AIRCRAFT ACCIDENT FINAL REPORT

A 10/17

Air Accidents Investigation Bureau (AAIB)

Ministry of Transport

Accident Involving a Eurocopter AS355 F2

Registration 9M-SSZ

at Kota Kinabalu International Airport (WBKK), Sabah, Malaysia

on the 15 November 2017

Air Accidents Investigation Bureau
Ministry of Transport
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Issued on 15 November 2018

AIR ACCIDENTS INVESTIGATION BUREAU (AAIB)
MALAYSIA

ACCIDENT REPORT NO. : A 10/17

OWNER / OPERATOR	**:**	**LAYANG-LAYANG AEROSPACE SDN BHD**
AIRCRAFT TYPE	**:**	**EUROCOPTER AS355 F2**
NATIONALITY	**:**	**MALAYSIA**
REGISTRATION	**:**	**9M-SSZ**
PLACE OF OCCURRENCE:		**KOTA KINABALU INTERNATIONAL AIRPORT, SABAH, MALAYSIA**
DATE AND TIME	**:**	**15 NOVEMBER 2017 AT 1637LT**

This investigation is carried out to determine the circumstances and causes of the accident with the sole objective for the preservation of life and the avoidance of accidents in the future. It is not for the purpose of apportioning blame or liability (ICAO's Annex 13 to the Chicago Convention).

All times in this report are Local Time (LT) unless stated otherwise. LT is UTC +8 hours.

INTRODUCTION

The Air Accidents Investigation Bureau Malaysia

The Air Accidents Investigation Bureau (AAIB) is the air accident and serious incident investigation authority in Malaysia and is accountable to the Minister of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and serious incidents.

The AAIB conducts the investigations in accordance with ICAO's Annex 13 to the Chicago Convention, the Civil Aviation Act of Malaysia 1969 and the Civil Aviation Regulations of Malaysia 2016.

It is inappropriate that AAIB reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting processes has been undertaken for that purpose.

In accordance with ICAO's Annex 13 paragraph 4.1, a notification of the accident was sent out to the Civil Aviation Authority Malaysia (CAAM) as the State of Occurrence, Registration & Operator and also to the French Accident Investigation Authority, the *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA)*, France as the State of Design and Manufacturer **(APPENDIX A)**.

Unless otherwise indicated, recommendations in this report are addressed to the investigating or regulatory authorities of the State having responsibility for the matters with which the recommendations are concerned. It is for those authorities to decide what action is to be taken.

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APPENDICES

ABBREVIATIONS

AAIB	Air Accidents Investigation Bureau
ACCU	Accumulator
AFCS	Automatic Flight Control System
CAAM	Civil Aviation Authority of Malaysia
CPL	Commercial Pilot License
ICAO	International Civil Aviation Organisation
LH	Left Hand
LT	Local Time
PAX	Passengers
POB	Persons on Board
RH	Right Hand
RT	Radio Telephony
UTC	Coordinated Universal Time
WBKK	ICAO Code for Kota Kinabalu International Airport

SYNOPSIS

On 15 November 2017, a Eurocopter AS355 F2 bearing the registration 9M-SSZ was involved in an accident at Kota Kinabalu International Airport, Sabah, Malaysia. The aircraft had 4 POB.

9M-SSZ was carrying out a hover check at the dispersal area of Terminal 2 to ensure the functionality of its AFCS. Unfortunately during the checks the aircraft experienced a hard landing.

The AAIB Chief Inspector was notified immediately and an investigation team was dispatched.

1.0 FACTUAL INFORMATION

1.1 History of the Flight

On Wednesday, 15 November 2017, 9M-SSZ was required to carry out a hover check for intermittent tripping of the auto-pilot (AFCS). There was one pilot and three maintenance crew onboard at the time.

During the hover check the pilot stated that he wanted to check the servo light functionality. However, instead of pushing the SERVO push-button he later stated that he may have unintentionally pushed the ACCU (Accumulator) momentary push-button instead.

Before he could even lower his hand back down to the collective the aircraft violently slammed down onto the tarmac. A quick check by the pilot revealed that no one was injured and he then proceeded to shut down the aircraft while informing the control tower of the accident over the RT.

After egressing from the aircraft the pilot and maintenance crew started to assess the damage to the aircraft and tried to reason out what precipitated the accident in the first place.

1.2 Injuries to Persons

All four occupants onboard the aircraft did not experience any injury.

	9M-AWD	
Injuries	**Crew**	**Pax**
Fatal	-	-
Serious	-	-
Minor / None	1	3

1.3 Damage to Aircraft

The forward portion of the aircraft's starboard skid broke off on impact with the tarmac. Additionally, the tail rotor also hit the ground with the tail-boom suffering tears in its skin with numerous points of buckling. The aircraft was later declared a total write-off.

For images of damage to the aircraft on-site please refer to **APPENDIX B**.

1.4 Other Damages

No other damages were observed other than scuff marks on the tarmac of the dispersal area.

1.5 Personnel Information

The pilot of the helicopter held a valid CPL and was properly qualified for the hover check being carried out. The other three personnel onboard were the maintenance crew.

1.6 Aircraft Information

The helicopter in question is owned and operated by Layang-Layang Aerospace Sdn Bhd, a regional charter airline based in Sabah, Malaysia.

Aircraft Type	Eurocopter AS355 F2
Manufacturer	Airbus Helicopters
Registration	9M-SSZ
Serial No.	5292

1.7 Meteorological Information

The weather on that fateful day was clear with some scattered clouds and light and variable wind conditions.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

Information about the accident was relayed by RT to the control tower by the pilot.

1.10 Aerodrome Information

Not applicable.

1.11 Flight Recorders

The Eurocopter AS335N F2 is not equipped with flight recorders (FDR and/or CVR) nor is it mandated by law to do so.

1.12 Wreckage and Impact Information

The wreckage was secured and brought back to the operator's hangar nearby. From eyewitness statements the aircraft was said to have descended vertically before impacting the tarmac.

1.13 Medical and Pathological Information

As stated earlier there were no injuries to the occupants of the aircraft.

1.14 Fire

There was no post-impact fire. The fuel cell of the aircraft remained intact.

1.15 Survival Aspects

The maintenance crew onboard the aircraft egressed without any difficulty. However, the pilot had to exit via the door on the port side of the aircraft as he could not open his starboard door.

Although the helicopter had experienced a hard landing, the crashworthy stroking seats helped to absorb and dissipate the energy produced by the impact thus safeguarding the aircraft's occupants from injury.

1.16 **Tests and Research**

Not applicable.

1.17 **Organisational and Management Information**

All organisational and management aspects of the operator were found to be in order throughout the investigation.

1.18 **Additional Information**

Nil.

1.19 **Useful or Effective Investigation Techniques**

Nil.

2.0 ANALYSIS

2.1 A meeting was held with all concerned parties including an expert type rated engineer on the AS355 F2 to find out what really happened during the accident. The main bone of contention was trying to find out what would be the effect of operating the ACCU momentary push-button on the flight controls with specific reference to **APPENDICES C, D & E** from the latest Airbus Maintenance Manual and also the current AS355 F2 Flight Manual.

2.2 During the meeting, it was agreed that by operating the ACCU momentary push-button, the solenoid valve will open and pressurise the return line to the tail servo unit. The pilot may experience stiffness and loss of control on the tail rotor for a split second before the relief valve operates and releases

the hydraulic lock (this is because both lines are pressurised i.e. supply and return).

2.3 The return line from the tail rotor servo system is also interconnected to the lower servo unit of the RH Servo Control, Front Servo Control and LH Servo Control where the split second effect may be experienced on the collective. Since the pilot's left hand was at the overhead panel (ACCU momentary push-button), he did not have time to react to the collective going down.

2.4 It was also agreed that the ACCU momentary push-button at the overhead panel shall only be used in sequence only after the Solenoid Valve Control Switch on the collective is actuated.

3.0 CONCLUSION

The pilot contributed to the accident by pushing the wrong push-button during a hover check.

This accident is classified as an Abnormal Runway Contact (ARC).

4.0 SAFETY RECOMMENDATIONS

CAAM is to ensure that the lessons learnt from this accident is disseminated to all the helicopter operators.

INVESTIGATOR-IN-CHARGE
Air Accidents Investigation Bureau
Ministry of Transport
15 November 2018

	AAIB Malaysia Accident/Serious Incident Notification Form	Ref No **A 10/2017** MOT/BSKU(S)600

Ministry of Transport Malaysia
(Air Accident Investigation Bureau)
No 26, Jalan Tun Hussein,
Presint 4, 62100 Putrajaya,
Malaysia

Telephone: +603 8892 1071
Facsimile: +603 8888 0163
Website: www.mot.gov.my
Email: yahaya@mot.gov.my

A. Classification accident / Incident (Serious) / Incident (Minor)	**ACCID**	~~**INCID (Serious)**~~	~~**INCID**~~

B. Detail of Aircraft / Flight	**Manufacturer**	**: EUROCOPTER FRANCE**
	Model	**: AS355F2**
	Nationality	**: Malaysia**
	Registration	**: 9M-SSZ**
	Flight Number	**: 9M-SSZ**
	Serial Number	**: 5292**
C. Detail of Owner / Operator / Lessee (If applicable)	**Owner**	**: Layang-Layang Aerospace Sdn.Bhd.**
	Lessee (If Applicable)	**: Layang-Layang Helicopter Academy**
	Operator	**: Layang-Layang Helicopter Academy**
D. Date and Time (Local / UTC) of the event i.e. accident or serious incident	**Date**	**: 15 November 2017**
	Time	**: 1637 LT**
E. Last point of departure and point of intended landing of the aircraft	**Last point of departure**	**: Kota Kinabalu International Airport (KKIA), Sabah, Malaysia**
	Point of intended landing	**: KKIA, Sabah, Malaysia**
F. Last known position	**Latitude**	**: 5° 56' 35.0" N**
	Longitude	**: 116° 03' 05.6" E**
	Descriptions	
	Terminal 2, KKIA, Sabah, Malaysia	

G. No of crew and passengers aboard; killed or seriously injured.	**Total occupants on board:** • **Pilot : 1** • **Crew : 3** • **Passenger : 0** **Conditions** **No injuries reported.**		
H. Qualification of the pilot in command and nationality of the crew and passengers	Pilot in Command qualification : **ATPL** Pilot in Command nationality : **Malaysia** First Officer nationality : **N/A** Passengers nationality : **Malaysia**		
I. Description of the accident or serious incident and the extent of damage to the aircraft so far as is known:	**During a hover check, the aircraft contacted the tarmac hard causing the forward portion of the starboard skid to break off and the tail rotor to strike the ground. The tail boom suffered tears in its skin in addition to numerous points of buckling.** **The aircraft was declared a total write-off.**		
J. An indication to what extent the investigation will be conducted or is proposed to be delegated by the State of Occurrence	**The Air Accident Investigation Bureau (Malaysia) has classified this as an Accident and has conducted an investigation in accordance with the provision of Annex 13 to the Convention of International Civil Aviation.**		
K. Presence and description of dangerous goods on board the aircraft	**No** ~~**Yes (Please describe)**~~ ~~**Unknown**~~		
L. Operation Type	~~**Commercial Aviation**~~ **General Aviation** ~~**Others**~~	~~**Scheduled**~~ **Non Scheduled**	**Passenger** ~~**Cargo**~~ ~~**Others**~~
M. Level of damage to aircraft (If information is available)	**Destroyed** ~~**Substantial**~~ ~~**Minor**~~ ~~**None**~~ ~~**Unknown**~~		
The State of Occurrence shall forward a notification of an accident or serious incident with a minimum of delay and by the most suitable and quickest means available to: a) the State of Registry b) the State of the Operator c) the State of Design d) the State of Manufacture and e) the International Civil Aviation Organisation, when the aircraft involved is of a maximum mass of over 2250 kg.			

Version: E, F, F1, F2, N, NP

Load compensator
Load compensator

A. Reason

(*Figure 1*)

To assist the tail rotor control if the pressure drops inside servo-unit (1).

B. Description

(*Figure 1*)

The load compensator consists of :

- a hydraulic actuator (2)
- an accumulator (6)
- a compensator lever (5)
- an attachment link (3) between the compensator and the rod (4)
- a non return-valve (7)
- a solenoïd-valve (9)
- a diaphragm union (10)
- a relief valve (8).

C. Operation

(*Figure 1*)

Hydraulic actuator (2), supplied by accumulator (6), actuates lever (5) in rotation.

Rod (4) connected to lever by attachment link (3) is submitted to a load that varies in direction and intensity according to lever position.

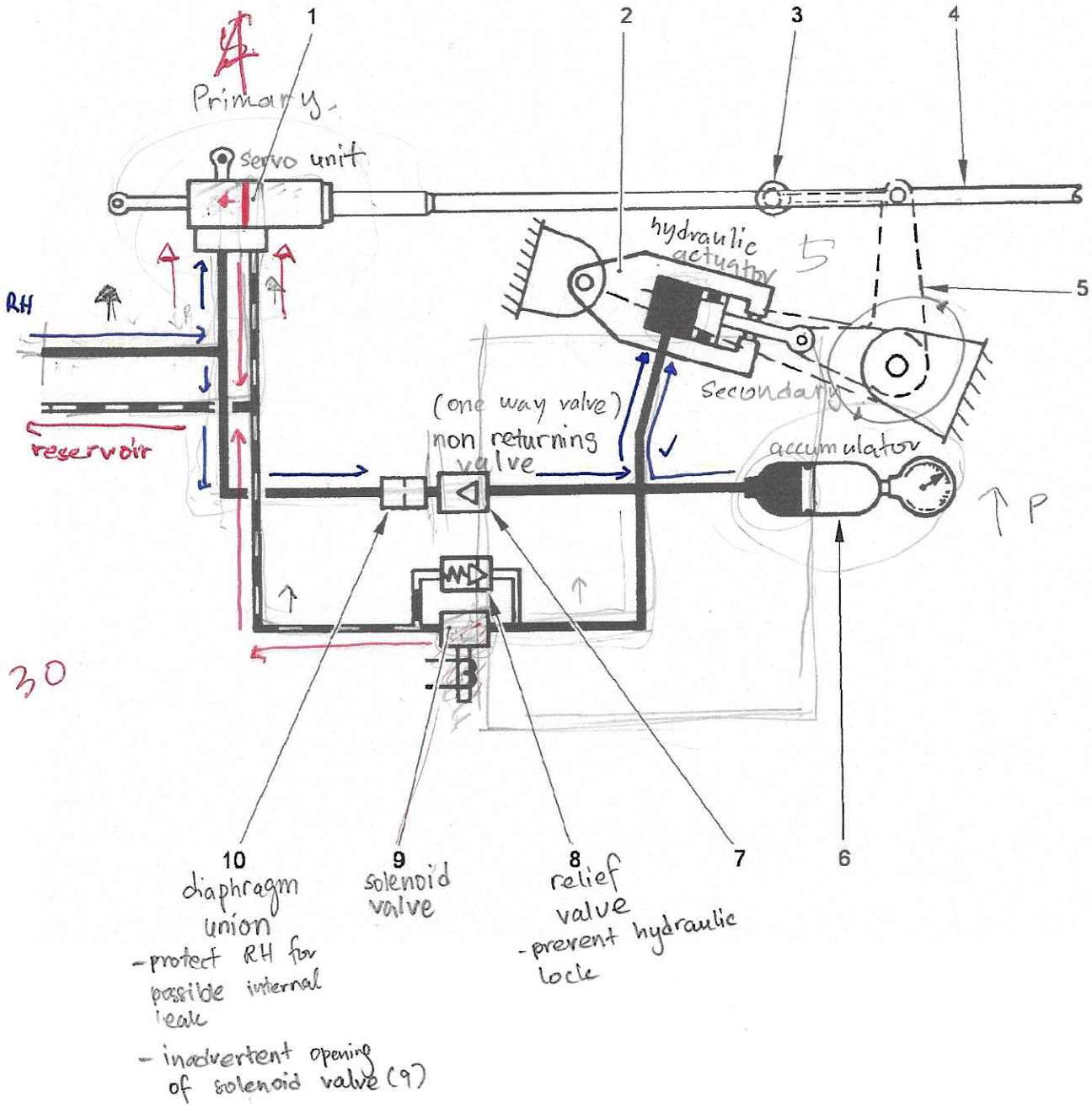
A non-return valve (7) prevents the hydraulic fluid from returning into the system in case of pressure loss.

A solenoïd-valve (9) controlled by a push-button allows the accumulator (6) pressure to drop in the tail servo-unit return line.

A diaphragm-union (10) protects the RH hydraulic generation system against a possible internal hydraulic leak or an inadvertent opening of solenoïd-valve (9).

A relief-valve (8) prevents hydraulic locking.

Figure 1



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Version: E, F, F1, F2, N, NP

Twin hydraulic system
Twin hydraulic system

A. General

The LH and RH systems of the twin hydraulic system deliver power to:

- the tandem-cylinder main servo-controls
- the single-cylinder tail servo-control, supplied by the RH system only.

B. Description

(*Figure 1*, *Figure 2*, *Figure 3* and *Figure 4*)

Operating pressure: 35 bar (507.5 PSI) - Hydraulic fluid H 515, AIR 3520 or MIL.H.83282.

The system consists of:

- A "power generating" section basically consisting of a hydraulic reservoir, a gear pump and a regulation/filter unit per system.
- A "power absorbing" section basically consisting of 4 servo-controls (3 of which are the tandem-cylinder main servos).
- A "Control and monitoring" section located in the cockpit.

> **i NOTE**
>
> *Except for the tail servo-control (17), the whole hydraulic system is grouped on the MGB/rotor shaft assembly (Figure 1, DETAIL B).*

The LH system delivers power to the upper bodies of the main servo-controls.

The RH system supplies power to the lower bodies of the main servo-controls and to the rear servo-control.

Item	Description	
(1)	LH hydraulic reservoir	- Usable capacity: 3 liters (0.79 USG)
(2)	RH hydraulic reservoir	- Usable capacity: 3 liters (0.79 USG)
PRE MOD 074622: (3)	"HYD" amber caption	- Pressure drop
(4)	Strainer on pump suction line, 0.8 to 1 meshes	
(5)	LH hydraulic pump	- Delivery: 6 liters/mn (1.58 USG/mn) - Pressure: 40 bar (580 PSI)
(6)	RH hydraulic pump	- Delivery: 6 liters/mn (1.58 USG/mn) - Pressure: 40 bar (580 PSI)
(7)	Regulating valve	- Setting: 35 bar (507.5 PSI)
(8)	Filter	- Filtering capacity: 25 microns

Item	Description
(9)	LH pressure switch - Closes when pressure drops belows 24 bar (348 PSI)
(10)	RH pressure switch - Closes when pressure drops belows 24 bar (348 PSI)
(11)	RH servo-control
(12)	Servo-control upper body
(13)	Servo-control lower body
(14)	Front servo-control
(15)	LH servo-control
(16)	Rear servo-control isolation solenoïd valve
(17)	Tail servo-control
(18)	Solenoïd valve (16) control switch on pilot's collective lever handgrip.
(19)	Switch - Same function as that of item (18) on copilot's collective lever handgrip. (7), (8), and (9) and (7), (8) and (10) constitute the "regulation/filter" unit.
(20)	"LIMIT" light, load sensor on RH servo upper cylinder.
(21)	"SERVO" light, indicates seizing of one of the main servos distributor.
(22)	"SERVO" monitoring system test push-button (on 15 ALPHA panel).
POST MOD 074622:	
(23)	"HYD1" amber light - Pressure drop in the (upper) left system.
(24)	"HYD2" amber light - Pressure drop in the (lower) right system.
(25)	Repeat cycle timer

C. Operation of the systems

1. Normal operation

(*Figure 2* and *Figure 4*)

Hydraulic pumps (5) and (6) are running. Regulating valves (7) maintain a constant 35 bar pressure in the systems:

- pressure switches (9) and (10) are energized, their contacts are open,
- PRE MOD 074622: "HYD" caption light (3) is off,
- POST MOD 074622: "HYD1" light (23) and "HYD2" light (24) are off,
- the main servo-controls (11), (14), (15) and the rear servo-control (17) are supplied with power.

2. Loss of the hydraulic pressure PRE MOD 074622:

(*Figure 3*, DETAIL A)

> **i NOTE**
>
> *The diagram represents a pressure loss in the LH system.*

The operation is simular for both systems. The pressure drop (fluid leakage, defective pump, ...) causes:

- closing of pressure switch (9),
- illumination of "HYDR" caption light (3).

The upper bodies (12) of the main servo-control (11), (14) and (15) are no longer supplied with power.

The lower bodies (13) of the main servo-controls and the tail servo-control (17) remain pressurized.

The helicopter can still be controlled in the whole flight envelope.

Should the pressure loss occur in the RH system, are unserviceable:

- the lower bodies of the main servo-controls,
- the tail servo-control.

3. **Hydraulic pressure drop POST MOD 074622:**

(*Figure 5* and *Figure 6*)

Pressure drop in the lower system (13):

The pressure drop (fluid leakage, defective pump, etc.) causes:

- pressure switch (10) to close,
- "HYD2" light (26) to come on.

The lower bodies (13) of the main servo-controls (11), (14) and (15) are no longer pressurized.

The upper bodies (12) of the main servo-controls (11), (14) and (15) remain pressurized.

The aircraft can still be controlled in the whole flight envelope.

Pressure drop in the upper system (12):

The pressure drop (fluid leakage, defective pump, etc.) causes:

- pressure switch (9) to close,
- "HYD1" light (23) to come on.

The upper bodies (12) of the main servo-controls (11), (14) and (15) are no longer pressurized.

The lower bodies (13) of the main servo-controls (11), (14) and(15) remain pressurized.

The tail servo-control (17) remains supplied with power.

The aircraft can still be controlled in the whole flight envelope.

4. Defective operation of the tail servo-control

(*Figure 3*, DETAIL B)

> **i NOTE**
>
> *The diagram represents a "tail servo-control isolated" configuration.*

The pilot is warned of a defect in the operation of the tail servo-control by a "stiffening" of the pedals in case of seizing of the distributor.

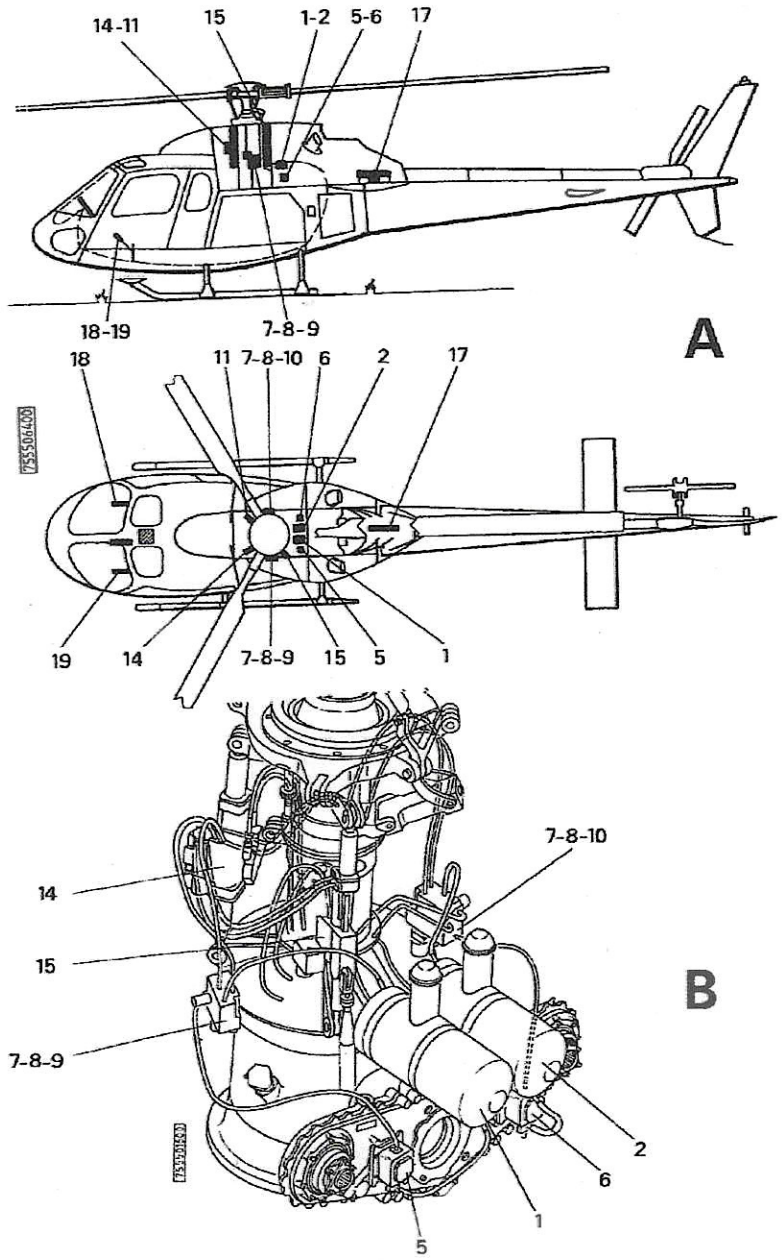
Tripping of switch (18) or (19) on the pilot's or co-pilot's collective lever handgrip causes:

- solenoïd valve (16) to be energized and to close,
- tail servo-control (17) to be isolated.

The loads at the pedals are reduced.

POST MOD 074622: A repeat cycle timer (25) is activated when switch (18) or (19) is set to "ON".

Figure 1


14-11
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5-6
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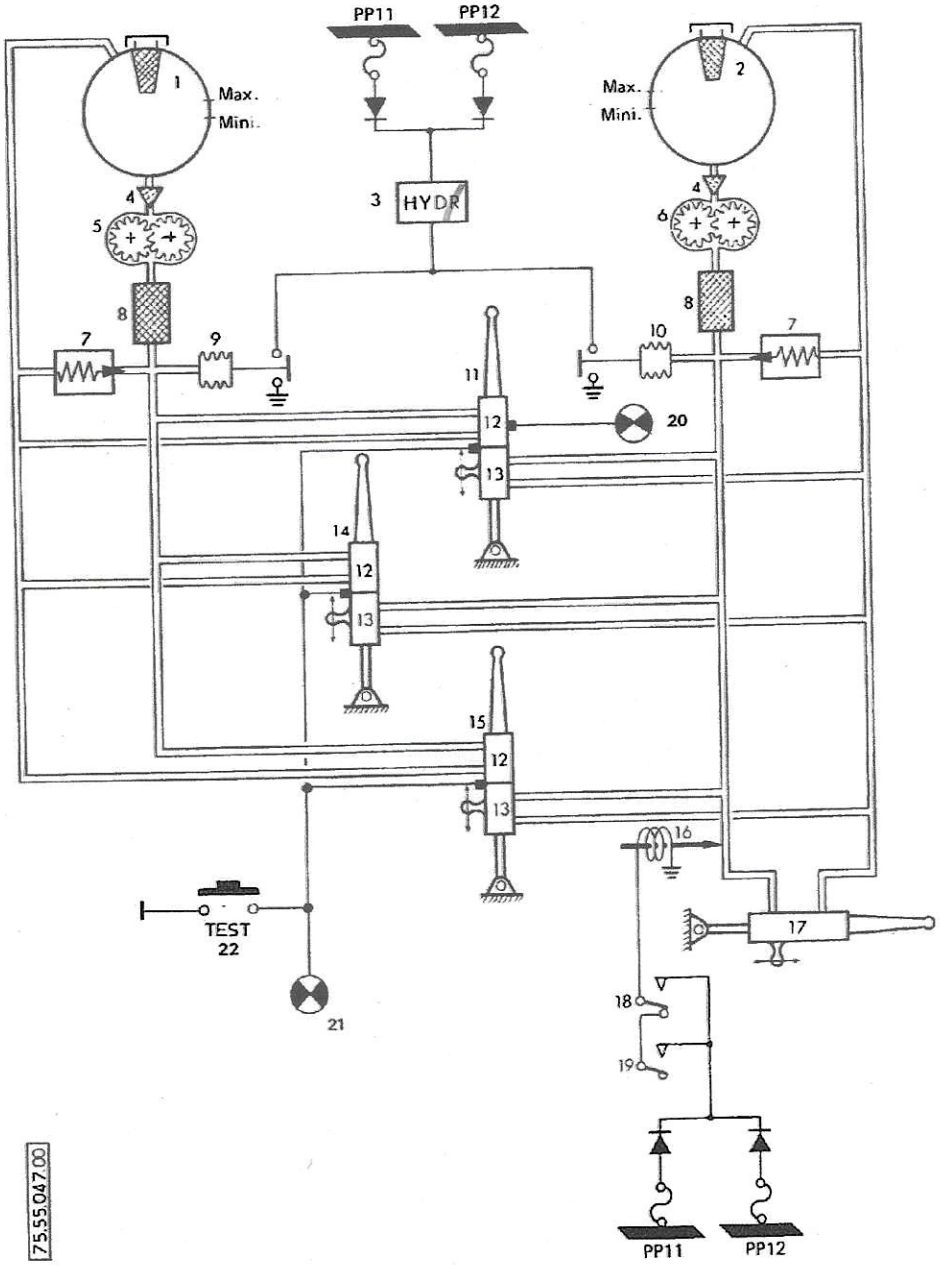
Figure 2


PP11
PP12
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Max.
Mini.
2
Max.
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3
HYDR
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5
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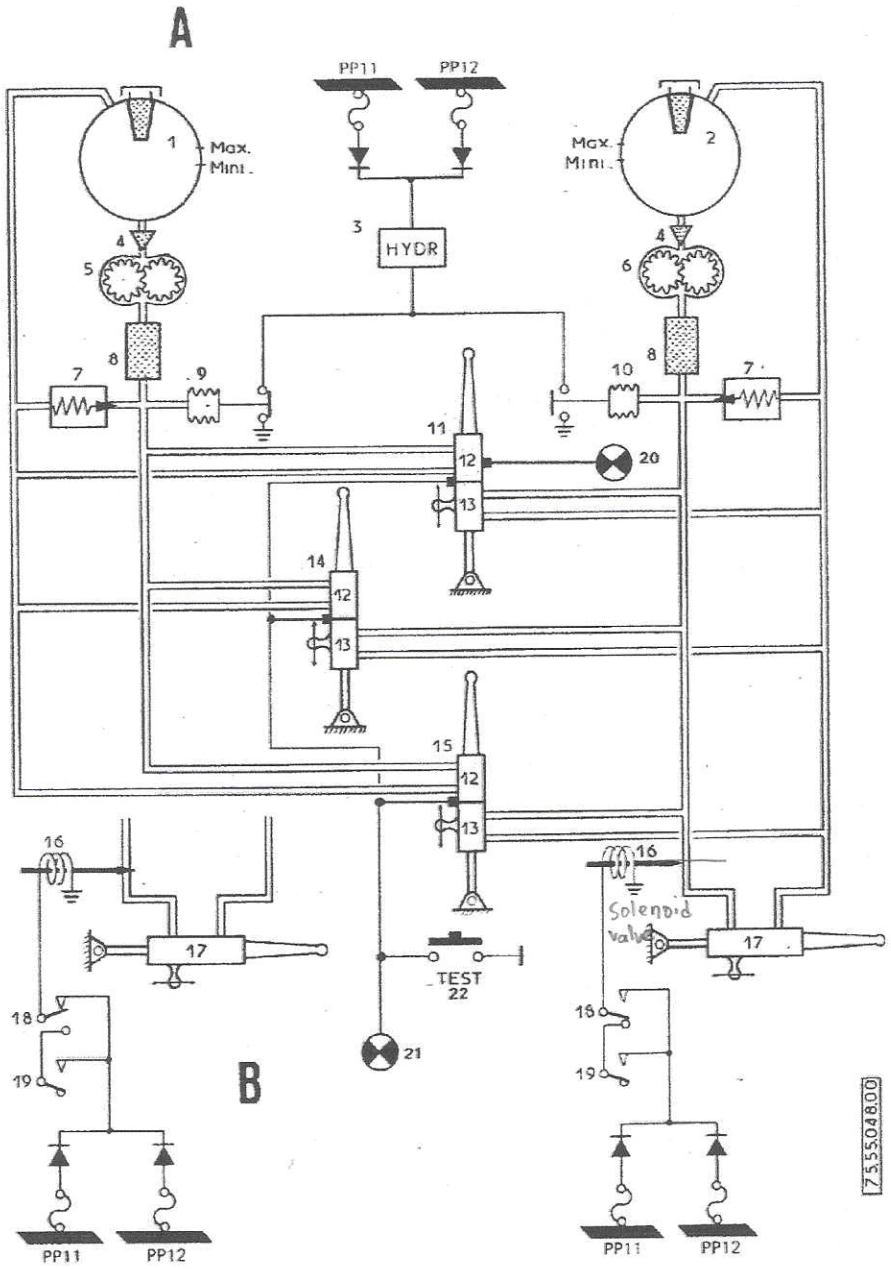
Figure 3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TEST
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Solenoid valve
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PP12
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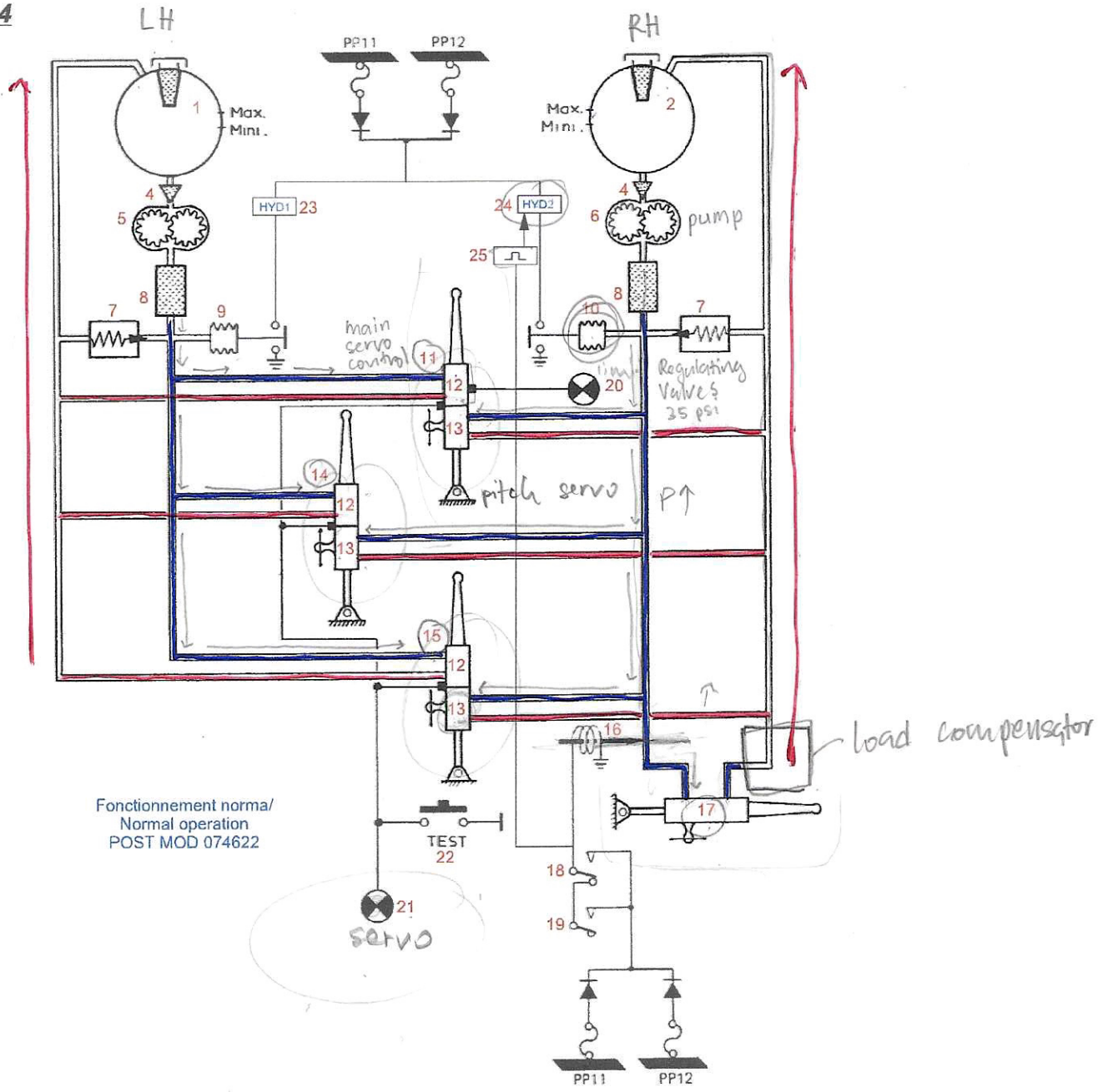
Figure 4


LH
RH
PP11
PP12
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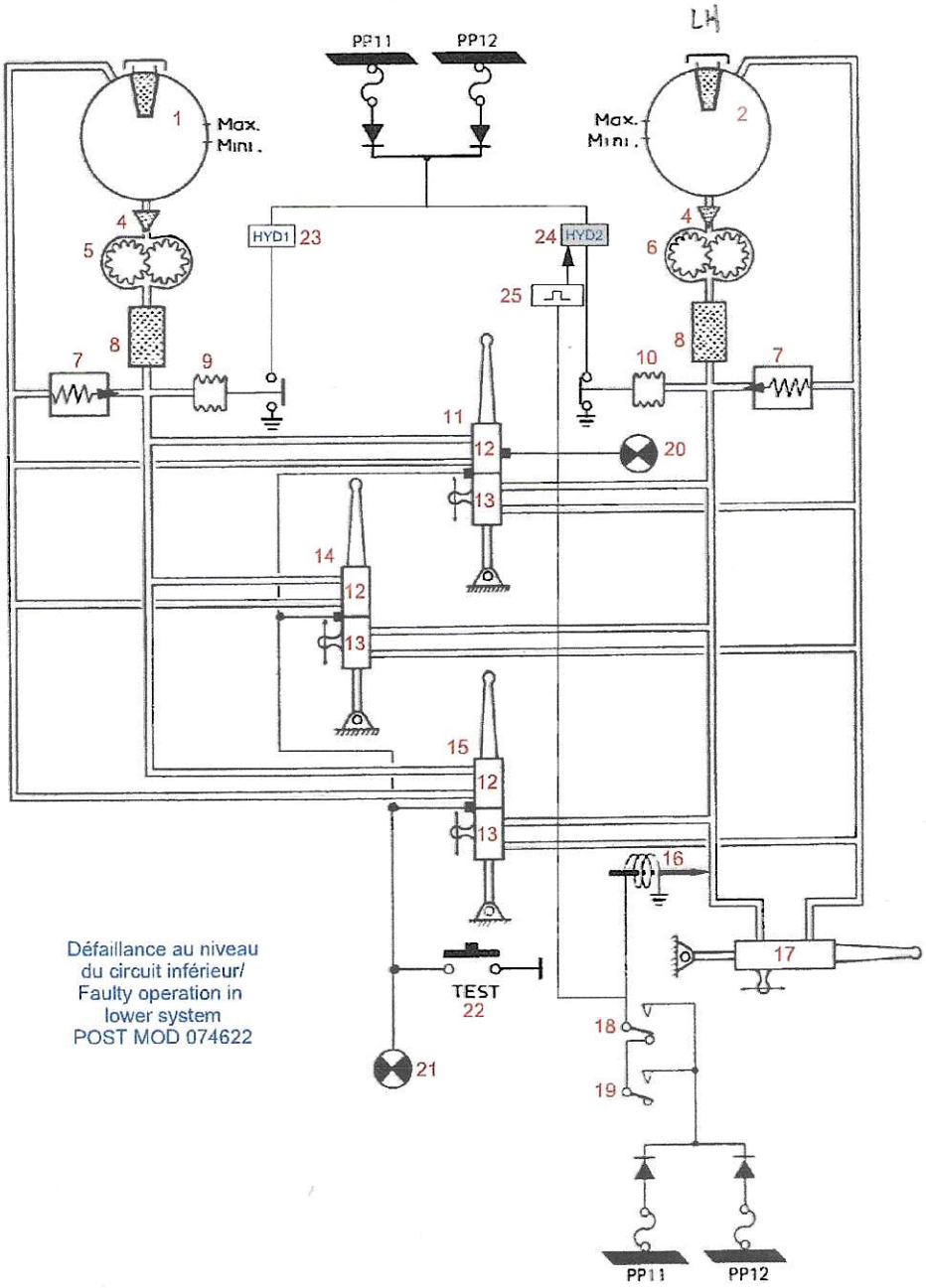
Mini.
2
Max.
Mini.
4
5
HYD1
23
24
HYD2
4
6
pump
25
8
7
9
main servo control
11
10
8
7
Regulating Valve 35 psi
12
13
20
14
12
13
pitch servo
P1
15
12
13
16
load compensator
17
Fonctionnement normal/
Normal operation
POST MOD 074622
TEST
22
18
19
21
servo
PP11
PP12

Figure 5


LH
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Mini.
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Mini.
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HYD1
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HYD2
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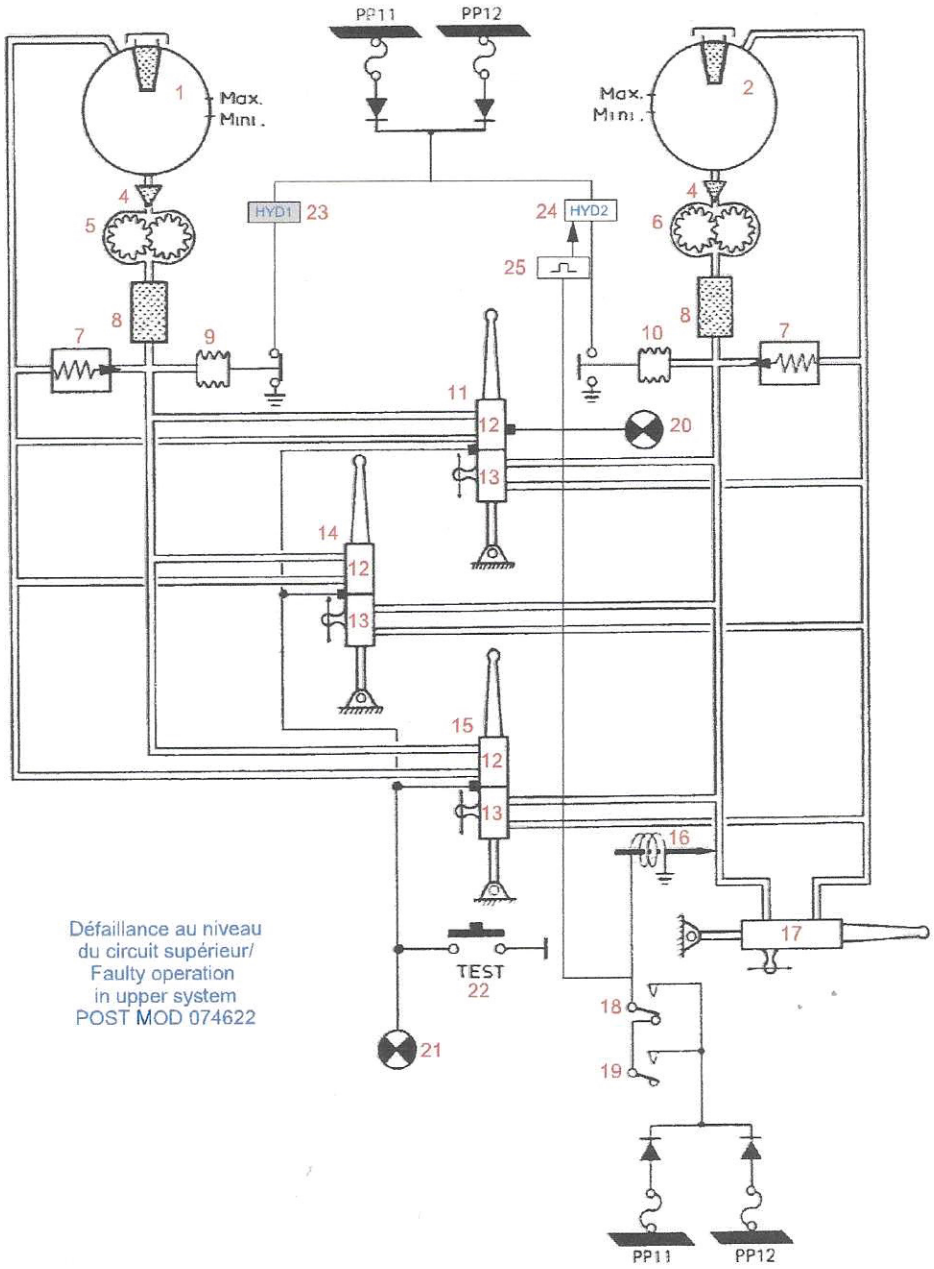
16
17
Défaillance au niveau
du circuit inférieur/
Faulty operation in
lower system
POST MOD 074622
TEST
22
18
21
19
PP11
PP12

Figure 6



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8.2 Source of smoke not identified

- Shut off the heating and demisting systems.
- Switch on the emergency overhead lights if necessary.
- Press the EMERGENCY CUT-OUT button.
  If electrical power is required for continuing the flight, proceed as follows :
  . Release all push-buttons and switch off all electrical consumers, except "Direct Battery" and "Standby Horizon" push-buttons.
  . Release the EMERGENCY CUT-OUT button.

CAUTION : DO NOT PRESS THE "EXT.PWR/BATT" BUTTON (S).

- Switch on the following components in the order indicated below :
  a) LH generator (GEN LH push-button).
     If necessary attempt to rearm generator (REARM GEN).
  b) RH generator (GEN RH push-button).
     If necessary attempt to rearm generator (REARM GEN).
  If the two power generating systems operate correctly :
  c) Press the EXT.PWR/BATT push-button (s).
  d) Switch on the necessary consumers one by one.

9 TAIL ROTOR MALFUNCTION

CAUTION : LANDING IS MADE EASIER BY A WIND COMING FROM THE RIGHT. IF THE AIRSPEED IS LOWER THAN 20 kt (36 km/h), GO AROUND IS IMPOSSIBLE DUE TO THE LOSS OF EFFICIENCY OF THE FIN. R R R

9.1 Tail rotor drive shaft failure

Loss of the tail rotor in power-on flight results in a yaw movement to the left, the extent of which will depend on the power and speed configuration at the time the failure occurs.

9.1.1 Loss of tail rotor in hover or at low speed near the ground

- Near the ground :
  Land quickly to prevent excessive rotation occurring.
- Far from the ground :
  Bring a/c nose down, pick up speed, then apply procedure of § 9.1.2.

9.1.2 Loss of tail rotor in cruising flight

- In cruising flight reduce the power as much as possible and maintain forward speed (weathercock effect), select a suitable landing area for a steep approach at a power enabling a reasonably coordinated flight.
- On final approach, shut down the engines and make an autorotative landing at the lowest possible speed.

9.2 Tail rotor control failure

- Set IAS at 60 to 70 kt (111 to 130 km/h - 69 to 81 MPH).
- Shut off the yaw servocontrol hydraulic system using the switch on the collective pitch lever.
- Press the ACCU test push-button to discharge the yaw servo accumulator.
- Make a shallow approach to a clear landing area with a slight side slip to the left. Perform a run-on landing ; the side slip will be reduced progressively as power is applied.

3.2 Ng indicator failure

- Continue the flight
- Monitor the readings on the other instruments for the engine concerned.

3.3 t4 indicator failure

Equalize the torques on the trim without exceeding 700°C on the other t4 indicator.

4 HYDRAULIC SYSTEM FAILURES

4.1 HYD - SERVO - LIMIT lights come on

Refer to SECTION 3.3 § 2 "WARNING CAUTION ADVISORY PANEL" (amber lights).

4.2 Yaw control servo-unit slide valve jammed

- In hover : if the angular speed is zero, land normally. Otherwise switch off the hydraulics using the button on the collective pitch lever.
- In cruising flight : reduce the speed, with side slip if necessary, and then switch off the hydraulics using the button on the collective pitch lever.

4.3 Yaw control servo-unit hydraulics lost
(R.H. hydraulic system failure)

This is indicated by :
- the illumination of the HYD + SERVO lights
  Refer to Section 3.3, paragraph 2 : WARNING CAUTION ADVISORY PANEL.
- the presence of low friction and continuous load on the yaw control right pedal in L.H. cross-wind.

→ Do not press the "ACCU" pushbutton on pannel 15 ALPHA, as this would cause the compensator accumulator to discharge and control loads might become significant (R.H. foot). R

- Doors ---------- Closed
- Seats and control pedals ---------- Adjusted
- Seat belts ---------- Fastened.

NOTE : Check particularly that the co-pilot seat belt is fastened when this seat is not occupied.

- "STANDBY STATIC" switch ---------- Set to NORMAL position
- Direct battery switch ---------- On. Associated light on R
- Battery ---------- On. Voltage checked
- Generators ---------- On.
  Before embodiment of mod. AMS 1732 : Set generators to ON after starting second engine.
- Anti-collision light ---------- On
- Fuel contents gauges ---------- Quantities checked
- Fuel tank crossfeed valve --------- Closed or as required
- Warning caution advisory panel ---- . Test lights
  . Dimmer as required (+ or -)
- Instruments ---------- Checked. Readings correct
- Heating * and demisting systems --- Off R
- Engine air intake anti-ice -------- Off R
- Rotors ---------- Clear
- Servo controls---------- Test SERVO-CONTROLS light goes out
- Yaw control pedals ---------- If necessary recenter by pressing ACCU test pushbutton. Freedom of travel.
- Collective pitch control lever ---- Locked in low pitch position
- Cyclic pitch control stick -------- Neutral. Friction clamp tight
- Fuel shut-off control ---------- Levers forward. Locked
- Rotor brake ---------- Off. Front stop
- Fuel flow control levers ---------- Aft gate

NOTE : 1) Lights on using aircraft battery
GEN LH (GENE G), GEN RH (GENE D), HORN (KLAXON), SERVO, R
PITOT PIL, PITOT AUX*, ENG OIL PRESS (PH MOT)*, HYD R
(HYDR), MGB P (PH BTP), AC LH (CONV G)*, AC RH (CONV D)*.

2) Lights on using external power
GEN LH (GENE G), GEN RH (GENE D), HORN (KLAXON), SERVO, R
PITOT PIL, PITOT AUX*, ENG OIL PRESS (PH MOT)*, HYD R
(HYDR), MGB P (PH BTP), BATT LH (BATT G), BATT RH (BATT D),
AC LH (CONV G)*, AC RH (CONV D)*.

4 STARTING

4.1 Starting No. 1 engine

- Switch on the booster pump ------ Pressure correct
- Operate the starter ---------- Ng increases

When Ng = 15 % :

- Push the fuel flow control lever forwards in start gate ---------- Monitor the Ng, t4, engine oil pressure, NR/Nf, torque

Note : If t4 increases quickly, move the fuel flow control lever back slightly.

*Optional

When Ng = 60 % :

- Release the start button.
- Extinguish the AUTOR1 or AUTOR2 warning light (post Mod. 1823).
- Accelerate the engine by pushing the fuel flow control lever forwards to the "Flight" gate.
  . Check for normal response of engine and rotor parameters.
  . Check that the "GEN" (GENE) (post-Mod.AMS 1732), HYD (HYDR), MGB P (PH BTP) and "SERVO" lights go out at 200 rpm approx.
  . Check that horn sounds at 350 rpm approx.

NOTE 1 : During engine acceleration do not allow rotor speed to stagnate between 288 and 347 rpm. R R

NOTE 2 : In low OAT conditions, during the starting sequence, the maximum engine oil pressure may temporarily be exceeded, it is therefore recommended to move the fuel flow control lever forward slowly.

NOTE 3 : If the engine has been shut down for more then 15 minutes, stabilize at idle speed (Ng = 60 % approx.) for one minute before accelerating by pushing the fuel flow control lever into the "FLIGHT" gate.

4.2 Starting No. 2 engine

- Proceed as for No. 1 engine with No. 1 engine generator not engaged.

When No. 2 engine is running at idle speed :

- Engage both generators (pre-Mod. 1732) ---- Lights out.
- Engage A.C. power system (optional) ------- Lights out.
- Accelerate No. 2 engine by moving fuel flow control lever to flight gate.

NOTE : Should battery charge be insufficient to start No. 2 engine while observing the limitations engage No. 1 engine generator before re-starting No. 2 engine.

5 CHECKS AFTER STARTING

5.1 General checks

- Ground power unit (if used) --------- Disconnected.
- Voltage and current ----------------- Correct.
- All engine and rotor parameters ----- Correct.
- Instruments on instrument panel ----- Working.
- Radio - Radio navigation equipment -- On.
- Pitot heating system ---------------- On.
- Hydraulics :

CAUTION : DURING YAW COMPENSATOR CHECK, BE SURE NOT TO UNLOCK INVOLUNTARILY THE COLLECTIVE PITCH TO AVOID UNDUE COLLECTIVE PITCH RISE.

→ . Yaw servo-unit ------------------- Cut-off test (button on collective pitch lever) Check loads on yaw control pedals are light.
→ . Yaw compensator ------------------ Press ACCU test pushbutton on overhead panel. Check loads on yaw control pedals are heavier.
. Yaw servo-unit --------------------- On.
- Aural warning system ---------------- On (Push-button pressed).

The flying controls are used to fly the helicopter through variation of the pitch angle of main and tail rotor blades.

The basic aircraft is fitted with controls at pilot's station (RH seat). As an optional item, the aircraft can be provided with dual controls if flown with a copilot. These controls can quickly be removed for transportation of long loads inside the cabin.

The flying controls consist of three channels :

- a lateral and fore-and-aft cyclic pitch channel
- a collective pitch channel
- a yaw channel.

The main rotor controls are of the rigid type (control rod) and the tail rotor controls are mixed (ball type control cables and rods).

Three mobile cylinder servo-controls whose piston rod is integral with the M.G.B. directly operate the swashplate (two in lateral, one in fore-and-aft). These servo-controls allow the aircraft to be flown manually in the event of a hydraulic supply failure.

A tail rotor servo-control mounted on the tail boom actuates a rod which controls the tail rotor plate bellcrank. In the event of hydraulic supply failure to the RH system a load compensator coupled to the yaw control linkage restricts the pedal actuating loads. An accumulator provided for the load compensator can be discharged through the ACCU pushbutton located on panel 15 ALPHA.

The mixing unit allows operation of the cyclic and collective pitch controls separately and without interaction.

When the aircraft is fitted with the optional autopilot each channel is completed by the following :

- for the pitch and roll channels :
  - an electric actuator
  - a trim actuator
- for the yaw channel :
  - an electric actuator
  - a collective pitch - yaw coupling system
  - an elastic rod
  - an adjustable friction lock on the pedals
  - a pedal movement detector.

2.3 Hydraulic system controls and monitoring R

The following are available to the pilot :

- collective lever switch (7) to cut off supply to the tail rotor servo-control
- overhead panel pushbutton (9) to test the hydraulic pressure drop indicating circuit.

The systems are monitored through three lights on the failure warning panel :

- a "SERVO" (SERVO-CONTROLS) light indicating that a main servo-control distributor valve is seized
- a "LIMIT" light indicating that significant load is induced on the upper cylinder of the RH main servo-control
- a "HYDR" (HYD.) light indicating a hydraulic pressure drop.
- two optional lights, one marked "HYDR D" (RH HYD) for the RH system and one marked "HYDR G" (LH HYD) for the LH system, indicating a hydraulic pressure drop in the relevant system.

Key to Figure 1

Item	Description	Item	Description
1	Roll servo-control	12	Hydraulic reservoir
2	Pitch servo-control	13	Filter
3	Roll servo-control	14	Pressure regulator
4	Yaw servo-control	15	Low pressure switch
5	Yaw hydraulic supply electro-valve	16	Load compensator actuator
		17	Check-valve
6	Collective pitch grip	18	Accumulator discharge electro-valve R
7	Yaw hydraulic supply switch		
8	Front panel	19	Accumulator
9	"SERVO" test pushbutton	20	Electro-valve control ACCU pushbutton
10	Failure warning panel		
11	Hydraulic pump		

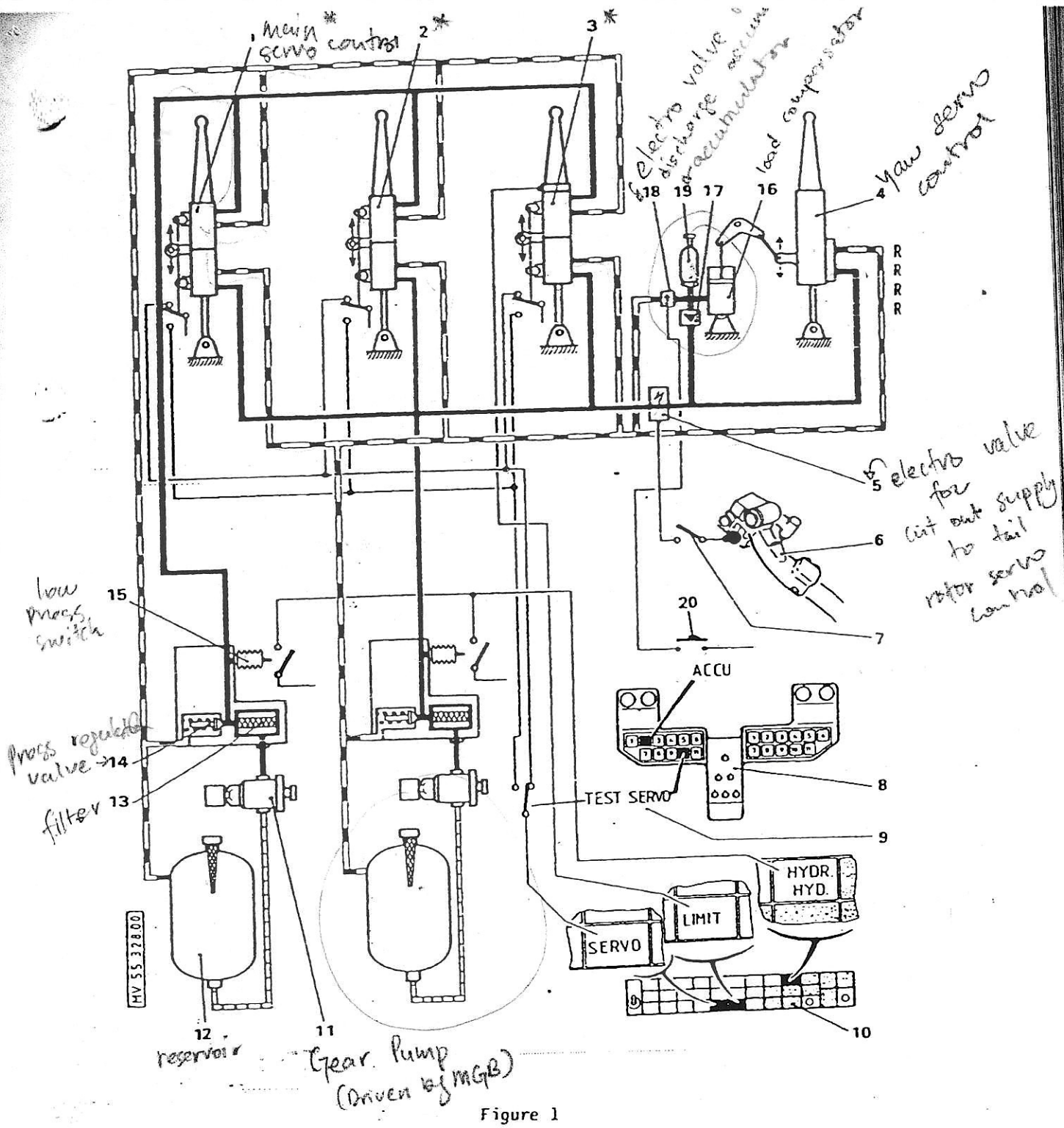

Figure 1

SECTION 7.7 : HYDRAULIC SYSTEMS

TEST ON TAIL ROTOR

SHEET No. 5	HELICOPTER AS 355F	CHECKS AFTER OPERATIONS ON FLYING CONTROLS Hydraulic checks

TEST PHASES AND REQUIREMENTS	RESULTS TO BE OBTAINED OR LIMITATIONS	RESULTS OBTAINED
Start engine as prescribed in the Normal Procedures of the Flight Manual, SECTION 4.1. Aircraft on the ground. Full low pitch.	HYD warning light goes out before NR is 200 rpm	Correct / Incorrect
(1) Cut out tail rotor servo-unit on the collective pitch lever.	355 E-F-F1 : The loads at the pedals increase but can still be controlled.	Correct / Incorrect
	355 F2 : The loads at the pedals remain weak.	Correct / Incorrect
(2) 355F2 : Press the ACCU pushbutton. Cut in the tail rotor servo-unit again.	The loads at the pedals can still be controlled.	Correct / Incorrect
355 F1-F2 Press the SERVO test pushbutton.	The SERVO warning light comes on.	Correct / Incorrect

AS 355 F2 SUPPLEMENT : 3 AXIS AUTOMATIC PILOT SFIM
55 T31

2 LIMITATIONS

All limitations specified in Section 2 remain applicable, independently of the following :

- Fore and aft c.g. location : aft limit at 3.52 m (138.6 in.).
- If height to clear obstacles is less than 400 ft (120 m), the pilot must keep his hands on the controls.
- When the aircraft is on the ground, the AP must be disengaged except when checks are to be performed.
- Do not engage the AP before take-off if trim test (Refer to § 4.1.1) is not satisfactory.
- Coupler fitted :
  . Do not engage the GLIDE at a radio altimeter height greater than 4500 ft. R R R

3 EMERGENCY PROCEDURES

All emergency procedures specified in Section 3 remain applicable, together with the following additional procedures :

3.1 General

If jerks or sudden movements independent of air turbulence are felt during flight with autopilot engaged, this may be caused by the autopilot. Consequently disengage the autopilot.

- If the anomaly disappears after disengagement, re-engage each channel in turn until failure is identified. Retain channels that operate properly.
- If the anomaly persists the AP is not at fault. Re-engage the autopilot if required.

3.2 Failure of hydraulic system

- Comply with normal procedure (SECTION 3.2).
- If the RH hydraulic system is faulty (loads at rudder pedals) the complete yaw channel is inoperative.

NOTE : In case of hydraulic pressure loss in the RH system or intentional cut-off of the hydraulic pressure to the yaw servo-control, it is recommended to switch off the yaw channel.