



Islamic Republic of IRAN

Civil Aviation Organization

Aircraft Accident Investigation Board

Final Report



State File Number: A971228EPIDG
Type of Occurrence: Accident
Date of Occurrence: 19 Mar, 2019
Place of Occurrence: Tehran Mehrabad Airport
I.R of Iran
Aircraft Type: F28 MK 100
Registration: EP-IDG

Date of Issue: 15 Mar 2020



The Islamic Republic Of Iran

Civil Aviation Organization

Aircraft Accident Investigation Board

Final Report

State File Number: A971228EPIDG

Type of Occurrence: Accident

Date of Occurrence: 19 Mar 2019

Place of Occurrence: Mehrabad International Airport (OIII) /I.R of IRAN

Aircraft Model: F28 Model MK 100

Registration: EP-IDG

Operator: IRAN AIR

Issue date: 15 March, 2019

Civil Aviation Organization

Aircraft Accident Investigation Board (AAIB)

Mehrabad International Airport

Tehran/I.R of Iran

Fax: + 98 21 6601 8659

Tel.: + 98 21 6604 7965

E-mail: AIG@cao.ir

Table of Contents

FOREWORD -----	3
SYNOPSIS: -----	4
1. FACTUAL INFORMATION: -----	5
1.1 HISTORY OF THE FLIGHT: -----	5
1.2 INJURIES TO PERSONS: -----	6
1.3 DAMAGE TO AIRCRAFT: -----	6
1.4 OTHER DAMAGE: -----	6
1.5 PERSONNEL INFORMATION: -----	6
1.6 AIRCRAFT INFORMATION:-----	6
1.6.1 General information: -----	6
1.6.2 Engines: -----	7
1.6.3 Landing Gear Information: -----	7
1.7 METEOROLOGICAL INFORMATION: -----	10
1.8 AIDS TO NAVIGATION: -----	10
1.9 COMMUNICATIONS:-----	10
1.10 AIRPORT INFORMATION: -----	10
1.11 FLIGHT RECORDERS: -----	11
1.12 WRECKAGE AND IMPACT INFORMATION: -----	11
1.13 MEDICAL AND PATHOLOGICAL INFORMATION: NOT RELEVANT -----	12
1.14 FIRE: -----	12
1.15 SURVIVAL ASPECTS:-----	12
1.16 TESTS AND RESEARCH: -----	12
1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION: -----	14
1.18 ADDITIONAL INFORMATION: -----	14
1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES: -----	14
2. ANALYSIS: -----	15
2.1 ANALYSIS HYDRAULIC FAILURE ON PREVIOUS FLIGHTS: -----	15
2.2 ANALYSIS OF FLIGHT, APPROACH AND TOUCHDOWN: -----	17
2.3 TECHNICAL INVESTIGATION:-----	18
3. CONCLUSIONS: -----	21
3.1 FINDINGS: -----	21
3.2 CAUSES:-----	21
4. SAFETY RECOMMENDATIONS: -----	22
4.1 SAFETY ACTIONS DURING ACCIDENT INVESTIGATION: -----	22
4.2 NEW SAFETY RECOMMENDATIONS: -----	22
5. APPENDIX: -----	22

"In the name of God"

Foreword

The Civil Aviation Organization, in accordance with international requirements and local regulation of the Islamic Republic of Iran is in charge of monitoring the proper implementation of the regulations and standards of flights in the "Civil Aviation Industries" of the country. In order to identify the sources of threats on flights safety based on the Regulations on the Investigation of an Accident in Civil Aviation Accidents, adopted in 2011 by the government and the International Regulations of the International Civil Aviation Organization (ICAO) Annex 13, the Aircraft Accident Investigation Board (AAIB) institutes the Investigation of the civil aircraft Accidents/Incidents. After determination of the Causes and the Contributing Factors, it will issue Safety Recommendations in order to prevent the same accidents or similar events in future.

According to Aircraft Accident Investigation regulation 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.

Based on Annex 13 to the Convention on International Civil Aviation, Chapter 3, Paragraph 3.1, and Chapter 5, Paragraph 5.4.1; the following is stipulated and recommended;

"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."

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretation.

Synopsis:

On Mar 19, 2019 at 18:35 UTC, the Aircraft Accident Investigation Board (AAIB) was notified by contact of Tehran Mehrabad Airport tower about an accident involving a Fokker 100 with flight No. IRA215 from Qeshm Island to Tehran while performing emergency landing on RWY 29L. The aircraft attempted to have main gear-up landing due to landing gear hydraulic system failure. The cockpit crew performed related checklist and tried to extend landing gears by releasing the gear manually; however, only the nose landing gear was released, so the crew had to perform gear-up landing. After landing, the 24 passengers and 9 crewmembers were evacuated safely from the aircraft with no injuries and no fire occurred.

In accordance with Annex 13 to the ICAO Chicago Convention, the Notification was sent to ICAO and DSB; the Netherlands (as a State of aircraft Design and Manufacturer) & AAIB and the United Kingdom (as a State of Landing Gear Manufacturer). Based on Annex 13 items 4.5 and 4.6, these States assigned their Accredited Representatives to support the investigation.

The main cause of the accident was determined as a combination of technical failure on landing gear manual extension system and component failure of hydraulic system.

1. FACTUAL INFORMATION:

1.1 History of the Flight:

On Tuesday March 19, 2019, a Fokker 100 with registration EP-IDG was planned to have two scheduled passenger flights from Tehran to Qeshm Island and a return flight.

On flight No IRA214 from THR to GSM during final stage of climb before cruise phase approaching position "ANK", the cockpit crew encountered hydraulic pump #1 fault light on left engine. So, after co-ordination with onboard flight mechanic, they decided to switch off the relative engine driven Hydraulic pump then switched it on again. Therefore, the system came back to normal condition with consideration of enough pressure and fluid quantity in the approved limit.

The flight No IRA215 departed from GSM to the destination THR at 15:25UTC as a schedule flight with 24 passengers and 9 crew members. Fifteen minutes before descent, again the same failure on hydraulic system #1 occurred and also HYD low quantity warning was received. The crew switched off the related HYD engine driven pump and flight was continued to destination. While descending to Tehran, the related checklist was performed and the crew tried an alternate landing gear extension by releasing the gear manually. When the nose landing gear was released but the main gear doors were not opened, the crew declared an emergency due to partial gear up landing and requested holding to reduce aircraft fuel and preparing airport emergency facilities.

The crew performed a partial gear up landing and aircraft landed at 17:56 UTC on RWY 29L in Mehrabad International Airport on its nose gear and aft belly. After landing, passengers were evacuated safely from the aircraft with no injuries and no fire occurred either.

After the accident, the aircraft was removed from the runway to southern apron with the cooperation of involved airport emergency organizations and the RWY was returned to service about three hours after the accident.

On the next day, by lifting up the aircraft from the trolley cart, the main landing gear doors automatically opened and the main landing gears were lowered and locked. The aircraft was pushed to a hanger for further inspection and related analysis.



1.2 Injuries to Persons:

There were 9 crewmembers and 24 passengers onboard without any injuries due to this accident.

1.3 Damage to Aircraft:

As a result of emergency landing with MLG up, the beneath structure of the aircraft (aft part) and MLG doors were damaged substantially and rear edge of Flap sustained damage partially too.

The fuselage was damaged from frames 18921 to 19861 and frames 20320 to 25016 on lower belly (stringers 1 to 4 and 70 to 74),

1.4 Other Damage:

The scraping of the wing and fuselage along the runway caused abrasion damage to the runway surface.

1.5 Personnel Information:

The aircraft Captain as pilot flying (PF); male, 60 years old, ATPL No; # 625 with total flight time 14110 hrs. (8093 hrs. experience on current type F100) as well as First Officer (PNF); male, 26 years old; CPL NO; 4194 with total flight time 190 hrs; Both of Iranian nationality and valid Pilot licenses (including medical certificates) issued by Iran Civil Aviation Organization.

The operator's "Flight Crew License and Training Records" revealed that both pilot and the co-pilot had passed their recurrent flight training on type of Fokker 100.

The pilots were properly certificated and qualified under IRI CAO regulation for type of Fokker 100 aircraft.

There was no evidence indicating any medical or abnormal behavioral conditions of the crewmembers that could have adversely affected their performance during the accident flight.

1.6 Aircraft Information:

1.6.1 General information:

The aircraft F28 MK 100 with serial number 11302 and registration EP-IDG was a low-wing, twin-engine, turbofan aircraft manufactured by the Netherlands in 1991.

The aircraft Certificate of Airworthiness #100 was issued on: Nov 14, 2018 by Iran Civil Aviation Organization and was valid until Nov 15, 2019.

The aircraft base maintenance was performed in approved PART-145 maintenance organization in Tehran. The aircraft last periodic check (A-51, C06CHK) was

accomplished based on AMP REV.06, AMM REV. 039 (01.DEC 2016) during Nov 20 2018 until Feb 01 2019 when aircraft had 49489 FH/ 51036FC.

The aircraft had 49818 FH/ 51333 FC on accident time.

The airplane was certificated and equipped, and maintained in accordance with CAO.IRI operation and airworthiness requirement.

Last Certificate of Registration: C of. R (#666); issued date on: Nov. 22 2010.

Aircraft Certificate of Airworthiness (C of A #666) valid until: Jun. 28 2019.

Airworthiness Review Certificate ARC (#666): valid till: Jun. 28, 2019.

Aircraft Noise Certificate #666 valid until: Jun. 28 2019.

Aircraft insurance: valid until Jul. 22, 2019 (covering 110 seats),

1.6.2 Engines:

The airplane was equipped with two TAY 650-15 engines. The related information of engines is:

Manufacturer: Rolls-Royce

Model: Tay 650-15

Serial number n° 1: 17229

Serial number n° 2: 17579

Hours and cycles engine n° 1: 39384 FH 36929 C

Hours and cycles engine n° 2: 37982 FH, 26665 C

The aircraft has been certified by the European Aviation Safety Agency after manufacturing with TCDS under number EASA A.037 .The service goal of the aircraft is also 90000 flight hours. (Limit of Validation-LOV: 90000 hrs.).

According to the latest information, the aircraft had 49818 hours' flight time and 51333 flight cycles since new when the accident occurred.

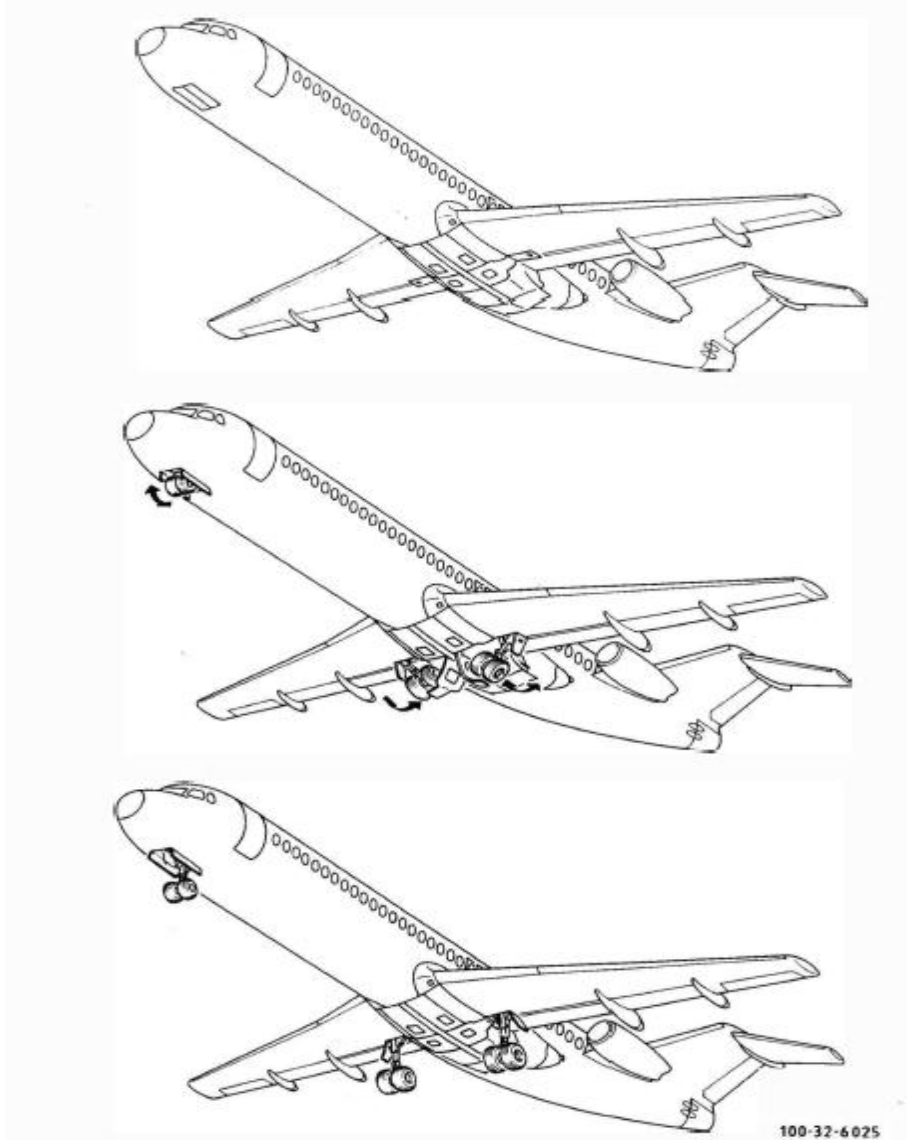
The Aircraft weight and balance data sheet was effective from January 30, 2019 as done in the airline and valid up to four years.

1.6.3 Landing Gear Information:

Introduction:

The aircraft was tricycle type with two main landing gears on right / left-hand side and a nose landing gear. The landing gear system was retractable. The landing gears operate hydraulically with system #1 pressure. The main gears retract inward; while the nose gear retracts forward. Each gear is mechanically locked in the down position. System pressure holds them in the up-position. Each wheel bay has a door, which closes hydraulically when the gear is down or when the gear is up. The nose gear doors close only when the gear is up. A small door connected to the main fitting

of each main gear closes the strut bay. The wheel bay doors have mechanical locks, which hold the doors closed when # 1 hydraulic system is off. In that case, gears will rest on the doors. These locks are released hydraulically or mechanically by the gear alternate extension system and the gears free fall and lock in the down-position by spring force inside down lock actuators.



Main Landing Gears:

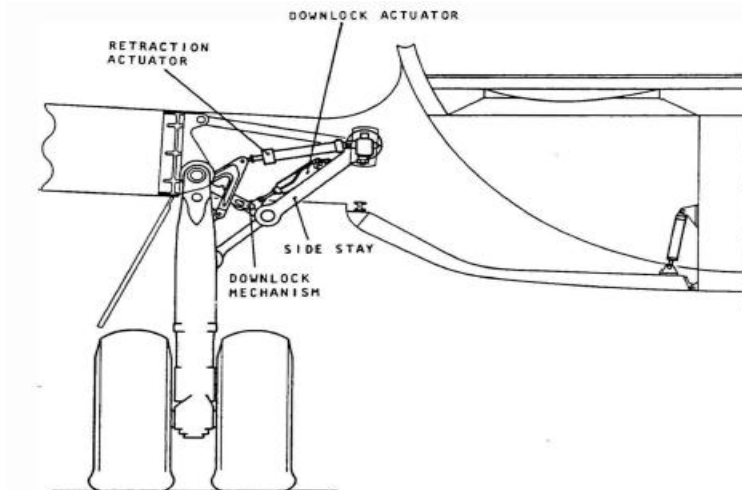
Each main gear has a shock strut with a main fitting and a sliding member. The main fitting is attached to the main gear bracket, between the rear and false spars of the outer wings. This attachment is the turning point of the main gear. Both main fitting and sliding member together form a shock absorber. Torque links connect the main fitting and sliding member with each other; they make sure that the wheel axles cannot turn. A side stay assembly with an upper and lower member gives support to the main gear. The side stay members are attached to the main fitting and the side stay bracket, which in turn is attached to the rear spar and the false spar of the outer wing. Toggle links between the side stay and main gear provide a geometric down lock (over center) when the main gear is down.

The retraction actuator is attached to the main fitting on one side and to the side stay bracket on the other side.

Downlock Mechanism:

A spring-loaded down lock actuator keeps the toggle links in the overcenter down locked position, when the gear is down. During an up-cycle, hydraulic pressure releases the down lock and then the side stay can fold when the gear moves up.

At the joint of the toggle links, an abutment face determines the amount of overcenter travel for the downlock; this is the primary down stop. A secondary down stop is on the upper toggle link s. It is used when the primary down stop runs off its adjustment. The upper and lower toggle links have bushed holes for the ground safety pin. Downlock switches are attached to the upper toggle link and to the lower side-stay member. These switches are used for the indication.



Indications:

L/G position lights are located below the L/G selector. The L/G down and locked position is indicated by a green light for each respective gear. The lights will be out when the L/G is fully retracted. A blue light incorporated in the L/G selector knob will come on during retraction until all L/G doors are closed and locked and during extension until all landing gears are down and locked. When the lights come on due to alternate L/G extension, it remains on until the L/G selector is selected down.

A Level 2 Alert is presented when a disagreement between the position of the L/G selector and the gears of the doors is detected.

A level 3 alert is presented when the L/G is not down and locked and the aircraft is in an approach configuration. The approach configuration is defined as a radio altitude less than 1000 ft and either a flap position greater than 23 degrees or a thrust lever position less than MIN TO. If radio altitude is not available, the alert will be presented by either flap or thrust lever position only. The L/G-NOTDOWN alert cannot

be cancelled by depressing the master warning lights. The alert is cancelled only when all L/G are down and locked.

History of landing gears:

Nose L/G P/N: 201071004, S/N: DRG/7076/89,

R/H Main L/G P/N: 201072022, S/N: DRG/6606/91,

L/H Main L/G P/N: 201072021, S/N: DLG-0219,

The Landing Gears Maintenance /Inspections are as follows:

Title	Limitation		Remaining Cycles	Remaining Days	Last Shop Visit
	Cycles	Days			
NLG	20000	4380	9266	1964	06/08/2012
R/H MLG	16000	4380	2977	3852	06/12/2013
L/H MLG	16000	4380	2977	3852	06/12/2013

L/G Alternate control (4000FH) interval check performed about end of C-06 Check (20 Nov, 2018- 01 Feb, 2019).

Following the tasks as per maintenance program per No; 323100-00-01, 02, 04, 05; 291300-00-02, 07, 11(Including: functional check of hydraulic system, lubrication of Teleflex cable, inspection of: pulleys, fairleads, pressure seals, brackets of L/G cable system were accomplished during Last C check which contained Fokker AMM 0100 "TASK 32-33-00-720-815-A" for functional test – L/G alternate control.

1.7 Meteorological Information:

At 17:00 UTC, Runway and taxiway surface were “DRY”, wind was 300 degrees / 04 knots, visibility more than 10 kilometers, temperature 12 degrees of Centigrade. Dew point -05 and QNH 1015 Hpa. Meteorological condition did not affect the occurrence of this accident.

1.8 Aids to Navigation:

On the day of accident and during emergency landing, all navigation aids (on board & ground) except airport TACAN were serviceable.

1.9 Communications:

All communications between flight crew and ATC were done normally and based on downloaded CVR information; there was not any problem about communication facilities.

1.10 Airport Information:

Mehrabad International Airport (OIII) is located in the west of Tehran and designated for scheduled domestic and unscheduled international flights. The airport is operated by Iranian Airport & ANS Company. The airport characteristics had no adverse effects on the accident scenario.

1.11 Flight Recorders:

The aircraft FDR & CVR were removed from the aircraft without suffering any damage and downloaded at Avionic shops of Aseman Airlines. Both Flight Data Recorder (FDR) & Cockpit Voice Recorder (CVR) were analyzed successfully.

General overview of FDR data is:

Time (UTC)	Recorded Data	Remarks
15:24:04	Engine2 Start	Engine Start
15:24:42	Engine1 Start	Engine Start
15:36:32	N ₁ From 30 To 70	Take-off Power
15:37:04	Ground Speed 130	Lift up
15:37:12	Magnetic Heading 226	Landing Gear Up
15:52:33	Computed Airspeed 278 Pressure Alt: 28000 Ft	Cruise (Top of Climb)
16:20:27	Hydraulic Oil Pressure Low sys #1 Warning	#1 HYD System Failure
17:01:00		Top of Descent
17:18:04	Pressure Alt:6970 For 1':25" Heading Change From 314 to 285	Level Flight
17:22:58	Landing Gear was not down Go Around Min Alt (Radio Height):405 Ft	Go Around
17:25:00	2000 Ft Radio Height Level For 2 Min	Level Flight
17:30:48	Complete loop bank to right (Magnetic Heading 121+360=121) Vertical G: about 1.6 (Max:1.85) Radio Height: 3600 to 3200 Ft	Loop Right Bank
17:30:48	Complete loop Bank to Left (Magnetic Heading 127 -360=127 50 Seconds Vertical G: about 1.6 (Max:1.96) Radio Height: 3800 to 3200	Loop Left Bank
17:41:43	Aircraft descend to Radio Height 216 ft. Pressure ALT=3875 ft	checking L/G status
17:49:07	Aircraft descended from Pressure ALT=7000 ft and continued for landing	
17:56:00	landing	

1.12 Wreckage and Impact Information:

The aircraft made an emergency landing on RWY 29L without main landing gears down, so the aft part of aircraft fuselage as well as some part of control surfaces

sustained substantial damage. For about 3 hours the RWY in use closed after the aircraft was removed and towed to the airline hanger for inspection and maintenance. The airline is not planning to return the aircraft to service, for the time being because of substantial damage and high cost of repairs.

1.13 Medical and Pathological Information: Not Applicable

1.14 Fire:

There were no indications of a post-impact fire on the aircraft. However, airport firefighting and emergency service cars sprayed fire extinguisher agent upon aircraft stop at the end of RWY.

1.15 Survival Aspects:

At 17:15 UTC Mehrabad announced emergency situation to related organizations based on airport emergency response plan. The Airport firefighting and additional rescue forces took up their positions alongside runway 29R. During the emergency landing on the Runway, the occupants were not exposed to the vertical accelerations of the touchdown and to the forces produced by the deceleration of the airframe in the subsequent sliding phase. The occupants were guided to move forward of the cabin and briefed to fasten their seat belts by note of cabin crew and were prepared for an emergency landing.

Fire-fighting vehicles arrived at the site in a matter of seconds, protecting the aircraft by spraying foam over the fuselage to prevent fire.

All occupants were able to leave the airplane without any injury and assistance through the forward passenger door exit, but they did not exit immediately. When rescue teams reached the accident site, passengers were onboard and were disembarked by attempt of airport rescue personnel within a couple of minutes. The passengers were transferred to the terminal building by shuttle vehicles normally.

1.16 Tests and Research:

Post-Accident Inspections:

In the hanger, the following tasks were done on aircraft-related landing gear system and components for investigation purpose as required by AAIB.

According to the Fokker AMM 0100 "Task 32-33-00-720-815-A"

Functional Test of Landing Gear Alternate Control (Refer to MPD 323300-00-02), And 32-31-04-05 Pulley, uplock Mechanism MLG Door, 29-11-01-01b Main Engine Pump Zone 430-440)

- Task 29-00-00-811-811-A "Engine Driven Pump (EDP) Failure.
- The Pump Leakage at the time of accident occurrence was inspected. Hydraulic Pump {Aerohydrous" P/N #42046 S.N: B159AB "{Shelf Life Expiry: 26.3.2021 }

The inspection showed that due to faulty check valves, the high pressure of hydraulic fluid occurred and caused pressure and temperature to rise in return line and consequently EDP case outlet pressure rose, EDP overheated and subsequently gasket no. 295 was dismantled from its original position and caused hydraulic "leakage".



Some other tests were done on the landing gear system by cooperation of the airline engineering department in two sections as:

- a) Examination of landing gear alternate system:
- After aircraft was jacked up, the normal landing gear operation was performed with hydraulic electric pump "ON" and it was found that the main and nose landing gears extension and retraction as well as the respective doors' operations were normal.
 - Landing gear alternate functional check was performed with hydraulic pressure available, and it was found that the main and nose landing gears and respective doors operation were normal.
 - Landing gear alternate functional check was performed without hydraulic pressure and it was found that the operation of the nose landing gear and respective doors were normal but the main landing gear and respective doors did not open and also the mechanical handle needed too much force to perform the alternate landing gear operation (above maximum limitation about 90 lbs.). The scenario of accident was simulated again.
 - Main landing gears' selector valve P/N: 71544-1 was changed, but the problem still persisted.
 - Dump valve P/N: 71545-1 was changed, but the problem still persisted.
 - Both main landing gear doors' selector valves P/N: 71543 were changed, but the problem still persisted.
 - In accordance with CMM: 32-31-04, page 176, item No.6, main landing gear doors uplock mechanisms were removed and sent to the accessory shop for further investigation. It was found that three uplock rollers seized specially on forward right-hand side door up-lock & sign of worn out and deformation on the holes of main landing gear up lock mechanism lever assembly. It caused hard movement of alternate extension lever.
 - Referring the failure of up-lock door mechanism, the fine adjustment was performed and simultaneously the alternate mechanism was lubricated slightly and as a result the alternate lever force decreased to about 40 lbs. (within limits), leading to normal function of the landing gear alternate system.
- b) Examination of hydraulic loss problem according to the defined task and engineering disposition was done, the following procedures were performed on hydraulic system of the aircraft:

- After hydraulic servicing, heavy external hydraulic leakage was found on ENG#1, system #1, pump case (between mating surfaces of front housing and pump case mounting flange)
- Engine#1 hydraulic pump (S/N off: B159AB) was changed with the new part
- For troubleshooting, the hydraulic pump (S/N off: B159AB), that was removed, was sent to hydraulic shop for more investigation.
- The shop report findings are as follow:
 - 1- One of the front housing mounting flanges (FWD mating faces) bolts had been completely loosened and the others had lost their own tightening torque, which could be the sign of EDP overheating.
 - 2- The front housing mounting flange (FWD mating faces) gasket was discolored and became brittle, and also a piece of the gasket which was missed caused the leakage to begin.
 - 3- There were overheating symptoms on the corresponding gasket which indicates that the hydraulic pump cooling was not performed properly due to the case outlet "back pressure".
 - 4- All internal parts of the hydraulic pump were in satisfactory conditions and free of any defects.
- In preliminary investigation it was found that the check valve P/N: MS24593-4; (F100 IPC Ref: 29-13-08-15A, item #60) was faulty which could have caused the drain line to become trapped, resulting in the pump overheat.
- The "return filter assembly" and "differential pressure switch" were removed and sent to hydraulic shop for free hydraulic flow check (by hydraulic tester) which were found to be OK.
- Eng#1 system#1 "case drain Q.A.D" & " union " were removed and sent to hydraulic shop for free hydraulic flow check and found OK.
- Regarding the above investigation, the Engineering Disposition (ED) was issued by engineering department that included instructions which are as follows:
 - 1- The dimension of hydraulic lines which are connected to return manifold were measured and checked for general condition.
 - 2- The hydraulic return line pressure value was measured and it was above 100 PSI, so system #1 return line filter check valves and one of sys#1 return manifold check valve were removed and sent to hydraulic shop and all were found faulty; (the pressure drop through the check valves; at 40 lit/min was more than 15 PSI).
 - 3- Regarding the above shop result, the mentioned check valves were changed and return line pressure valve was measured and found to be below 40 PSI within limits and normal condition.

1.17 Organizational and Management Information:

Iran Air is the main carrier of the country. Related Air operator Certificate AOC No. IR 100 was valid until 15 Nov. 2019.

The airline has approved CAMO in Iran for continued airworthiness management of aircraft under approved CAME.

1.18 Additional Information:

No additional information was described.

1.19 Useful or Effective Investigation Techniques:

The standard and normal techniques based on ICAO Accident Investigation Manual (DOC.9756) were applied.

2. ANALYSIS:

2.1 Analysis Hydraulic Failure on Previous Flights:

The aircraft was released from C-06 check dated 01 Feb. 2019. In accordance with aircraft technical logbooks, there was no report about malfunction until Mar 16, 2019.

On Mar. 16 2019, on flight No.IRA217 during climb from XBJ to destination THR faced hydraulic system#1 engine#1 pump failure. A hydraulic leak was also observed from speed brake area after landing. Then the respective area was checked and it was found that engine #1 reverse selector valve (return line) with P/N; D72011-411 was cracked, so the respective line end cap procedure was accomplished and thrust reverser deactivation instruction was done and the item was C/F as per MEL.78-30-01, CAT "C" and also the item was transferred to differed items (DDCS No; 07). Consequently, #1hydraulic system was serviced. Finally, engine run was performed and the result was OK.

On Mar. 16, 2019, during flight IRA415 from THR to destination BUZ, the crew faced hydraulic system #1 engine #2 pump faults. After landing in BUZ station, troubleshooting was performed and precautionary C.B Reset and Engine run was done by crew, with engine #2 hydraulic pump "ON"; no abnormality was found as per AMM.29-21-01, and the aircraft was released for the next flight.

On Mar. 16 2019, during flight IRA414 from BUZ to destination THR the crew faced hydraulic system #1 and engine #1 pump fault. After landing in THR station, with reference to DDCS #7, during engine run hydraulic pump operation was checked and found to be normal, as per AMM.71-00-00. Also, after landing, in THR station, sign of hydraulic leak on speed brake area under tail area was seen and as a remedial action with reference to DDCS#7, respective hydraulic line was changed with a new one IAW; AMM.29-13-08, thrust reversers were activated and operation leak check was performed. The result was OK, so DDCS# 7 was cleared.

On Tuesday March 19, 2019, flight IR382 took off from THR to ZAH at 03:30UTC, immediately after take-off, the aircraft encountered hydraulic system #1, engine#1 pump failure, so the captain decided to return to THR and made an overweight landing (42400 kg.) with a rate less than 300 ft/min at 04:05UTC according ATL#8219. After troubleshooting, it was found that hydraulic pump (EDP) on system #1, engine#1 was faulty, so the respective pump changes as per AMM.29-11-01, and operation were checked during engine run and they were found to be OK. (P/N: 42046, S/N ON: B159AB, S/N OFF: A069AB). The faulty pump with S/N; A069AB was investigated and revealed and found some overheated internal parts.

On the same day, the next flight No; IRA214 from THR to GSM during final stage of climb before cruise phase approaching position "ANK", the cockpit crew encountered an abnormality in hydraulic pump system #1. So, after co-ordination with flight mechanic who was onboard, they decided to switch off the relative engine driven hydraulic pump and then switch on respectively; however, this action was not recommended in Aircraft QRH. Therefore, the system came back to normal condition with consideration of pressure and fluid quantity in the approved limit. In addition, if #1 hydraulic system fails again, they could continue the flight based on QRH. The crew did not report the event on aircraft technical logbook but they noted this subject in the interview meeting with AAIB and it was confirmed by recorded audio files of the CVR.

**HYDRAULIC SYSTEM 1 LOW PRESSURE**

SYS 1 ENG AND 2 PUMP.....	CHECK OFF
HYDRAULIC SYSTEM 1 FAIL PROC.....	APPLY
SPEED.....	MAX 250 kt/M.65
STATUS: Flight controls single channel. Normal flaps inoperative. Normal gear inoperative. Speed brake inoperative. Reversers inoperative. Nose-wheel steering inoperative.	

HYDRAULIC SYSTEM 1 FAIL PROCEDURE

ALTN FLAP PROC.....	APPLY
ALTN LG PROC.....	APPLY
LANDING FLAP 25	

Remarks:

- When after a low pressure alert in combination with a low quantity alert in system 1 the pumps are switched off, pump fault lights of system 2 may come on for a short while during the use of flight controls

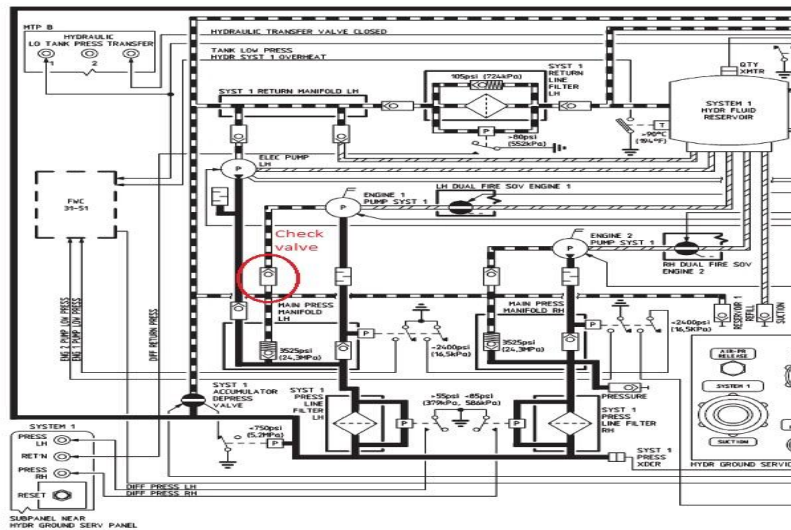
Based on airline CAME, in case a defect is repeated 4 times in 10 flights, maintenance control center will derive a recurring defect report from database and analyze the defect and finally extract deadline and forward to CAMO manager's delegate and engineering department for immediate action. It was the time that #1 hydraulic failed and due to not recording the HYD failure by the crew on flight 214, related recurrent defect notification was not issued.

All recorded events show that there was a hidden failure in No. 1 hydraulic system that was not detected by airline maintenance and related consequences appeared during flights before the accident. The revealed investigation of aircraft system after the accident determined the failure as:

The check valve P/N: MS24593-4; (F100 IPC Ref: 29-13-08-15A, item #60) as per AMM 29-00-00-811-811-A and engineering Disposition N; 1815/19 has been checked and found faulty which could have caused the drain line to become trapped, resulting in the pump overheat. Regarding this finding, some other research determined that measured hydraulic return line pressure value was above 100 PSI, so system #1 return line filter check valves and one of sys#1 return manifold check valve were found faulty consequently; (the pressure drop through the check valves at 40 lit/min was more than 15 PSI). Finally, regarding the above shop results, the mentioned check valves were changed, and the return line pressure value was measured and found to be below 40 PSI with normal operation of No.1 hydraulic system.

Aircraft Trouble shooting Schematic Manual (TSM) defines only system diagram and technicians referred to AMM and the maintenance section of the airline based on AMM task No. 29-00-00-811-811-A changed the EDP. Related fault isolation procedure was not done accordingly that could detect failure respectively.

The airline should be concerned about repetitive similar events on No. 1 hydraulic system and make extensive troubleshooting on this system. Also, Fokker service Co. has not continued their cooperation/support with Iran air and the airline could not contact the manufacturer to follow up detection of the failure.



2.2 Analysis of flight, approach and touchdown:

The flight No; IRA215 on Mar. 19 2019 took off from GSM to destination THR normally at 15:37UTC as a scheduled flight with 24 passengers and 9 crew members. After 25 minutes, the aircraft reached cruise level FL.280 and continued the flight. 8 minutes later, again the hydraulic system #1 failed and HYD oil pressure low sys #1 warning appeared. The crew invited the onboard mechanic and with his consultation, they switched off the related HYD engine driven pump and flight was continued to destination.

At 17:00 UTC the aircraft started to descend. While descending to Tehran, L/G extension was not successful so the related checklist was performed and pilots tried alternate landing gear extension by releasing the gear manually. While the nose landing gear was released but the main gear doors were not opened, then the cockpit crew requested go-around at 17:22 UTC. The flight continued to left downwind then to KAZ to solve the problem. The crew also applied G force turn based on QRH to open the main landing gears but it was not successful. The main causes of the event were seizing of up-lock mechanism on L/G manual extension system.

At 17:41 UTC the flight made a low path on RWY so that L/G situation could be checked by ground staff. The airport staff confirmed that the main landing gears were not down locked. Then the crew declared an emergency due to partial gear up landing and requested holding to reduce aircraft fuel and preparing airport emergency facilities.

The crew performed a partial gear up landing and aircraft landed at 17:56 UTC on RWY 29L at Mehrabad Airport on its nose gear and aft belly. The rescue personnel of the airport reached the aircraft immediately due to previous preparation made before disembarkation of passengers, so crew and passengers were evacuated from forward left door with no injuries and occurrence of any fire either.

ALTERNATE LANDING GEAR PROCEDURE

ALTN LG SELECTOR OPERATE
NORMAL LG SELECTOR DOWN (IF POSSIBLE)

NOTE: The L and R MAIN LG DOOR alerts will be displayed after alternate landing gear selection. Do not apply the MAIN LG DOOR FAULT procedure.

- If successful:
AFTER LANDING CLEAR RUNWAY, DO NOT TAXI
NOSE-WHEEL STEERING INOP
- If unsuccessful:
PERFORM A LEVEL '2G' TURN (60 DEG OF BANK) AT 200 KT
 - If successful:
AFTER LANDING CLEAR RUNWAY, DO NOT TAXI
NOSE-WHEEL STEERING INOP
 - If unsuccessful (and normal LG selector is down):
ALTN LG SELECTOR NORMAL (DOWN) POSITION
GEAR UP / UNSAFE LG PROC. APPLY
NOSE-WHEEL STEERING IS OPERATIVE.

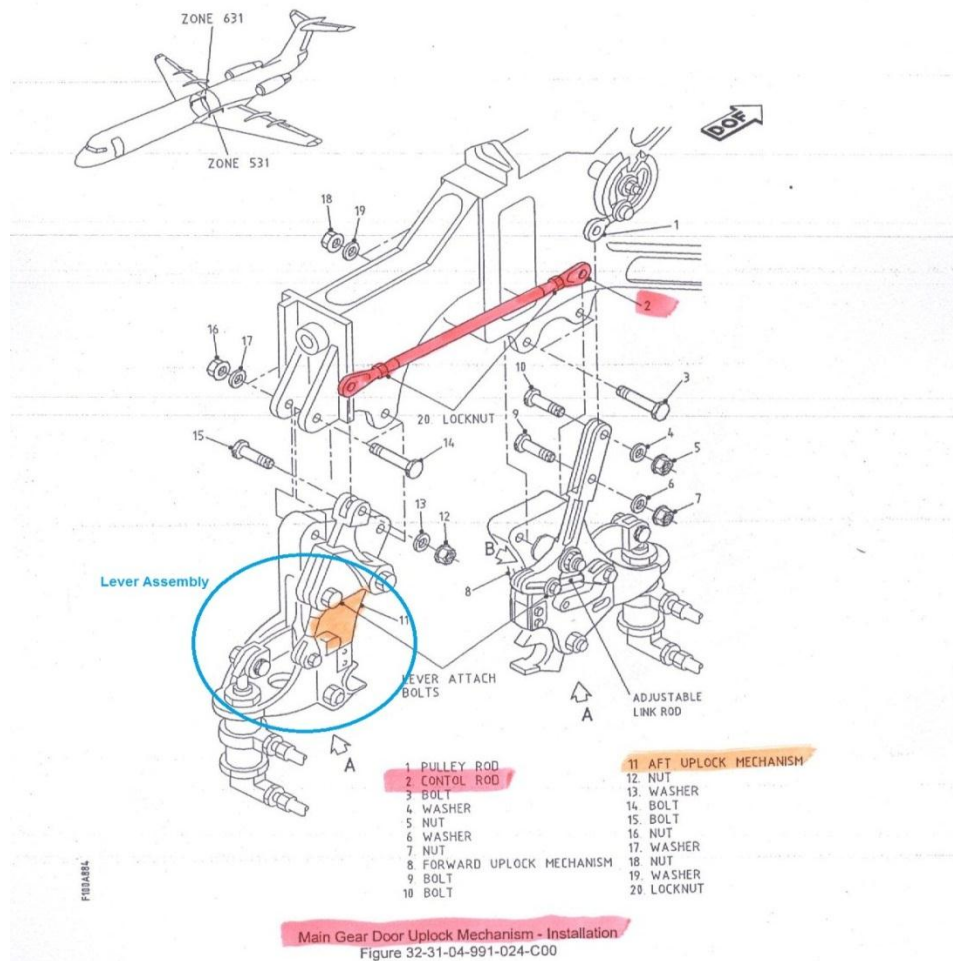
2.3 Technical Investigation:

The aircraft was under C check up to from 20Nov, 2018 to 01 Feb, 2019. The related task cards of the L/G system were focused on. The operation of landing gears was performed both in the normal hydraulic operation and also on alternate manual extension with/without hydraulic pressure based on aircraft maintenance manual chapter 32-33-00. The maintenance documentation showed that the functional check L/G alternate control related to task AMM 32-32-00-720-815A and detailed inspection of L/G control cable per task AMM 32-00-00-200-816 was performed. After the accident, inspection of cable was performed again and tension of cable was observed normal.

According to the design characteristic of the aircraft, the L/G should extend with their weight force normally, while alternate manual L/G extension by releasing up-lock mechanism. All four door up-lock mechanisms of aircraft landing gears were focused on. In accordance with CMM:32-31-04, page 1076, item No.60 , rollers of the door up lock, especially in FW R/H position (3EA) found seized, which caused hard movement of alternate extension lever.

Further research was performed to analyze the failure as:

1. The control rod of up-lock mechanism required small adjustment.
2. Investigating on up-lock mechanism lever assembly with maintenance reference CMM32-31-04 on page 1076, items 40&50 revealed that shape and measurement of holes of this lever has changed too.
3. In the troubleshooting process of up- lock mechanism, required fine adjustment on control rod was done in accordance with AMM 32-31-04.
4. Required lubrication on up- lock mechanism.
5. With the made rectifications on the above cases, the alternate control lever force was reduced to its lb40 within limit and the procedure for performing the functional test landing gear alternate control had been performed smoothly according to Task: 32-33-720-815-A.



According to the Aircraft Technical Log (ATL) page 8132, the last check of this aircraft (C-06) had been done in Maintenance center. Some items in this heavy check are as follows:

- Door up-lock mechanism inspection.
- Functional test of landing gear alternate control system in accordance with task No; 32-32-00-720-815A.
- Door up-lock mechanism lubrication.

The alternate system did not work correctly after 297 flight cycles, and gear alternate extension lever moved hardly. In interview with personnel involved releasing this task, they insisted that the system worked normally but in MAX permissible limit.

Evidence such as the seized rollers, lever assembly deformation and up-lock mechanism failure may have emerged due to component aging and some other defects need adjustment and lubrication. Only 297 cycles and 327 hours of flight after “C” check could not have caused such an extensive failure on the alternate landing gear extension. It can be analyzed that periodical L/G inspections at the last maintenance action (C06 check) might not have been of good quality. The existence of each item mentioned above is indicative of the long time they took to occur; clearly, these problems did not happen suddenly. To analyze seizing of up-lock mechanism, generally the following subjects should be noted:

1. Any human factors, such as

- ✓ lack of proceeding of the task card;
- ✓ Inefficient inspection;
- ✓ Incorrect lubrication method and timeline; and
- ✓ Ineffective training
- ✓ Suspected improperly cleaning procedure

Each of the above can be helpful in generating these findings.

it is worth to point out that the correct functioning on the MLG doors up-lock mechanism should be checked at every execution of the “Functional check of landing gear alternate control system” task 323300-CM-02 (ref ALS Part 1 report SE-473), due every 4000 FH. It is also to be noted the presence of the following MRB/MPD tasks, aiming at ensuring the correct functioning of the MLG doors up-lock mechanism which probably not performed accurately by maintenance:

- MRB/MPD task 323300-00-01 “LUBRICATION OF MLG AND NLG DOOR UPLOCK MECHANISM” (interval 4000 FH/3 years)
- 323300-00-05 “GENERAL VISUAL INSPECTION OF LANDING GEAR DOOR UPLOCK RELEASE OPERATING MECHANISM” (6000 FH interval).
- - 321201-00-02 “GENERAL VISUAL INSPECTION OF MLG DOORS OPERATING MECHANISM, INCLUDING HINGES AND UPLOCK BRACKET” (3000 FH interval).
- - 323200-00-02 “GENERAL VISUAL INSPECTION OF MLG INBOARD DOOR UNLOCKING MECHANISM” (3000 FH interval).

3. CONCLUSIONS:

3.1 Findings:

- 1- The crew was certified to operate the aircraft.
- 2- The weather was good; the meteorological conditions had no influence on the accident.
- 3- The airplane was properly certificated and maintained in accordance with existing regulations but the quality of maintenance regarding observed failures was not at a good level to prevent the accident.
- 4- The check valve with P/N; MS24593-4 of No. 1 hydraulic system was faulty that caused trapping hydraulic returns line pressure and as a result EDP overheated so its internal parts damaged and followed by hydraulic leak.
- 5- On the flight before accident flight, the crew encountered EDP #1 fault light on left engine temporarily and did not record on aircraft technical logbook. If this event had been recorded by the crew, the remedial action should be taken before departure at Qeshm Airport according to airline CAME.
- 6- The cockpit crew encountered a HYD oil pressure low system #1 during accident flight and consequently problem with landing gear extension while approaching Tehran Mehrabad Airport.
- 7- Technical failure (seizing) on L/G door up-lock mechanisms led to unsuccessful alternate manual extension on the main landing gears.
- 8- The two events “check valve failure” and “MLG doors up-lock rollers failure” are independent from each other’s and the crew encountered a HYD oil pressure low sys #1 during flight which lead to use of MLG alternate extension procedure.
- 9- The flight and landing proceeded in the emergency condition and finally pilots were forced to do partial gear up landing.
- 10- The captain was pilot flying and he was flying manually, without connecting the automatic pilot.
- 11- The 24 passengers and nine crew members onboard evacuated the aircraft via L1 door in a couple of minutes with the assistance of airport rescue personnel.

3.2 Causes:

The aircraft involved accident due to the main gear up landing on the runway. The Aircraft Accident Investigation Board (AAIB) determines that the accident took place due to a combination of failures in hydraulic system and L/G manual extension.

The investigation revealed that the contributive factors in human failures were as:

- Not following procedures
- Ineffective maintenance
- Pilot nonstandard action to HYD #1 pump fault light based on QRH on previous flight IRA.214

4. SAFETY RECOMMENDATIONS:

4.1 Prompt Safety Actions during Accident Investigation:

As the initial findings of this accident, the following "**Prompt Safety Actions**" were also taken to enhance related safety:

- On Mar. 24, 2019 IR of Iran Civil Aviation Organization issued an emergency Airworthiness Directive (AD 2019-01-E) including alternate manual extension of L/G as per F100 AMM task for every "A" check.
- The AAIB was informed that on Apr. 25, 2019, Fokker Service recommended the operators that 2g level turn procedure is an acrobatic maneuver that could not be effective for L/G alternate extension and was deleted from aircraft abnormal procedures.

4.2 New Safety Recommendations:

Considering the final results of the investigation in order to prevent similar incidents, and to improve the safety of the flights, the following safety recommendations are issued:

Ref No: 971228 IDG;

To IR of Iran Civil Aviation Organization:

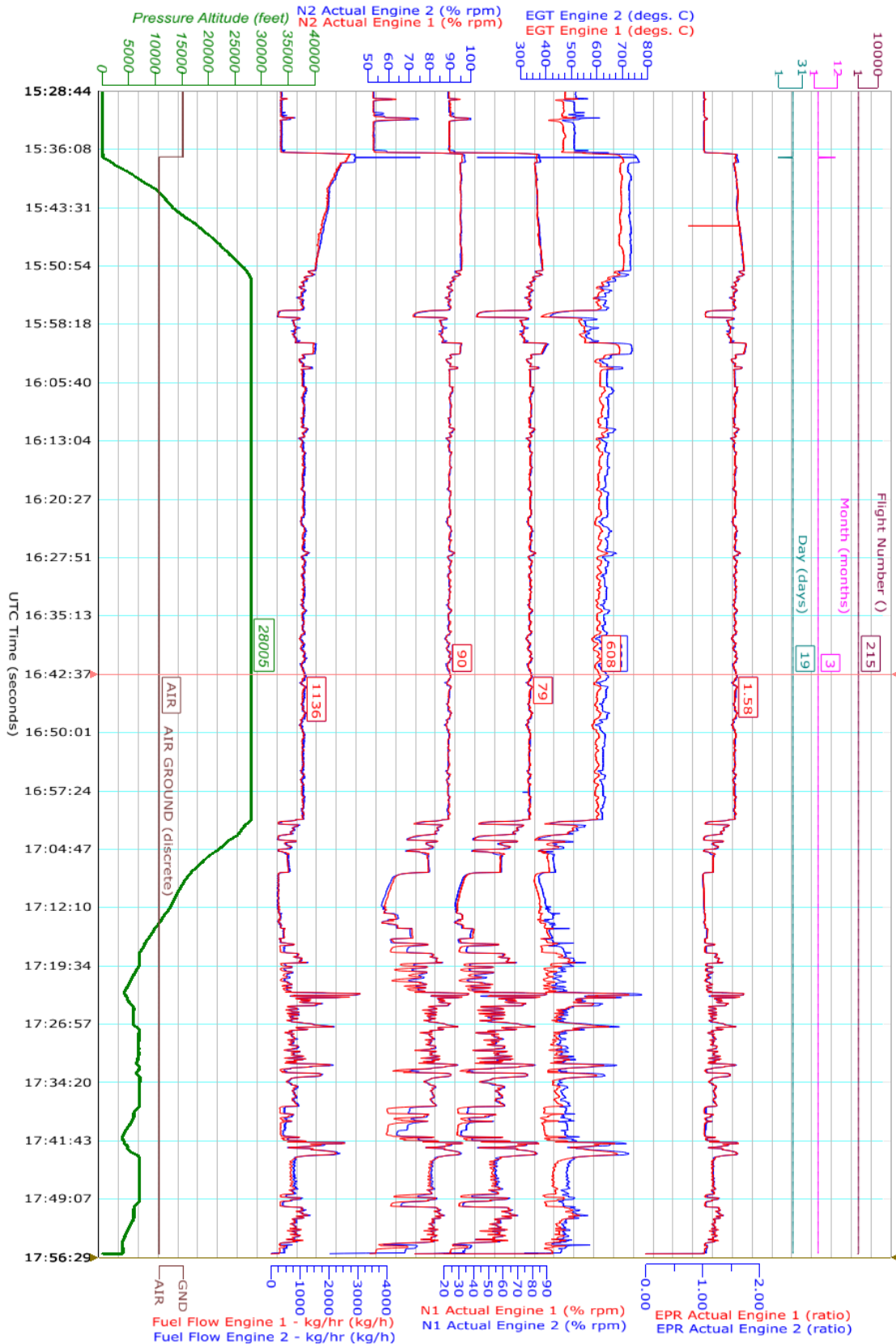
1. To follow up airline policies for repetitive defects on the aircraft.

To the Airline:

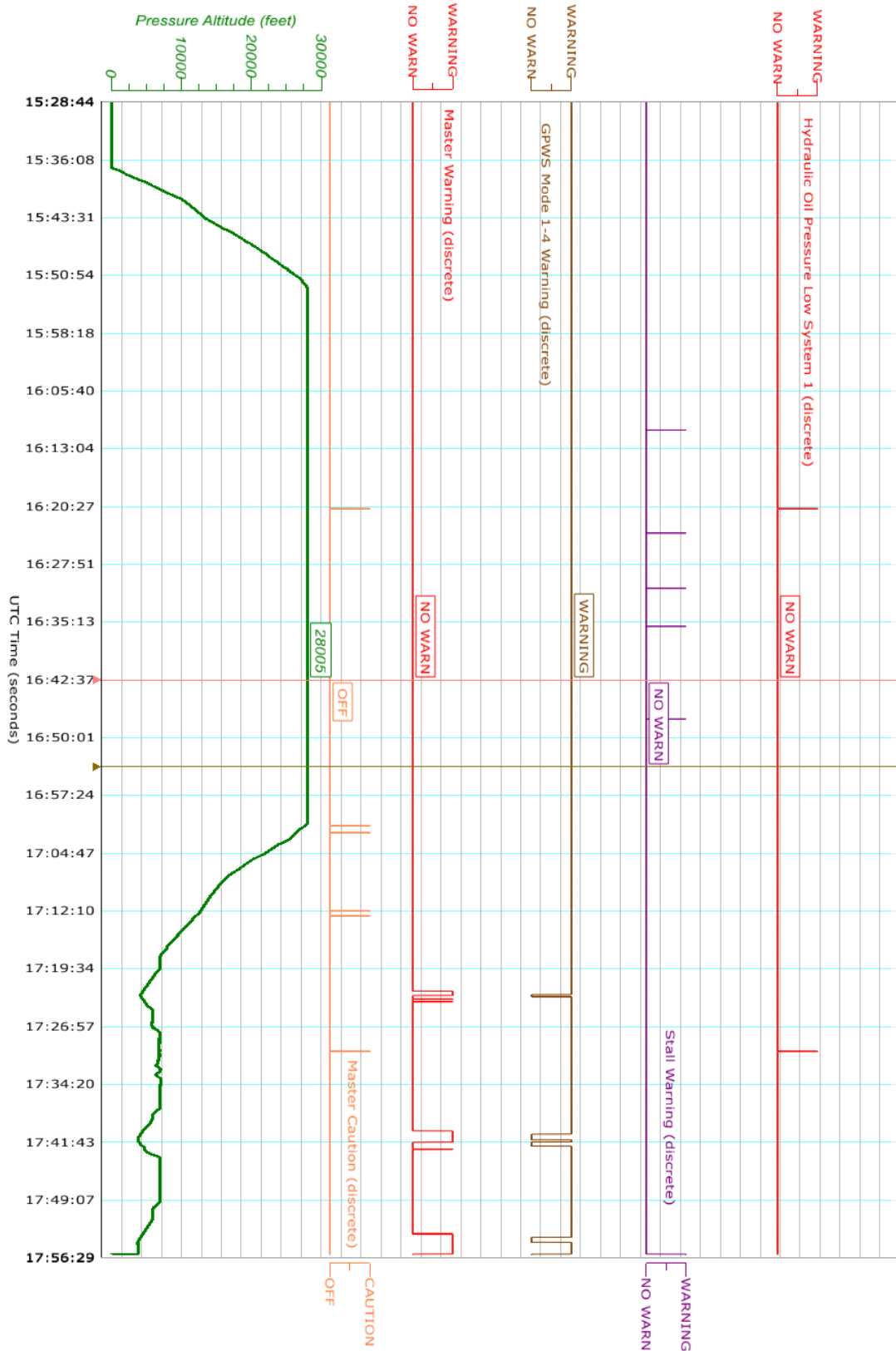
2. To reinforce the internal quality control and the quality inspections and/or audits, in order to ensure the suitability of the maintenance methodology and procedures of the tasks carried out in the workshop, with a view to guaranteeing the correct performance of the measurements and tests stipulated by the manufacturer's AMM (Aircraft Maintenance Manual).
3. To improve the training of technical personnel for the performance of the AMM /CMM tests of the main landing gear and testing and troubleshooting in order to guarantee the correct annotation of results, including calibrating cable tension on the workshop, with a view to guaranteeing the correct performance of the measurements and tests stipulated by the manufacturer's Maintenance Manuals and Mandatory modifications.
4. Engineering department to record annotation of results about AMM task for Normal/Manual operational check of L/G
5. Strictly adhere to the emergency and abnormal procedure in AFM and review in related proficiency check.

5. Appendix:

- *FDR Graphs*
- *Task Related to EDP Failure*
- *Task Related to L/G Functional Test*
- *Task Related to Inspection Alternate L/G Control Cable*
- *Fokker Recommendation for 2g Turn*



Flight and Engine Graphs



Warnings related to the flight

TASK 29-00-00-811-811-A - Engine Driven Pump (EDP) failure

EFFECTIVITY: 001999

WARNING: BE CAREFUL WHEN YOU OPERATE THE THRUST CONTROLS. MAKE SURE THE THRUST CONTROLS ARE CLEAR. INJURY TO PERSONS AND/OR DAMAGE TO EQUIPMENT CAN OCCUR.

WARNING: BE CAREFUL WHEN YOU OPERATE THE THRUST REVERSERS. MAKE SURE THE LIFT DUMPERS AND THRUST REVERSERS ARE CLEAR. INJURY TO PERSONS AND/OR DAMAGE TO EQUIPMENT CAN OCCUR.

NOTE: This task can be done to prevent pump failures.

NOTE: Examples of EPD failure are:

- **Overheat, the aluminum housing of the pump is colored bronze/yellow**
- **A blown seal.**

1.. Prerequisites

- A. Make sure the Aircraft is in this configuration:
- Electrical power is on (Refer to 24-00-00, Pageblock 201)
 - Hydraulic power is available (Refer to 29-00-00, Pageblock 201)

2.. Fault Isolation

- A. Connect the pressure test equipment
- (1.) Measure the case-drain pressure, in the case-drain line in between the check valve and the EDP.
 - (2.) Measure the return-line pressure, at the refill line on the Hydraulic Ground-Servicing Panel (HGSP).

- B. **NOTE: High return pressures, 100 psi thru 250 psi, causes pump failures.**

High case drain/return pressure (low cooling performance)

- (1.) For hydraulic system 1
 - (a) In the flight compartment, at the pedestal, put the LH and RH reverse-thrust levers in the stowed position then in the idle position.
- (2.) For hydraulic system 2
 - (a) In the flight compartment, apply and release the brakes to create a return flow.
- (3.) These causes may cause too high return pressures:
 - Incorrect quick disconnect installation/operation at the case drain port of the pump
 - **incorrect operation of the check valve in the case-drain line**
 - Restriction of a hydraulic line due to dirt, dents and/or collapse of the inner liner (refer to, SBF100-29-022)
 - Incorrect installed or clogged return-line filters, refer to service letter 162.

NOTE: After installation of the return-line filters it may be necessary to check the return pressure.

- C. **NOTE: High return pressures, 100 psi thru 250 psi, causes pump failures.**

Low pressure during cruise

- (1.) A degraded pump may be the cause of low pressure during cruise

NOTE: Internal leakage may cause low pressure warnings, in specific flight conditions.

- (2.) High internal leakage, check hydraulic system 1 and system 2 for internal leakage (Refer to Task 29-00-00-790-815 for more data) and Service Letter 208 to find the component that leaks internally.



TASK 32-33-00-720-815-A - Functional Test - Landing-Gear Alternate Control (Refer to MPD 323300-00-02)

EFFECTIVITY: 001999

- 1.. Materials
Not applicable
- 2.. Special Tools and Equipment
Not applicable
- 3.. Standard Tools and Equipment
 - Spring balance, 0-445 N (100 lb) 1
 - Stopwatch 1
 - Warning sign "KEEP CLEAR OF THE LANDING GEAR" 3

- 4.. Consumable Materials
Not applicable

- 5.. Expendable Parts
Not applicable

- 6.. Referenced Procedures

07-11-00-582-812	Lift the Aircraft with Jacks	Pageblock 201
07-11-00-582-822	Lower the Aircraft	Pageblock 201
29-00-00-862-812	Supply Hydraulic Pressure with the Test Cart	Pageblock 201
29-00-00-862-822	Release the Hydraulic Pressure and Remove the Test Cart	Pageblock 201

7.. Job Set-up

SUBTASK 32-33-00-940-095-A00

- A. Put the Warning signKEEP CLEAR OF THE LANDING GEAR near the nose and main landing gear.

SUBTASK 32-33-00-582-035-A00

- B. Lift the aircraft with jacks (Refer to 07-11-00-582-812) .

SUBTASK 32-33-00-862-015-A00

- C. Pressurize the hydraulic system 1 with the hydraulic system test-cart (Refer to 29-00-00-862-812) .

SUBTASK 32-33-00-860-175-A00

- D. Remove the landing-gear ground lock-pins.

SUBTASK 32-33-00-860-195-A00

- E. On the Maintenance and Test Panel (MTP A), do these steps:
 - (1.) Set the PANEL PWR switch to ON.
 - (2.) Set the FWC INHIB CANC switch, to INHIB CANC.

8.. Procedure

FOR A/C: 001001 004004

SUBTASK 32-33-00-720-025-A00

- A. (Refer to Fig. 32-33-00-990-055-A00)
Do the functional test of the landing-gear alternate control

Action

Result

- | | |
|---|---|
| <ul style="list-style-type: none"> (1.) In the flight compartment, on the main instrument panel, set the landing-gear selector-lever to LG UP. | <ul style="list-style-type: none"> (a) The landing-gear retracts. (b) The blue light in the landing-gear selector-lever goes off. |
|---|---|

TASK 32-33-00-720-815-A - Functional Test - Landing-Gear Alternate Control (Refer to MPD 323300-00-02)

EFFECTIVITY: 001999

- (2.) On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the PULL TO EXTEND (handle up) position.
Use the stopwatch to measure the time for the landing gear to extend.
 - (3.) On the hydraulic test cart, stop the hydraulic pressure.
 - (4.) On the main instrument panel, set the landing-gear selector-lever to LG DOWN.
 - (5.) On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the usual (handle down) position.
 - (6.) In the main landing-gear (MLG) strut-bay, make sure the button (3) on the selector valve (1) is not out of the button housing (2).
 - (7.) On the hydraulic test cart, slowly pressurize the hydraulic system 1 to 3000 psi.

 - (8.) In the flight compartment, on the main instrument panel, set the landing-gear selector-lever to LG UP.
 - (9.) On the hydraulic test cart, stop the hydraulic pressure.
 - (10.) Use the 0-445 N (100 lb) spring balance and the stopwatch to
 - Move the alternate landing-gear selector-lever to the PULL-TO-EXTEND position (lever up)
 - Measure the time between the movement of the lever and the moment the green LEFT and RIGHT lights come on.
 - (11.) Use the 0-445 N (100 lb) spring balance on the nose-landing-gear (NLG) axle to engage the NLG down lock.
 - (12.) On the main instrument panel, set the landing-gear selector-lever to LG DOWN.
On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the usual (handle down) position.
- (a) The landing gear extends and locks.
 - (b) The total time for the landing gear to extend and lock is less than 32 seconds.
 - (c) After 35 seconds a L MAIN LG DOOR and R MAIN LG DOOR warning is given.
 - (a) In the flight compartment, on the HYDRAULIC panel, the SYS 1 and SYS 2 PRESS (PSI) displays show zero.

 - (a) In the nose landing-gear bay, the nose landing-gear downlock engages.
 - (b) The MLG inboard doors close and lock.
 - (c) The L MAIN LG DOOR and R MAIN LG DOOR warning is removed.
 - (d) The blue light in the landing-gear selector-lever goes off.
 - (a) The landing-gear retracts.
 - (b) The blue light in the landing-gear selector-lever goes off.
 - (a) In the flight compartment, on the HYDRAULIC panel, the SYS 1 and SYS 2 PRESS (PSI) displays show zero.
 - (a) The load necessary to operate the lever is not more than 196 N (44 lbf).
 - (b) The door unlatches when the lever is at 75% of its full range of movement.
 - (c) The MLG locks down.
 - (d) On the landing-gear selector panel, the green LEFT and RIGHT lights come on in less than 34 seconds.
 - (e) After 35 seconds a L MAIN LG DOOR and R MAIN LG DOOR warning is given.
 - (a) The NLG down lock engages at a load of less than 343 N (77 lbf).
 - (b) On the landing-gear selector panel, the green NOSE light comes on.
 - (c) The blue light in the landing-gear selector-lever goes off.

FOR A/C: 005999

SUBTASK 32-33-00-720-025-A01

(Refer to Fig. 32-33-00-990-055-A01)
Do the functional test of the landing-gear alternate control

Action

- (1.) In the flight compartment, on the main instrument panel, set the landing-gear selector-lever to LG UP.
- (2.) On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the PULL TO EXTEND (handle up) position.
Use the stopwatch to measure the time for the landing gear to extend.
- (3.) On the hydraulic test cart, stop the hydraulic pressure.
- (4.) On the main instrument panel, set the landing-gear selector-lever to LG DOWN.
- (5.) On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the usual (handle down) position.
- (6.) In the main landing-gear (MLG) strut-bay, make sure the button (3) on the selector valve (1) is not out of the button housing (2).

Result

- (a) The landing-gear retracts.
- (b) The blue light in the landing-gear selector-lever goes off.
- (a) The landing gear extends and locks.
- (b) The total time for the landing gear to extend and lock is less than 32 seconds.
- (c) After 35 seconds a L MAIN LG DOOR and R MAIN LG DOOR warning is given.
- (a) In the flight compartment, on the HYDRAULIC panel, the SYS 1 and SYS 2 PRESS (PSI) displays show zero.

TASK 32-33-00-720-815-A - Functional Test - Landing-Gear Alternate Control (Refer to MPD 323300-00-02)

EFFECTIVITY: 001999

- (7.) On the hydraulic test cart, slowly pressurize the hydraulic system 1 to 3000 psi.
- (8.) In the flight compartment, on the main instrument panel, set the landing-gear selector-lever to LG UP.
- (9.) On the hydraulic test cart, stop the hydraulic pressure.
- (10. Use the 0-445 N (100 lb) spring balance and the stopwatch to
 - Move the alternate landing-gear selector-lever to the PULL-TO-EXTEND position (lever up)
 - Measure the time between the movement of the lever and the moment the green LEFT and RIGHT lights come on.
- (11.) Use the 0-445 N (100 lb) spring balance on the nose-landing-gear (NLG) axle to engage the NLG down lock.
- (12. On the main instrument panel, set the landing-gear selector-lever to LG DOWN.
On the pedestal, set the ALTERNATE LANDING GEAR CONTROL selector-lever to the usual (handle down) position.

- (a) In the nose landing-gear bay, the nose landing-gear downlock engages.
- (b) The MLG inboard doors close and lock.
- (c) The L MAIN LG DOOR and R MAIN LG DOOR warning is removed.
- (d) The blue light in the landing-gear selector-lever goes off.
- (a) The landing-gear retracts.
- (b) The blue light in the landing-gear selector-lever goes off.
- (a) In the flight compartment, on the HYDRAULIC panel, the SYS 1 and SYS 2 PRESS (PSI) displays show zero.
- (a) The load necessary to operate the lever is not more than 196 N (44 lbf).
- (b) The door uplocks release when the lever is at 75% of its full range of movement.
- (c) The MLG locks down.
- (d) On the landing-gear selector panel, the green LEFT and RIGHT lights come on in less than 34 seconds.
- (e) After 35 seconds a L MAIN LG DOOR and R MAIN LG DOOR warning is given.
- (a) The NLG down lock engages at a load of less than 343 N (77 lbf).
- (b) On the landing-gear selector panel, the green NOSE light comes on.
- (c) The blue light in the landing-gear selector-lever goes off.

9.. Job Close-up

SUBTASK 32-33-00-860-185-A00

- A. Install the landing-gear ground lock-pins.

SUBTASK 32-33-00-862-025-A00

- B. Release the pressure in the hydraulic system 1 after pressurization with the hydraulic system test-cart (Refer to 29-00-00-862-822) .

SUBTASK 32-33-00-582-045-A00

- C. Lower the aircraft (Refer to 07-11-00-582-822) .

SUBTASK 32-33-00-940-105-A00

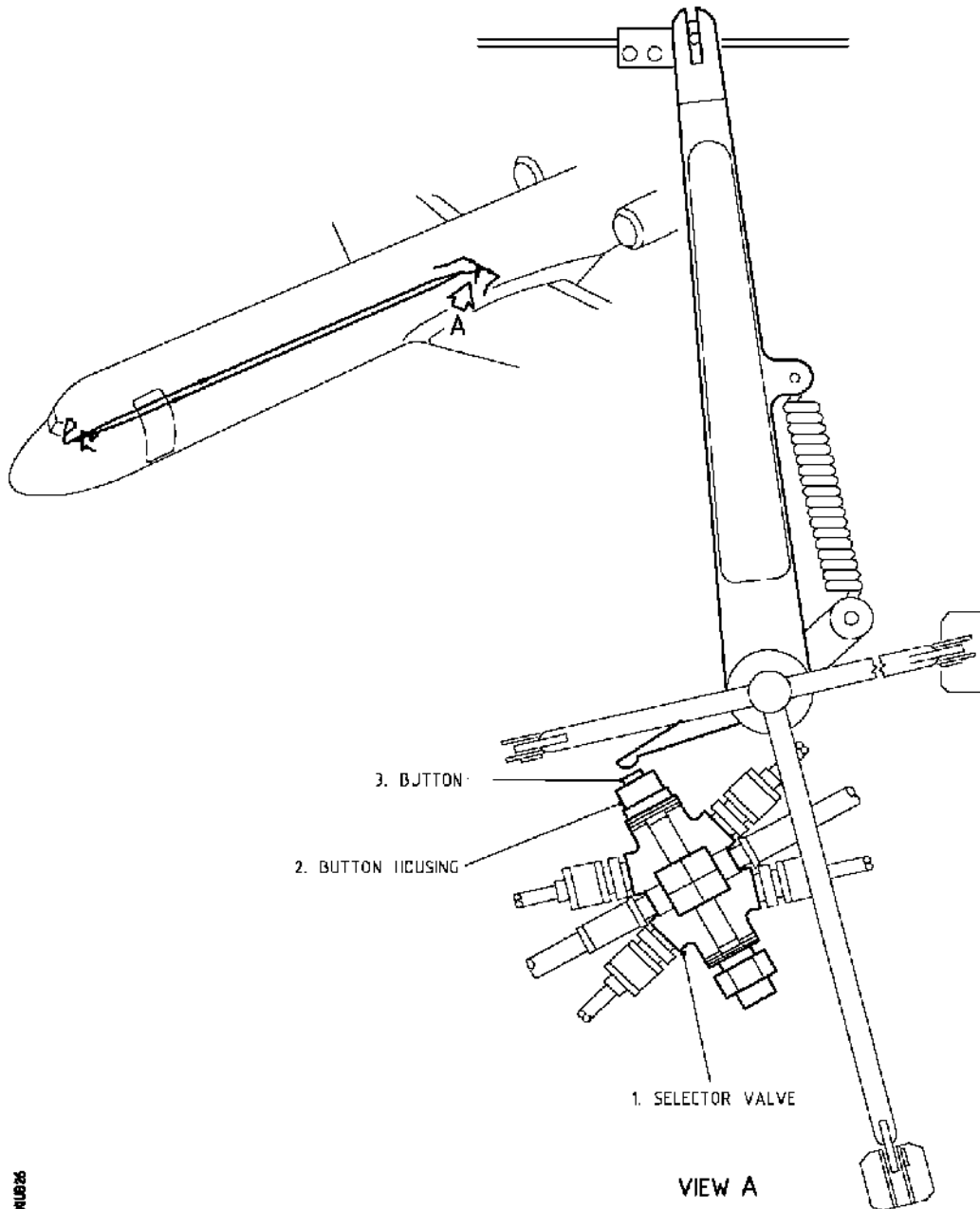
- D. Remove the warning signs
 - (1.) Remove the Warning signKEEP CLEAR OF THE LANDING GEAR .
 - (2.) Remove all the tools, materials, and equipment from the work area. Make sure the area is clean.

SUBTASK 32-33-00-860-205-A00

- E. On the Maintenance and Test Panel (MTP A), do these steps
 - (1.) Set the FWC switch, to OFF.
 - (2.) Set the PANEL PWR switch to OFF.

TASK 32-33-00-720-815-A - Functional Test - Landing-Gear Alternate Control (Refer to MPD 323300-00-02)

EFFECTIVITY: 001999



FOR/1826

Hydraulic Selector Valve
Figure 32-33-00-990-055-A00

FOR/A/C: 001001 004004

TASK 32-33-00-720-815-A - Functional Test - Landing-Gear Alternate Control (Refer to MPD 323300-00-02)

EFFECTIVITY: 001999

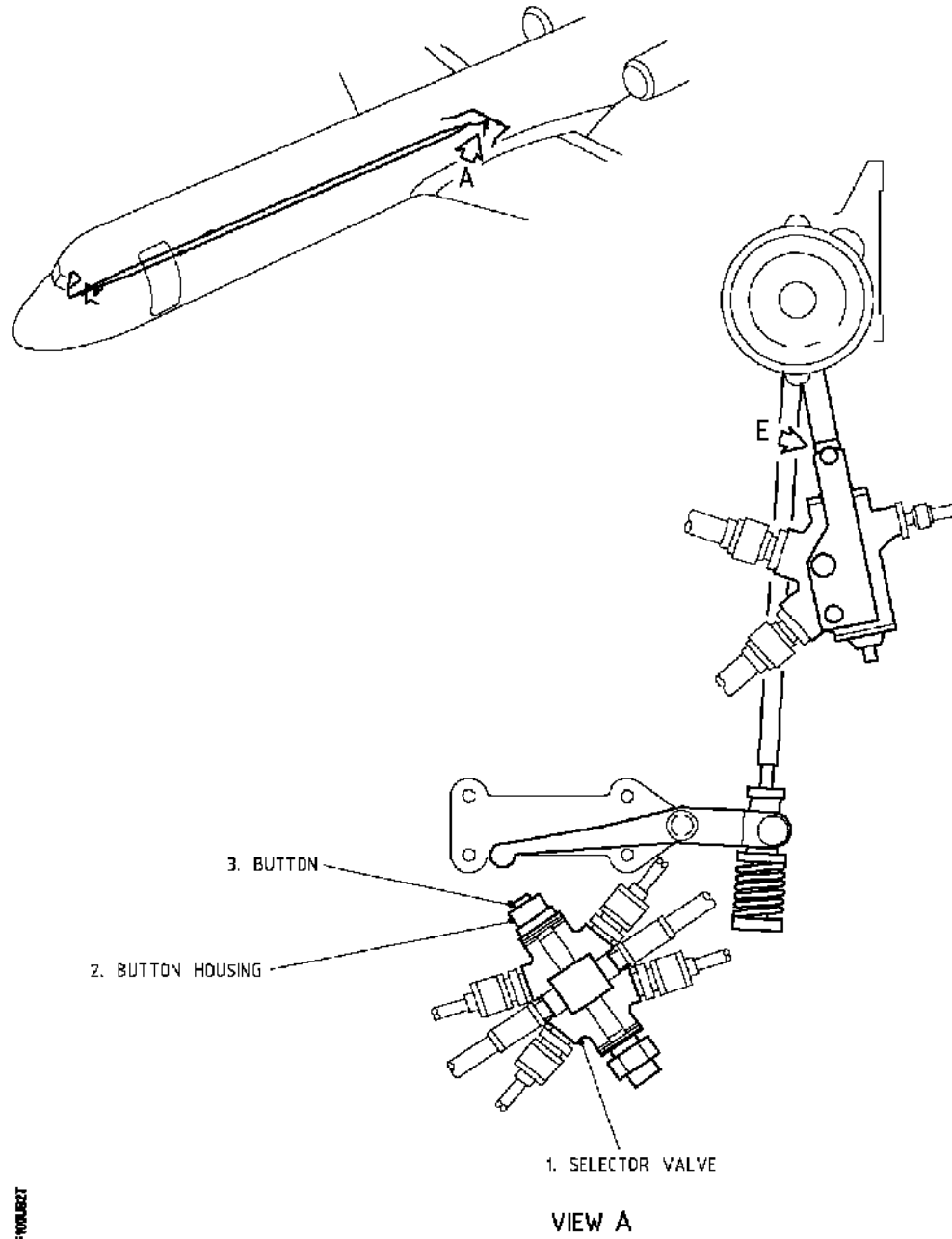


FIGURE 2

Hydraulic Selector Valve
Figure 32-33-00-990-055-A01

FOR A/C: 005999

TASK 32-00-00-200-816-A - Detailed Inspection of Landing-Gear Control Cables Inside the Pressure Cabin

(Refer to MPD 320001-00-01)

EFFECTIVITY: 001999

WARNING: YOU MUST PUT UP THE APPLICABLE WARNING SIGNS TO PREVENT INJURY TO PERSONS.

- 1.. Materials
Not applicable
- 2.. Special Tools and Equipment
Not applicable
- 3.. Standard Tools and Equipment
Warning sign "DO NOT OPERATE THE FLIGHT CONTROLS" 1
Warning sign "DO NOT OPERATE THE LANDING-GEAR ALTERNATE CONTROL" 1
Warning sign "DO NOT OPERATE THE BRAKE SYSTEM" 1
Warning sign "DO NOT OPERATE THE NOSE WHEEL STEERING SYSTEM" 1
Warning sign "WARNING - FLOOR PANELS REMOVED" 1
- 4.. Consumable Materials
Cloth, Cleaning (material No. Fk05-044) A/R
- 5.. Expendable Parts
Not applicable
- 6.. Referenced Procedures
20-14-02-200-812 Inspection - Cables Pageblock 201
- 7.. Job Set-up

SUBTASK 32-00-00-010-016-A00

- A. Open the access door(s) 822 (forward cargo door).

SUBTASK 32-00-00-940-016-A00

- B. Put the warning signs in position
- (1.) Put the Warning signDO NOT OPERATE THE FLIGHT CONTROLS in the flight compartment.
 - (2.) Put the Warning signDO NOT OPERATE THE LANDING-GEAR ALTERNATE CONTROL in the flight compartment.
 - (3.) Put the Warning signDO NOT OPERATE THE BRAKE SYSTEM in the flight compartment.
 - (4.) Put the Warning signDO NOT OPERATE THE NOSE WHEEL STEERING SYSTEM in the flight compartment.
 - (5.) Put the Warning signWARNING - FLOOR PANELS REMOVED at the entrance to the passenger compartment.

FOR A/C: 004004

SUBTASK 32-00-00-010-026-A03

- C. Get access to the landing gear cables
- (1.) Remove the access panel(s) 121AB , 127AB and 143AB from the forward lower fuselage.
 - (2.) Remove the access panel(s) 153PZ 154MZ 153RZ 154NZ 163FZ 164GZ and 163HZ from the ceiling of the forward cargo compartment.
 - (3.) Remove the access panel(s) 264EZ 264FZ 282AZ 282DZ and 284AZ from the center floor of the passenger compartment.

FOR A/C: 001001 005999

SUBTASK 32-00-00-010-026-A05

Get access to the landing gear cables

- (1.) Remove the access panel(s) 121AB , 127AB and 143AB from the forward lower fuselage.
- (2.) Remove the access panel(s) 153QZ 153RZ 153DY 153EY 163QZ 163RZ and 163SZ from the ceiling of the forward cargo compartment.
- (3.) Remove the access panel(s) 264EZ 264FZ 282AZ 282DZ and 284AZ from the center floor of the passenger compartment.

- 8.. Procedure

SUBTASK 32-00-00-210-016-A00

- A. **WARNING: PUT ON PROTECTIVE GLOVES WHEN YOU TOUCH THE CONTROL CABLES. THE CABLES CAN CAUSE INJURY TO YOUR HANDS.**

TASK 32-00-00-200-816-A - Detailed Inspection of Landing-Gear Control Cables Inside the Pressure Cabin

(Refer to MPD 320001-00-01)

EFFECTIVITY: 001999

Do an inspection of the landing gear cables:

- (1.) Find these cables:
 - The landing-gear alternate control cables LG1 and LG2
 - The left and the right brake control cables B1, B2, B3 and B4
 - The nose wheel steering cables NS1 and NS2.
- (2.) Examine the cables for broken wires.
 - (a) Use a cloth, cleaning (material No. Fk05-044) to rub the cable to find broken wires.

NOTE: The cloth will catch on the broken wires.

- (b) If you find broken wires, (Refer to Task 20-14-02-200-812 for corrective action) .
- (3.) Examine the cables for wear.

NOTE: The primary areas of wear are the sections of the cable which go around pulleys, rollers or drums.

Wear occurs along the working length of the cable, on one side only or around the circumference.

- (a) If you find wires which are worn more than 50 percent, (Refer to Task 20-14-02-200-812 for corrective action) .
- (4.) Examine the cables for:
 - Correct corrosion preventive treatment
 - Corrosion.If you find damage to the corrosion preventive treatment, or corrosion (Refer to Task 20-14-02-200-812 for corrective action) .
- (5.) Do a check of the tension of the cables (Refer to Task 20-14-02-200-812 for more data) .

9.. Job Close-up

SUBTASK 32-00-00-940-026-A00

- A. Remove all tools, materials, and equipment from the work area. Make sure the area is clean.

FOR A/C: 004004

SUBTASK 32-00-00-410-016-A03

- B. Close the access to the landing gear cables
 - (1.) Install the access panel(s) 121AB , 127AB and 143AB in the forward lower fuselage.
 - (2.) Install the access panel(s) 153PZ 154MZ 153RZ 154NZ 163FZ 164GZ and 163HZ in the ceiling of the forward cargo compartment.
 - (3.) Install the access panel(s) 264EZ 264FZ 282AZ 282DZ and 284AZ in the center floor of the passenger compartment.

FOR A/C: 001001 005999

SUBTASK 32-00-00-410-016-A05

Close the access to the landing gear cables

- (1.) Install the access panel(s) 121AB , 127AB and 143AB in the forward lower fuselage.
- (2.) Install the access panel(s) 153QZ 153RZ 153DY 153EY 163QZ 163RZ and 163SZ in the ceiling of the forward cargo compartment.
- (3.) Install the access panel(s) 264EZ 264FZ 282AZ 282DZ and 284AZ in the center floor of the passenger compartment.

SUBTASK 32-00-00-940-146-A00

- C. Remove the warning signs
 - (1.) Remove the Warning sign DO NOT OPERATE THE FLIGHT CONTROLS from the flight compartment.
 - (2.) Remove the Warning sign DO NOT OPERATE THE LANDING-GEAR ALTERNATE CONTROL from the flight compartment.
 - (3.) Remove the Warning sign DO NOT OPERATE THE BRAKE SYSTEM from the flight compartment.
 - (4.) Remove the Warning sign DO NOT OPERATE THE NOSE WHEEL STEERING SYSTEM from the flight compartment.
 - (5.) Remove the Warning sign WARNING - FLOOR PANELS REMOVED from the entrance to the passenger compartment.

SUBTASK 32-00-00-410-026-A00

- D. Close the access door(s) 822 (forward cargo door).



Airworthiness Recommendations Catalogue Fokker 70/100

Landing Gear and Hydraulic Abnormal Procedures Introduction of additional procedure steps

Effectivity

All F28 Mk0070/0100 aircraft serial numbers.

Background

In 1998, following a Fokker 100 nose landing gear up landing accident, several landing gear abnormal procedures and a hydraulic system abnormal procedure were revised in order to create identical procedures for the F28 Mk0100 and Mk0070 and to incorporate a procedure to attempt to force the affected landing gear(s) down by applying g-loads in a 2g level turn in case the normal and alternate landing gear down selection have been unsuccessful. At that time, Manual Change Notification- Operational (MCNO) F100-008 was issued to provide operators with the changed procedures in the Airplane Flight Manual (AFM), the Aircraft Operating Manual (AOM) and the Quick Reference Handbook (QRH).

However, subsequent to the publication of the MCNO, additional changes were introduced to all of the abnormal procedures affected by the MCNO. The most important change is the deletion of the instruction to perform a 2g level turn in the Alternate Landing Gear Procedure. This deletion was introduced following a review of all subsequent Fokker aircraft landing gear up accidents which showed that the 2g manoeuvre was never effective in extending and locking the affected gear(s) in the down position. In addition a 2g level turn is considered to be an aerobatic manoeuvre that it is not in line with the current flight techniques standard for large commercial aircraft.

As a result of the above, the change instructions in MCNO F100-008 have become obsolete.

Recommendations

Ensure that your AFM, AOM and QRH (as applicable) are kept up to date and adhere to the instructions in the latest revisions of those manuals.

Airworthiness Directive

None.

Other References

Related to the Fokker 100 nose landing gear up landing accident:

- Technical and Operational Notice (TON) 100.003, ref. TS97.50125.
- SBF100-53-088.
- Service Experience Digest Part 2 item 32-31-007.

Apr 01/19
Technical Services
Fokker Services BV

ATA100: 32-33
Subject: 1
Issue: 2

Printed, 25 April 2019 10:32:36 CET

