247	
Vertical G	1.01 g	1.04g	1.12g	1. 2	
Lateral G	+0.025	+0.082	-0.250	-0.416	
Roll Angle	1.9 Left	5.1 Left	10.8 Left	8.1 Left	

1.11.2 Cockpit Voice Recorder (CVR):

The CVR was manufactured by L-3 Communications Company with part number S200-0012-00 and serial number 000333733. A direct readout was performed at the French Safety Investigations Authority (BEA) facilities. The readout was performed as a two-step process, as described in manufacturer procedure. First, the four HQ channels were digitized while being replayed in real time using the official manufacturer lightweight equipment (DAPU - Digital Audio Playback Unit). A second similar readout was performed with the DAPU to retrieve the audio data from two SQ channels. 6 audio wav files were generated:

- *trk 1* containing Passenger Address recording, with a duration of 31 min 06 s
- *trk 2*, Captain/First Officer microphone recording, with a duration of 31 min 06 s
- *trk 3*, Captain/First Officer microphone recording, with a duration of 31 min 06 s
- *CAM trk*, containing the recording of the Cockpit Area Microphone, with duration of 31 min 06 s.
- *Mixed trk*, containing a mix of Captain, First Officer and Passenger Address channels with a duration of 02 h 05 min 10 s,
- *CAM trk*, containing the recording of the Cockpit Area Microphone, with duration of 02 h 05 min 10 s.

The audio files of CVR were reviewed. The event was recorded and crew management and their abnormal procedures were investigated. Some notable points from CVR audio files are:

- The captain was pilot flying during whole time of flight.
- Takeoff from Mehrabad Airport was done with normal operation of Landing gears and the flight was continued at flight level FL330.
- The flight was cleared direct to initial approach fix (IAF) on ILS 2 for RWY 31R.
- The cockpit crew understood the abnormal condition of left main landing gear and requested holding. They recycled the gears several times then used manual extension of landing gears finally.
- They made low altitudes approach to overview L/G condition by ATC and airport personnel.
- The controller of tower and safety man standing in TWY G confirmed uncompleted extension of left Main Landing gear.
- The pilot decided to do partially gear up landing procedure relying touch down on right main landing gear.

1-12 Wreckage and Impact Information:

The accident was occurred on Runway 31R after passing by taxiway G.



Figure 3- Position of Accident Site at Aerodrome

First the nose landing gear wheels of the aircraft skidded on runway shoulder and entered the area between runway 31L & 31R on soil area and subsequently the left wing has come down to the ground, and there was some damages on left wing trailing edge and related flap and aileron.

The right hand wheel assemblies were under excessive braking and there were signs of material overheat on brake assembly.

Following the rescue team operation, they tried to remove the aircraft from the area between runway 31L & 31R. They tried to lift the left wing with crane belt and put lifting jack under jack point of left wing but the crane and shoulder belts couldn't sustain the aircraft weight. The belt was ruptured suddenly and the aircraft fell down to the ground while the jack was not in suitable position and jack point. Subsequently the left wing structure was damaged by lifting jack.

The aircraft was removed from the accident area to safe parking for further investigation.

The aircraft and related left hand landing gear down lock mechanism hydraulic lines were examined and no abnormality was found. The hydraulic hose lines connected to actuator of LH landing gear were examined. The AAIB has ordered to assess/remove and inspect related hydraulic hose lines of both landing gears to find any sign of debris or foreign contamination which could effect on the safe performance of landing gear mechanism.

The restrictor screen filter and “T union filter” in the up line to the Retraction/Extension Actuator were examined at maintenance shop facility, and there were no sign of debris in last chance filter on T Union.

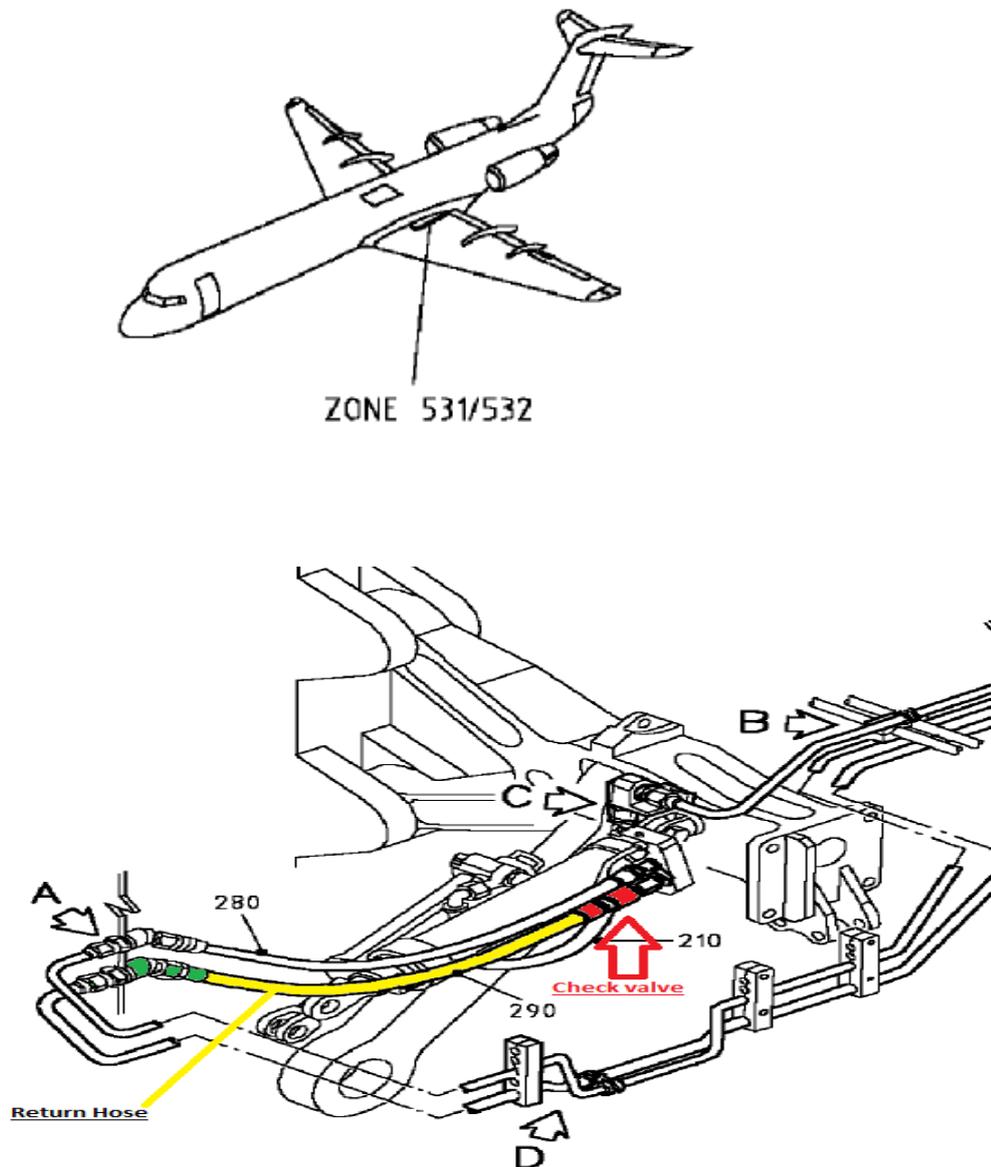


Figure 4- Position of Failed Check Valve

On the zone 531/532 the research was continued and relative hose and tubes were inspected. There was some debris on up pressure AND/OR Return hose. The restrictor Check Valve ASSY P/N; 99240/6F2876 from return line also has been focused on. The hydraulic interval screen filter of the restrictor on system side was damaged so the check valve was removed from its position on the system. The check valve was opened and inspection showed the sign of very tiny foreign contamination (similar to Media Blasting particles).

The screen filter on the check valve was damaged by passing some tiny particles were congested at screen and blocked the nozzle; consequently the left

landing gear failed to open both in normal mode and in manual mode release by gravity (Alternate Mode).

The investigation team continued the research in the hydraulic system from other components of the return line and did not find any abnormalities in the system so it is confirmed that only the pollution was available in the last **“Return Hose”** and export port of L/G actuator with P/N; 114220002 , S/N;DH-0028-92.

The R/H landing gear hydraulic system and other feed lines from reservoir were inspected without any abnormalities.

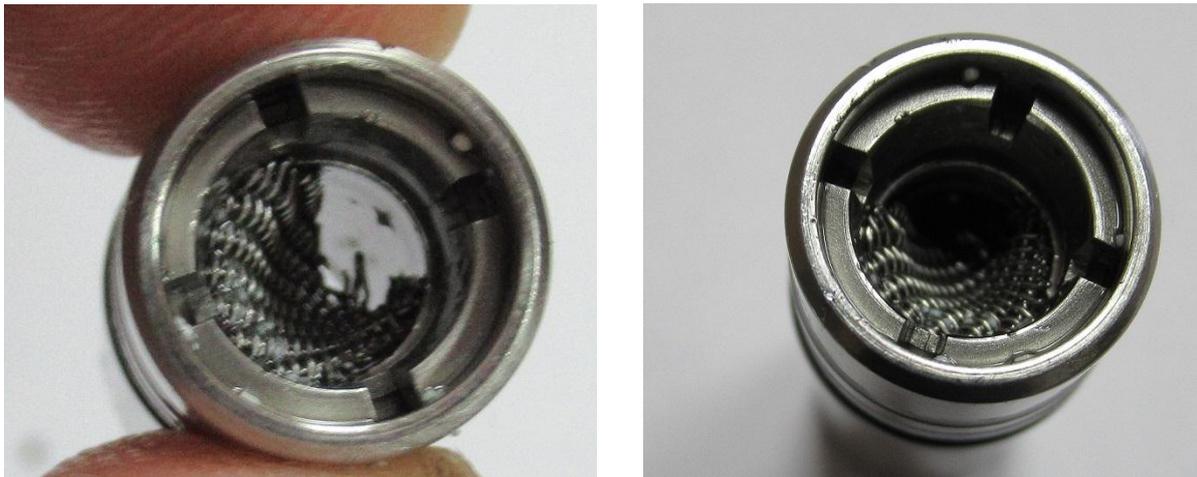


Figure 5- The L/H restrictor screen filter (HYD restrictor check valve)



Figure 6- The Opened L/H HYD Restrictor Check Valve



Figure 7- The Blocked Restrictor Check Valve

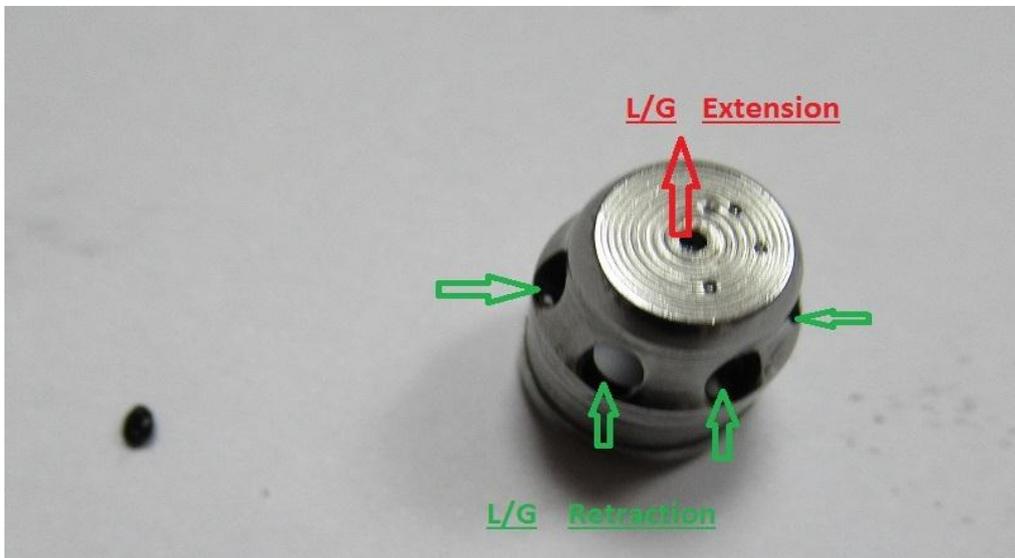


Figure 8- The Orifices on L/H HYD restrictor check valve



Figure 9- Direction of Housing, L/H Restrictor Check Valve filter damage

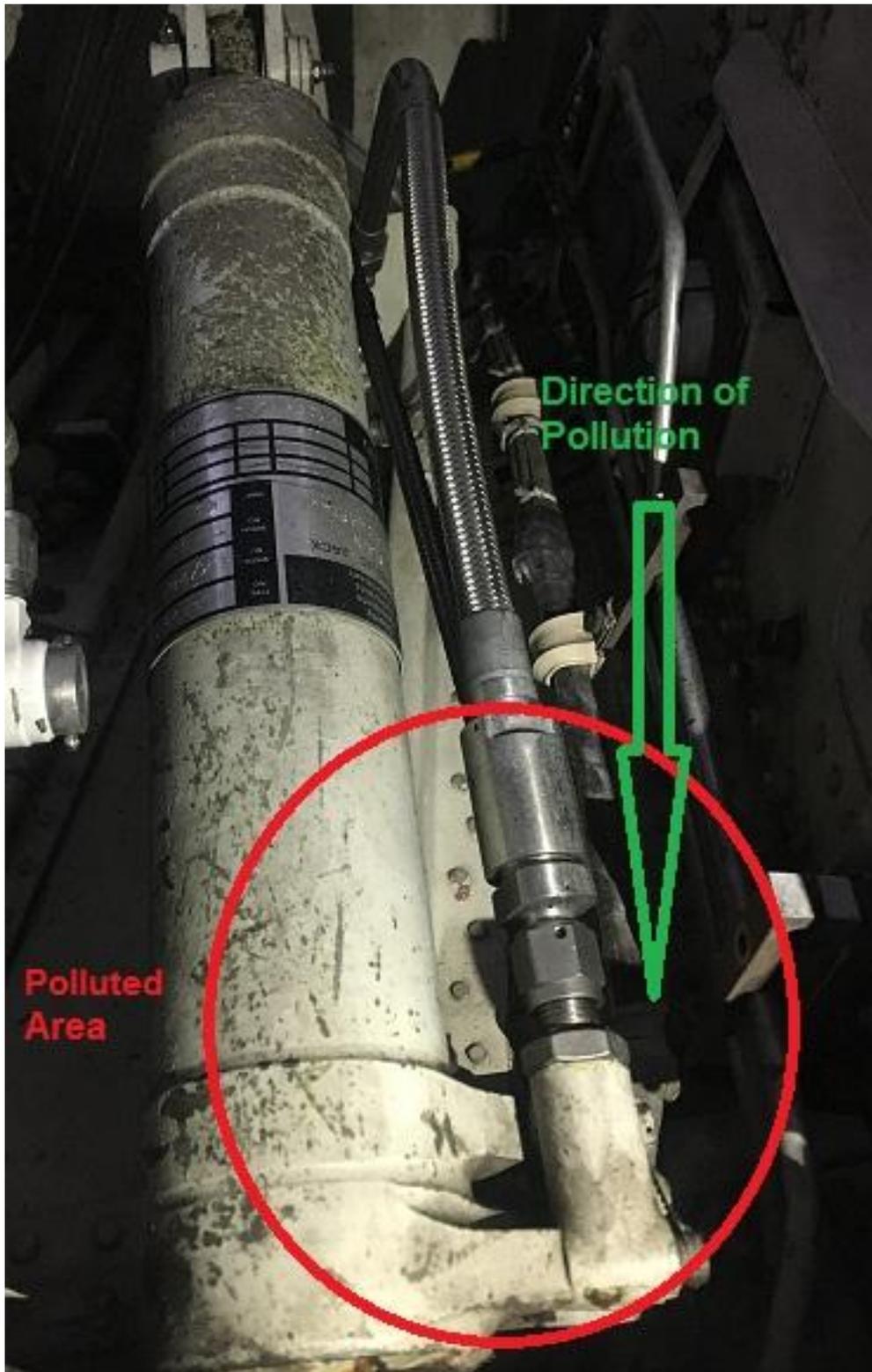


Figure 10- Retract actuator of left main landing gear

The evidences on the “Check Valve” showed that the orifice related to Landing Gear Extension was blocked by a small part of pollution but the orifices related to Landing Gear Retraction were not blocked from any pollution but pollution was seen internally.

The damaged screen filter of Restrictor was on Hydraulic side and it seems the debris had been present in the hydraulic lines from the hydraulic system and was not on the return line of the retraction actuator

On the latest “C” check based on AD 2015-0077 & SB NO; F100-32-166 & SB CSB-32-026 Landing Gear – Hydraulic Hose Restrictor Check Valve Screen of restrictor were inspected without any abnormalities.

The bulletin introduced a one time inspection of Screen filter which was done by Hydraulic Shop and reinstalled by Qeshm Air technical staff.

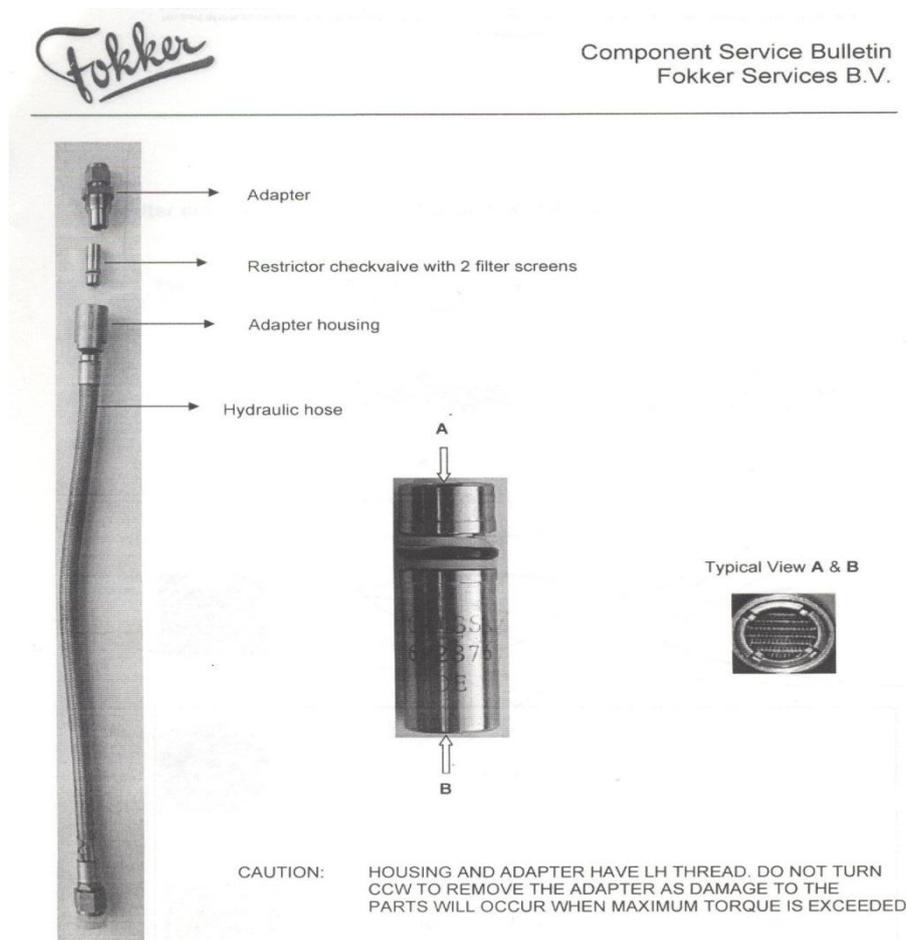


Figure 11- Instruction Scheme of CSB 32-026

1-13 Medical and Pathological information:

The pathological examination of the pilots was performed with no abnormal results.

1-14 Fire:

The aircraft and its system were free from fire, and there were no sign of firing on aircraft and its systems.

1-15 Survival Aspects:

The flight crew declaring emergency landing, so based on airport emergency plan (ERP), the related rescue organizations were informed and all ground services were dispatched to assist the aircraft and flight crew after landing. The passengers were disembarked from main exit doors by skid slides without any injuries.

1-16 Test and Research:

1-16-1 Test on the Pollution:

The polluted restrictor valve was opened and white small particles were observed also a black small particle had blocked the central orifice. The pollution seemed to be the same as Plastic media blasting particles which are used for removing paint form the aluminum & composite aircraft skins. So sample of Blasting Composition Material was provided. The polluted restrictor valve and sample of material were sent to the laboratory and microscopic evaluation was made.



Figure 12-Sample of Media Blasting Material

Due to low quantity of pollution, the material evaluation was not done, but macroscopic images showed similarity with the sample of Blasting composition material and other metal white particles but the black particle which caused blockage of restrictor was not same as sample of Blasting materials. The black pollution was expected as foreign contamination in the hydraulic system.



Figure 13- Microscopic Test of Pollutions

1-16-2 Research on Maintenance Hanger:

The "FARSCO" Hanger facility for recent "C" check of the aircraft was audited. Normally 2 or 3 aircrafts were parked in the main hanger.

The MRO facilitations are included with separate hanger for painting and blasting actives but some removal of painting are done on the aircrafts in the hanger. The aircraft position in the hanger was researched and cleared that while first removal of the L/G, a B747 was parked on the left land side of the aircraft. There was no evidence of some blasting activities on B747. The aircraft was repositioned in to another place the hanger when B747 exited from the hanger.

The "C" check was performed by Qeshm Air (1st base maintenance) by tenancy Hanger and maintenance facilities from "FARSCO".

1-16-3 Research on LH MLG Retract Actuator:

The retract actuator of left main landing gear was removed from the aircraft and was opened and analyzed in "Iran Air" hydraulic shop based on its CMM. There was some white pollution as sediment in the hollow cylinder which was seen on the check valve. All internal rings and spacer were normal without any cut in shapes so the black particle was not suspected to have originated from cylinder parts accordingly.

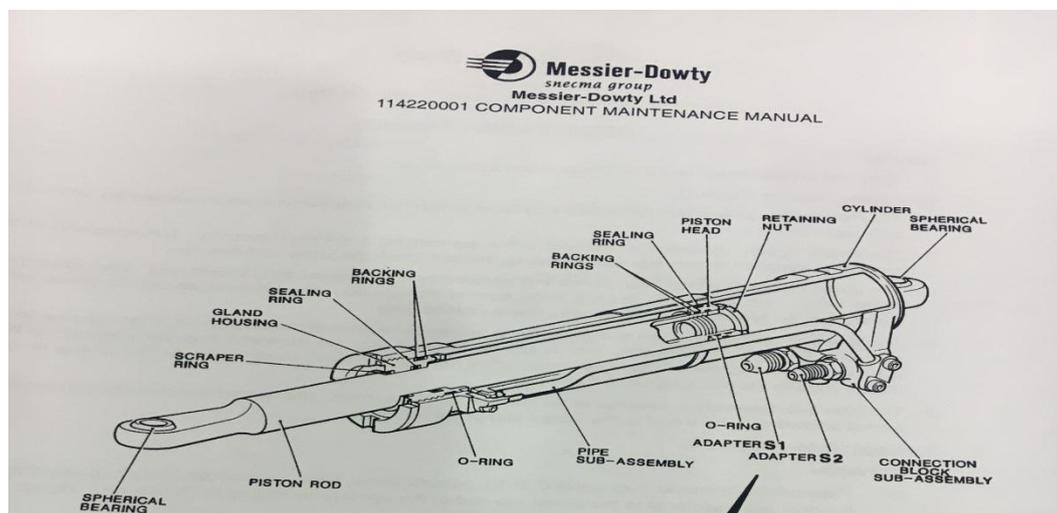


Figure 14- Scheme of L/G Retracting Actuator



Figure 15- Cylinder of Retracting Actuator

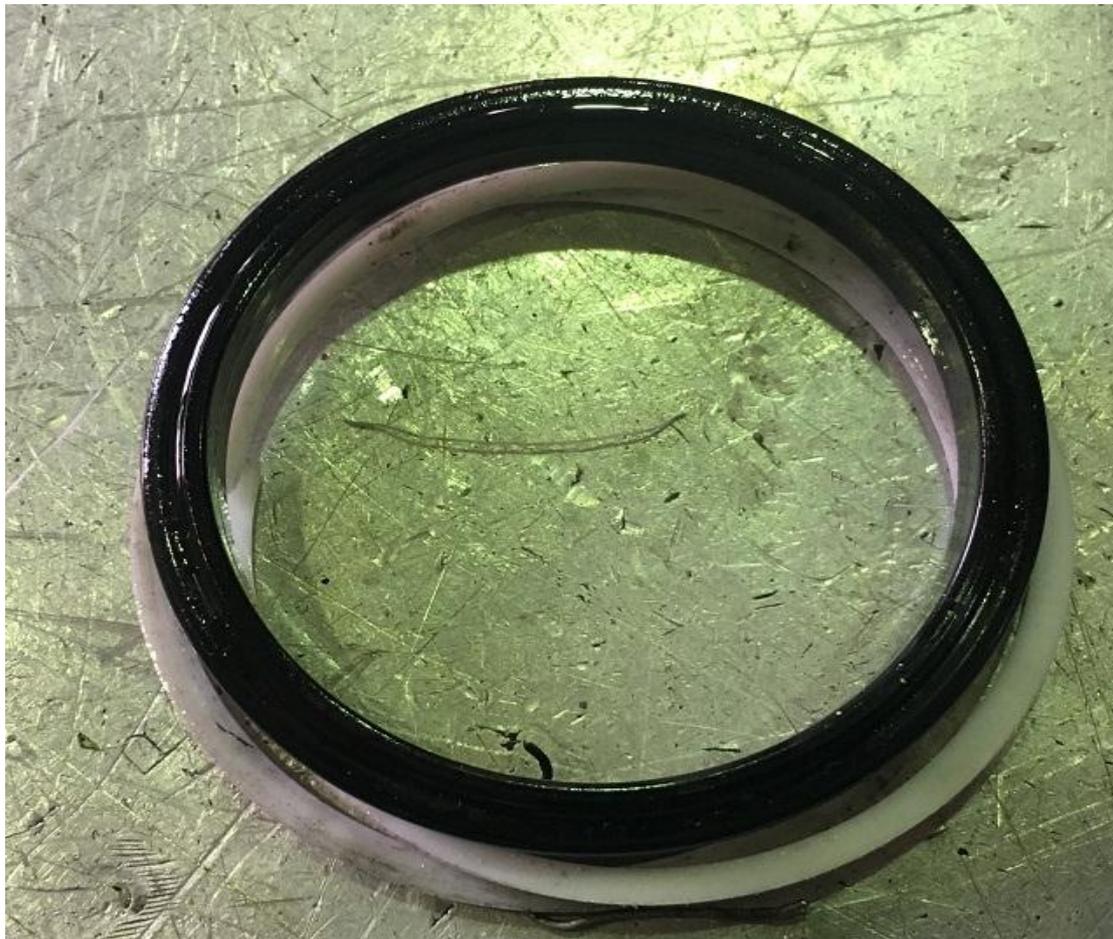


Figure 16- Sealing Ring of Retracting Actuator

1-17 Organizational and Management Information:

The Qeshm Air is responsible for the maintenance and operation of the aircraft.

The company has required certificates and ratings from CAO.IRI to maintain the aircraft in operational and airworthy condition and recently was authorized to perform "*C Check*".

The aircraft previous "C" check was performed by Iran Aseman Airlines in the Mashhad airport with the same landing gears.

The recent aircraft "C" check was performed as first base maintenance in "*FARSCO*" maintenance facilities with authorization and human resource of Qeshm Air. Some certified staffs temporarily separated from line maintenance and join to base maintenance group to perform "C Check"

During last "C" checks the aircraft landing gears were removed and were installed on an operational aircraft and the other landing gears were installed on aircraft "only as Dummy" and once again the previous landing gears were reinstalled on this aircraft.

Following aircraft release from maintenance during 28 days flying there were not any difficulties with the landing gears until the date of accident.

1.18 Additional Information:

Based on the findings of conducted investigation, the level of flight operation complies with the certification requirements.

1-19 Useful or Effective investigation techniques:

The Aircraft accident was investigated based on annex 13 to the convention of Chicago and related doc 9756 (ICAO).

2- ANALYSIS:

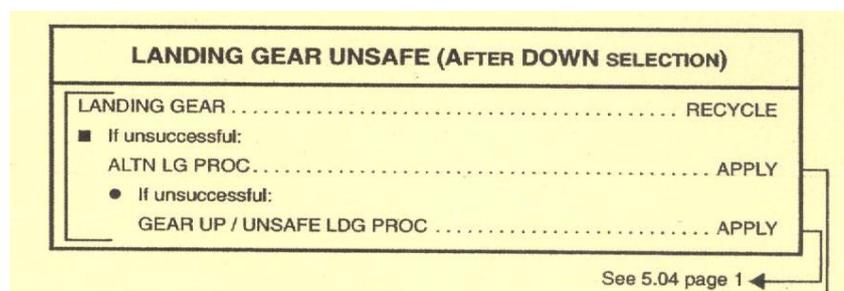
2.1 The Flight and Landing Preparations:

On February 16, 2018, at 13:08 (UTC), Qeshm Airlines flight 1202, a Fokker 100, EP-FQF, took off from Tehran Mehrabad International Airport (OIII) to destination Mashhad Shahid Hasheminejad International Airport (OIMM) with 97 passengers and 7 crew members onboard. The aircraft continued with FL330 and prepared for landing in RWY 31R. No abnormal condition was observed before landing gear extension while approaching to destination airport.

2.2 Scenario of Emergency Landing:

At 14:07 UTC time, the aircraft was in approach phase and copilot extended landing gear to prepare for landing.

On selection of landing gear down, an unsafe alert appeared as left main gear was not down and locked. As this condition persisted in spite of recycling attempts, the captain, who was the pilot flying, initiated holding. It was initially attempted to recycle the gear several times which unfortunately did not solve problem however he could recycle it once time. He could use alternate L/G procedure after first unsuccessful recycling. Abnormal procedure in Aircraft Quick Reference Handbook (QRH) has guidance for pilot in L/G unsafe condition as:



On establishing holding pattern, the pilot started the Landing Gear Gravity Extension as “Alternate L/G procedure” as stated in the quick reference handbook (QRH) but it was not successful.

The pilot made a low pass over the airport, which led the controller in the tower and a witness in the TWY G to conclude that the gear was “hanging in the bay” and only partially deployed.

Several attempts were done by pilots to resolve the problem:

- Two high-load-factor maneuvers with jolting the airplane hard on both left and right sides to free or loosen the gear has no apparent effect.
- Manual extension of landing gears to open L/G as effect of its weight
- Touch down on the right main landing gear to cause the left main gear to be shake for free extension.

The pilot followed the gear up unsafe landing based on QRH. The cabin crew was fully informed of what was going on, and the passengers were briefed about the condition of flight. After all efforts to lower the left main gear have been exhausted, the cabin crew was told to expect an emergency landing, to order the brace position upon touchdown and to evacuate the cabin after the aircraft stops on the runway.

GEAR UP / UNSAFE LANDING	
The PREPARATION items must be carried out in addition to the normal BEFORE APPROACH CHECK	
The APPROACH items replace the normal BEFORE LANDING CHECK	
PREPARATION	
CABIN CREW/ATC.....	NOTIFY
SEAT BELT/NO SMKG.....	ON/ON
FUEL WEIGHT (if possible)	REDUCE
WARN AUDIO	OFF
GPWS.....	OFF
OXYGEN BOTTLE	CLOSED
CABIN and FLIGHT DECK.....	PREPARE
APPROACH	
LIFD (one main gear up / unsafe only)	OFF
LANDING GEAR SELECTOR	DOWN
FLAPS	42
IGNITION	NORM
EMER LIGHTS	ON
APU	CHECK OFF
PACK 1 and 2	OFF
CABIN REPORT.....	OBTAINED
CABIN CREW.....	EMERGENCY STATIONS
BEFORE IMPACT	
BRACE FOR IMPACT	ORDER
WHEN AIRCRAFT STOPPED	
ON GROUND EMER/EVAC PROC (if required).....	APPLY
WARNING: IF THE GEAR DOES NOT COLLAPSE AND THE UNSAFE CONDITION IS STILL PRESENT AFTER LANDING:	
- DO NOT TAXI OR TOW THE AIRCRAFT.	
- MAINTAIN HYDRAULIC PRESSURE TO PREVENT GEAR COLLAPSE.	
- INSTALLATION OF THE NOSE GEAR SAFETY PIN MAY NOT PROTECT AGAINST NOSE GEAR COLLAPSE IN THIS CONDITION.	

Finally the aircraft had RWY excursion and stopped on the left hand side of RWY 31R and evacuation was made successfully without any injuries and the airplane was substantially damaged. The airport had disabled aircraft removal plan but the plan was not done at time of accident completely and it was tried to transfer aircraft with crane and belt by internal service provider in the airport which caused more damages on aircraft fuselage.

2.3 Failure Analysis on Left Landing Gear:

Following wreckage removal and displacing the aircraft to the safe place, due to the nature of accident and abnormal displacement of hydraulic linkages on left hand landing gear; the up pressure and /return, hosing restrictor check valve was opened and there was found that the inlet screen filter 3000psi (gear up

selection) on restrictor check valve was ruptured; therefore this component was dispatched to Tehran for further investigations.

Pursuing the investigation in order to determine normal operation of, "the restrictor check valve ASSY" on Right L/G and effectiveness of filter in the "T union" in the up line of the retraction actuator which are located in left /right main landing gear hydraulic support lines, the both items were examined and checked, there were found in normal condition.

In Tehran the investigation shown that the size of white sediment particles was tiny, but the quality of material were still unknown. The largest black debris was entrapped in the hydraulic return line (restrictor orifice) and blocked the passage way. The black debris probably entered to the hydraulic system while opening hydraulic line of landing gear.

During the investigation, the evidences proved that the main reason for filter rupture was accumulation of debris at extremity of filter entrance which blocked the orifice and caused back pressure, consequently has ruptured the filter (3000psi), which caused foreign contamination entered into the restrictor.

The design configuration of internal section of restrictor is in such a manner that in 3000psi, (gear up selection) the hydraulic fluid flows from the 7 orifices simultaneously and causes landing gear retraction in fastest way, but in gear down selection, the main gear extension is delayed as a result of restrictor which is assisted by spring pressure and make slower movement of main gear at extension.

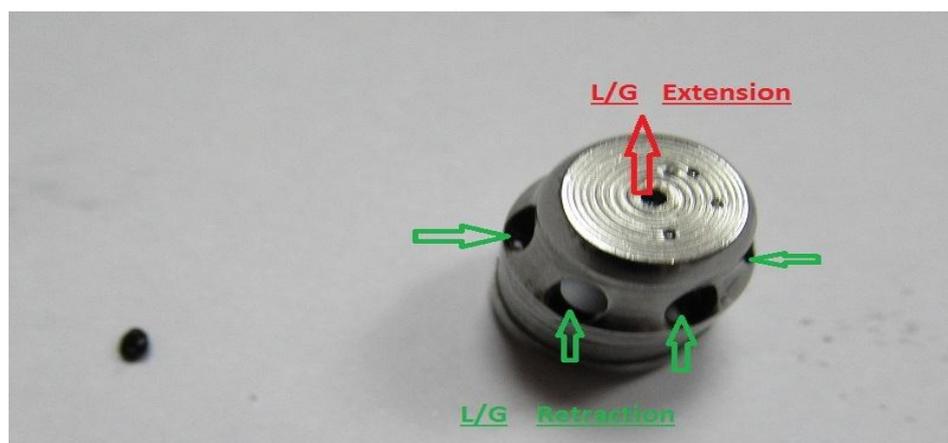


Figure 17- Hydraulic Flow Path from Restrictor

In the Retraction mode, the hydraulic fluid passage in restrictor is done via 7 wide orifices and foreign contamination and Hydraulic sediment can flow easily from them. In extension mode, the interval hydraulic flows from a small orifice in mid-section of restrictor and the foreign contamination blocked the hydraulic

flow between restrictor and main gear actuator at the time of accident and consequently the left main landing gear failed to open completely. The attempts of pilot to recycle landing gears could not change the condition of restrictor and force out the foreign contamination from mid hole.

During jacking time of the accident aircraft the Left main gear was extended with no restriction finally as a result of internal hydraulic leakage which was happened after accident.

2.4 Origin of Foreign Contamination and Internal Sediment:

The possible place of left landing gear hydraulic lines contamination was investigated, as follows:

The aircraft landing gears were changed twice during “C Check”. The return line of Landing gear actuator had not required to be opened during removal or installation of landing gear. The involved maintenance tasks of “C check” were focused during the investigation of the aircraft maintenance base (FARSCO. maintenance center) and found respected area (The filter screen check valve on the return line of the actuator) was opened based on engineering order to comply AD No; 2015-0077 in accordance with Fokker Services Service Bulletin SBF28-32-166 and one time inspection of a hydraulic hose in accordance with the instructions of Fokker Services CSB-32-026.

However there was not observation of any abnormalities in hydraulic line and screen filter, but probably the foreign pollution entered to the system while restrictor connector was opened while performing one time inspection.

The origin of hydraulic contamination or sediment could not be detected because there were little amount of contamination to do chemical analysis however the shape of most contamination was same as aviation media blast material. The manufacturer should have a database for same occurrences to detect mitigation of associated risk in hydraulic system.

The right hand main gear restrictor and T-UNION (last chance filter) were inspected between the two hydraulic systems without any abnormal condition, therefore it was concluded that the aircraft hydraulic No; 1 was in a clean condition.

Then both landing gears were installed on the aircraft and movement of foreign pollution in the hose of hydraulic system between T union and restrictor check valve caused damage on filter screen just after 240 flight cycles from latest “C Check”.

3- CONCLUSIONS:

3-1 Findings:

- The crew was certified to perform flight based on CAO.IRI regulation.
- The flight No; QSM 1202 from Tehran-Mehrabad Airport, to Mashhad airport had normal takeoff from RWY 29 L.
- The crew encountered to L/G problem while approaching to Mashhad Airport and recycled landing gears several times unsuccessfully; however they could do Alternate L/G down Procedure after first recycling.
- The flight entered a holding pattern to reduce onboard fuel and the flight crew worked the related checklists and emergency landing was carried out on the runway 31R at 18:29 local time.
- The aircraft was stopped between runway 31R and 31L and the "evacuation operation" was carried out. All passengers were evacuated in a safe condition.
- The aircraft sustained more damages left wing structure due to removal of disabled aircraft between RWY 31R&31L.
- Foreign pollution was entered to hydraulic system while performing maintenance task for one time inspection of Restrictor Valve and hydraulic hose from left landing gear actuator.
- Several occurrences were happened by blocking hydraulic line for landing gear Extension /Retraction of Fokker 28/100 due to design characteristics of related hydraulic system.

3.2 Probable causes:

Regarding analyses of the reports, The Aircraft Accident Investigation Board (AAIB) determined that the main cause of this accident was "*entering foreign contamination to hydraulic system by "maintenance activities during C Check" which caused damage on blockage hydraulic flow in restrictor check valve .*

The screen filter near hydraulic restrictor check valve was damaged by reflected force of Pollution and sediment available in the hydraulic system between and caused blockage the nozzle downstream to down lock LH landing gear mechanism.

Contributing Factors:

- Insufficient surveillance on maintenance operation of aircraft.
- Lack of enough experience for Qeshm Air maintenance personnel.

4- SAFETY RECOMMENDATIONS:

Considering the final results of the investigation to prevent similar accidents and incidents, the Aircraft Accident Investigation Board (AAIB) issues the following safety recommendations:

To: IRI Civil Aviation Organization:

- 96FQF1 To check hanger space with coordination of hangar visit plan for maintenance organization to carry out planned base maintenance relevant to projected aircraft hangar visit plan.
- 96FQF2 To require airport operator for establishing an effective disabled aircraft removal plan for their respective aerodromes in particular, planning, response and responsibilities of the relevant parties.

To EASA as relevant authority of Fokker Service:

- 96FQF3 The aircraft type certificate holder for the Fokker 100 should set periodic inspections of a hydraulic hose and restrictor in accordance findings of this accident and informed the F100 operators accordingly.

❖ EASA Comment: The one-off inspection of the restrictor check valve filter screen required by AD 2015-0077 was considered as an interim action to detect any degraded or failed filter screen, and not to detect contaminants present in the hydraulic system so that they could be removed. Furthermore, adding any inspection requirement with the objective of detecting the presence of contaminants in the hydraulic system would require having access to that system (by removing/disconnecting hoses, etc...), and this would introduce the increased risk to introduce contaminants, while executing this operation. The set of caution/notes and procedures currently present in the relevant SBs and in the AMM are deemed appropriate since, if correctly applied and adhered to, they ensure that no contaminants will enter the hydraulic system. With reference to the above mentioned assessment, we would ask to reconsider the need to issue this Safety Recommendation.

- 96FQF4 Review the design of the filtering hydraulic system at the landing gear retraction of the Fokker F.28 Mark 0100 and require operators to modify their airplanes and procedures to prevent system failure by foreign object contamination

❖ EASA Comment: Design improvements were introduced with the aim of improving the robustness of the hydraulic system. These design changes were mandated by means of EASA AD 2018-0076 and EASA AD 2018-0077. In regards to the design of the restrictor check with filter screen, the TCH has already launched the certification process of a restrictor check valve with an improved and more robust filter screen. This improvement will be mandated by means of an AD.

The set of caution/notes and procedures currently present in the relevant SBs and in the AMM are deemed appropriate since, if correctly applied and adhered to, they ensure that no contaminants will enter the hydraulic system.

To: Qeshm Air:

- 96FQF5 To empower human resources especially quality control in base maintenance operation and consider required training to comply with standards of maintenance and effective supervision on maintenance activities.
- 96FQF6 Fatigue risk assessment should be done before delivering aircraft certified staff from line maintenance to base maintenance.
- 96FQF7 To set and revise quality assurance procedures for removal, installation and interchange of aircraft components for safe maintenance actions.
- 96FQF8 To issue related maintenance tasks to insure prevention of foreign object pollution to the aircraft systems.