FOUGA MAGISTER CM.170

FLIGHT MANUAL

AZURPOLY

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1\ INTRODUCTION

1.1\ History

The CM.170 Magister is a French two-seat jet trainer aircraft build by Fouga. Its first flight was on 23rd of July, 1952, and service in French Air Force began in 1956. In total, 929 models were built for a dozen different armies, including France, Ireland and Belgium. Even though main use of the aircraft was pilot training, some have been used for close air support, during Six-Day war for instance.

It has two tandem seats, a distinctive butterfly tail configuration and wing tip tanks. Fouga was firstly powered by two Turbomeca Marboré II engines, each delivering 880 lbf of thrust. The Marboré IV was introduced later, with more power.

Athletic and playful, it is a reactive and polyvalent machine, which is capable of performing various types of operation, from sightseeing flights to committed aerobatics, activities for which it is mainly use nowadays by private pilots.

1.2\ Developer notes

The journey is still underway, and we are glad you are now part of it. As for our other products, we will propose updates each time we consider it as relevant, to bring new functionalities or fix discovered bugs.

Do not hesitate to contact us at contact@azurpolygroup.com or on www.azurpoly.com.

2\ GENERAL DESCRIPTION

2.1\ Specifications

Weights	
Empty weight	**2,290** kg
Gross weight (without tip tanks)	**2,850** kg
Maximum takeoff weight	**3,200** kg
Dimensions	
Wingspan (including tip tanks)	**12,5** m
Length	**10,06** m
Height	**2,8** m
Wing area	**17,3** m²
Tail area	**3,75** m²
Tail opening angle	**110** °
Engines	
Fuel capacity	**980** L
Maximum thrust	**3,92** kN
Maximum engine speed	**22,500** RPM

2.2\ Detailed views

Front panel (pilot)

1	Tachometer (RPM)	**23**	Main tank level (liters, without tip tanks)
2	Anemometer (kts)	**24**	Machmeter
3	Gyrocompass	**25**	Hydraulic pressure (hpz)
4	Attitude indicator	**26**	Voltmeter (volts)
5	Accelerometer (G-force)	**27**	Servo light
6	Nozzle temperature (Celsius)	**28**	Unlocked landing gear light
7	Altimeter (ft)	**29**	Starter light
8	Variometer (ft/min)	**30**	Panel lights (compass)
9	Turn coordinator	**31**	Servo switch
10	ADF indicator	**32**	Defrost handle
11	Landing gear state	**33**	Pitot heat switch
12	Oil temperature (Celsius)	**34**	Attitude indicator gyro supply switch
13	Pitch trim indicator (degrees)	**35**	Gyrocompass gyro supply switch
14	Flaps indicator	**36**	Generator switch
15	Oil pressure (hpz)	**37**	Battery switch
16	Cabin altitude (ft)	**38**	Landing gear handle
17	Oxygen regulator	**39**	Fuel pressure light
18	Sight setting (inoperative)	**40**	Landing gear alarm test
19	Horizontal situation indicator	**41**	Parking brake handle
20	Low fuel light (150 liters)	**42**	EFB button
21	Canopy lock light	**43**	Smoke switch
22	Engine fire lights	**44**	Compass

Lateral consoles (pilot)

1	Landing gear hyraulic circuit selector	**14**	COM frequency knob
2	Emergency spoilers selector	**15**	COM volume
3	Throttle	**16**	Intercom switch
4	Spoilers switch	**17**	Panel lights (radio)
5	Air conditioning temperature	**18**	ADF frequency
6	Flaps switch	**19**	NAV panel ON/OFF
7	Navigation lights switch	**20**	NAV volume
8	Air conditioning mode	**21**	VOR ident
9	Landing lights switch	**22**	VOR frequency knob
10	Panel lights (emergency)	**23**	VOR frequency knob
11	Panel lights (UV)	**24**	Starter light
12	Panel lights (console)	**25**	Starter
13	UHF panel ON/OFF	**26**	Fuel dump switches

Front panel (copilot)

1	Tachometer (RPM)	**12**	Flaps indicator
2	Anemometer (kts)	**13**	Oil pressure (hpz)
3	Gyrocompass	**14**	Oxygen regulator
4	Attitude indicator	**15**	Intercom panel (inoperative)
5	ADF indicator	**16**	Starter light
6	Nozzle temperature (Celsius)	**17**	Low fuel light (150 liters)
7	Altimeter (ft)	**18**	Generator light
8	Variometer (ft/min)	**19**	Pitot heat light
9	Turn coordinator	**20**	Engine fire lights
10	Landing gear state	**21**	Landing gear handle
11	Oil temperature (Celsius)	**22**	Panel lights (radio)

2.3\ Instruments

BEZU 32 gyrocompass

The aircraft is equipped with a gyrocompass (*BEZU 32 model*).

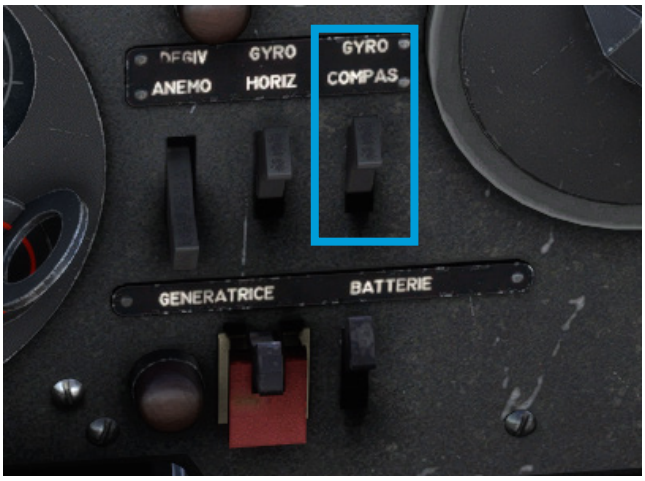
You can use the right knob to switch between two modes:

- Gyrocompass (D mode): Connected to the aircraft gyroscope, you will get a smooth rotation but you will need to recalibrate it frequently, like any gyrocompass.
- Magnetic compass (Cm mode): Indicating the magnetic heading, recalibration is not needed but display can become jerky, especially when aircraft is turning.

With the left knob, you can:

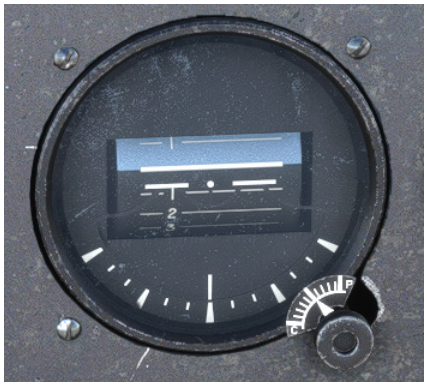
- Recalibrate the instrument (only if D mode is selected).
- Set heading bug (can be used to conserve a reference heading).

A switch allows to manage gyrocompass supply:



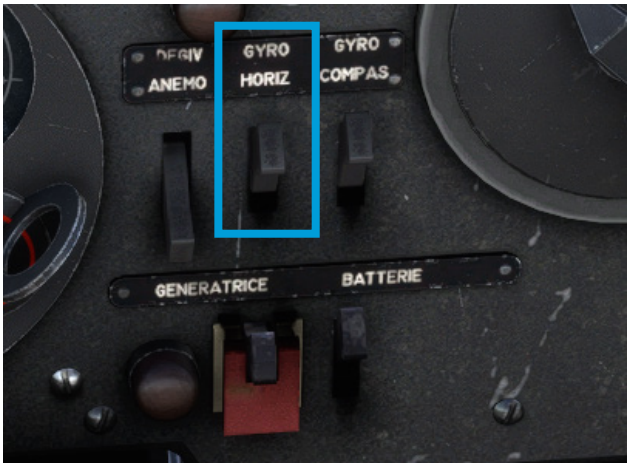
Attitude indicator

Attitude indicator fitted into the Magister is a classical one. The only setting available is the bars position change.



This instrument will indicate pitch angle between 0 and 80 degrees and bank angle with a graduation each 10 degrees between 0 and 60 degrees.

A switch allows to manage attitude gyroscope supply:



3\ AIRCRAFT SYSTEMS

3.1\ Flight controls

Although flight controls do not have big specificities compared to other aircrafts, butterfly tail imposes a special operation. Both pitch input from the stick and yaw input from the rudder are combined to create the ruddervator movement.

However, this is transparent for the user and will use the flight stick as you would do on any other plane.

Servo assistance

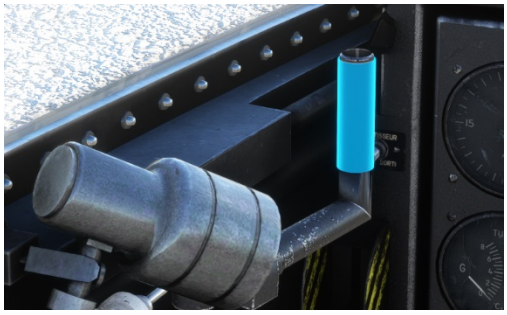
Aileron movement is assisted by servo, supplied by the hydraulic circuit. It can be disconnected by the pilot. As it is only an assistance aiming at easing aileron motion, servo effect has not been implemented in our aircraft.

A light will be visible when servo is disconnected.

3.2\ Canopy and pressurization

Pilot and copilot canopies can be handled separately.

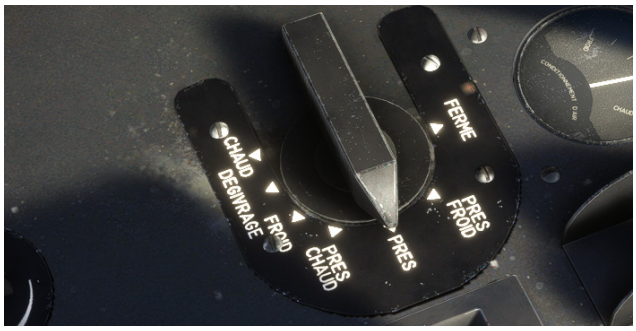
You can lock and unlock canopy from the handle. A red light will be visible as soon as one of the canopies is not locked.



To open or close the canopy, you have to click on its left arm.

Cabin pressurization and air conditioning is functional as soon as canopy is locked. A multi-position switch allows to choose air conditioning type:

- Closed (no air conditioning).
- Pressurization (temperature selection on three positions).
- Defrost (temperature selection on three positions).



Current selected temperature can be seen on the gauge.

When defrost is selected, air is directed upon the windshield. In addition, defrost handle on the main panel allows to spurt alcohol on the front glass to help defrosting (action is not simulated).

3.3\ Electrical system

Electric supply is provided in flight, thanks to a generator, rated 28.5V, connected to the left engine.

A converter allows to feed gyroscopes.

Lights

The Fouga is fully capable of night flying, and each light has been reproduced in the game.

In the exterior, you will find a landing light and navigation lights.

Navigation lights can be set on three positions:

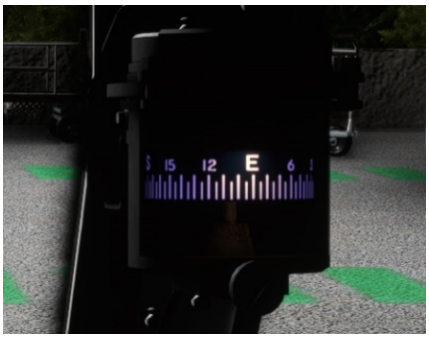
- OFF
- FIXED
- FLASHING, where lights will blink approximately one time per second.

As we have to manage three distinct position, keyboard input cannot be taken into account. You need to use the switch on the left console to turn on or off the navigation lights.

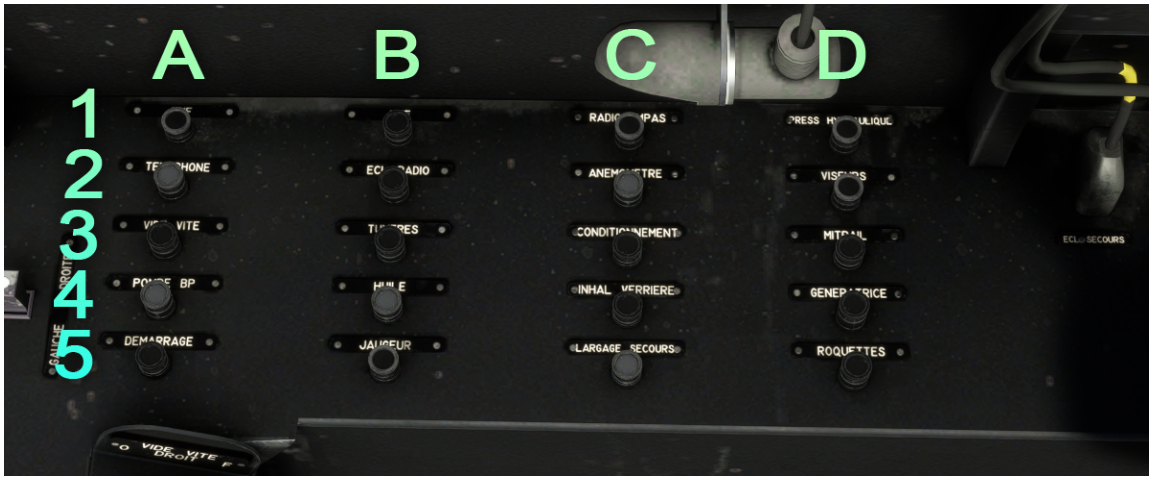
In the interior, you will find for pilot and copilot:

- Console lights (white).
- UV lights (front panel lights set by potentiometer).
- Emergency lights (red console lights set by potentiometer).
- Radio light (backlight for radio panels).

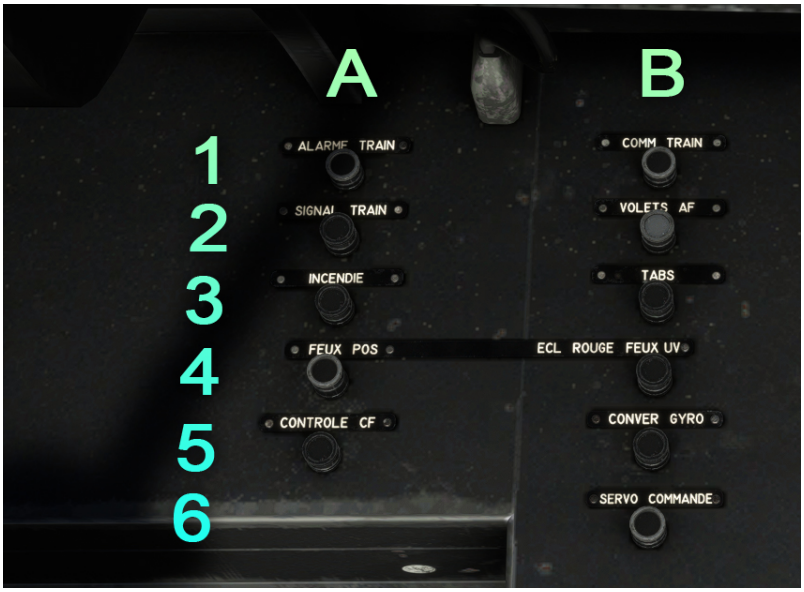
Pilot also has a compass light:



Fuses



A1	VHF	**C1**	Radio compass
A2	Intercom	**C2**	Pitot heat
A3	Fuel dump	**C3**	Air conditioning
A4	Low pressure fuel pump	**C4**	Low oxygen and canopy lights
A5	Starter	**C5**	Emergency drop
B1	UHF	**D1**	Hydraulic pressure indicator
B2	Radio lights	**D2**	Gun sight
B3	Nozzle temperature indicator	**D3**	Gun
B4	Oil pressure and temperature indicators	**D4**	Alternator
B5	Fuel level indicator	**D5**	Rockets



A1	Landing gear alarm light	**B1**	Landing gear
A2	Landing gear lights	**B2**	Flaps and spoilers

A3	Fire alarm lights	**B3**	Tabs
A4	Navigation lights	**B4**	Red and UV lights
A5	Turn coordinator	**B5**	Gyros
		B6	Servo

3.4\ Fuel system

The Fouga has three fuel tanks:

1. One fuselage tank (divided in two parts) containing 730 liters.
2. One tank on left wing tip (125 liters).
3. One tank on right wing tip (125 liters).

On some versions, bigger tip tanks (each 230 liters) can be installed. They are not implemented in our version yet.

In addition to those tanks, there is a back flying accumulator (11 liters) allowing to feed the engines when the aircraft is flying inverted. After approximately 30 seconds, engines will lose power and you will need to bounce back to resume fuel supply.

A low-pressure electric fuel pump is connected to the main electric circuit, allowing to feed high-pressure pumps and the back flying accumulator.

When fuel pressure goes below 350 millibars (too low to fill back flying accumulator) a red light will glow on the left of the panel:

3.5\ Hydraulic system

The Fouga is fitted with two hydraulic circuits, one NORMAL circuit and an EMERGENCY circuit. A pump connected to the left engine allows to maintain a 250 bars pressure into the circuit.

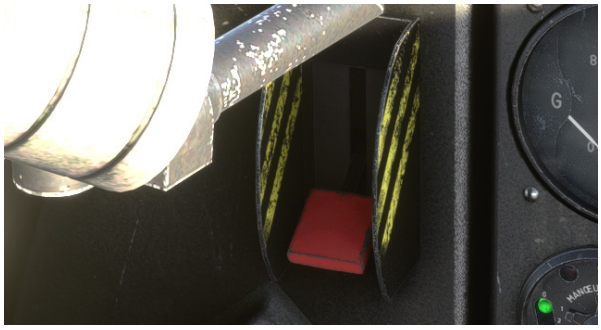
The following systems are connected to the hydraulic circuit:

- Landing gear.
- Flaps.
- Brakes.
- Spoilers.
- Aileron servo.

Emergency circuit is supplied thanks to the handle on the right of the pilot.

Landing gear

Equipped with a tricycle landing gear, the movement is managed with the red handle on the left of the main panel.



Nose gear has a free movement and is not connected to the rudder pedals. During taxi, turns are done using differential braking. As differential braking can be achieved with specific hardware only (rudder pedals with brakes), we chose to connect front wheel to the rudder to facilitate ground manoeuvres.

A gauge with several bulbs allows to control landing gear state:

- 3 red bulbs are turned on when landing gear is not locked (not fully open or not fully retracted).
- Two sets of 3 green bulbs are turned on when landing gear is expanded and locked.

A light above main panel will blink when one of the engines is below 15,000 RPM and the landing gear is not down.

In case of issues with lights, you can use the auditory check button. Once pressed, a continuous sound will be emitted if landing gear is down and locked.

Flaps

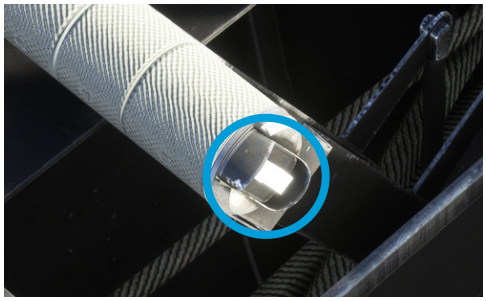
The CM.170 has trailing edge flaps, composed by two elements per wing.

Thanks to the switch on the left console, flaps can be set on any position between 0 and 40 degrees. You can still assign pre-assign takeoff (15 degrees) and landing (40 degrees) positions to any of your joystick button to facilitate its use.

Spoilers

The aircraft has six plates per wing, each of them can rotate between 0 and 90 degrees.

Spoiler switch is present on the right side of the throttle, for both pilot and copilot. Like flaps, it is a three positions switch.



3.6\ Oxygen

Oxygen bottles are located behind the pilot seat. With a 2000 litres capacity (initial pressure of 150 bars), system can be opened or closed from a valve on the right of the pilot.

Both pilot and copilot have an oxygen regulator with:

- Needle showing the remaining oxygen in the circuit.
- Blinker which should do a complete movement for each breathing in and breathing out of the pilot/copilot.
- Bulb which will light up when oxygen pressure drops below 25 bars.
- Switch (N – 100%) to provide pure oxygen.
- Switch (N – Secours) used in case of emergency to provide pure oxygen in overpressure (50 mbar).

Pure oxygen is automatically supplied above 34,000 ft.

Autonomy will depend on the cabin altitude, and can be read in the following table:

Cabin altitude (ft)	Autonomy for two pilots (hours)				
30,000	N	5.2	3.9	2.6	1.3
	100 %	5.2	3.9	2.6	1.3
25,000	N	5.2	3.9	2.6	1.3
	100 %	4	3	2	1
20,000	N	5.2	3.9	2.6	1.3
	100 %	3.2	2.4	1.6	0.8
15,000	N	5.2	3.9	2.6	1.3
	100 %	2.5	1.8	1.2	0.6
10,000	N	5.2	3.9	2.6	1.3
	100 %	2	1.5	1	0.5
0	N	7	5.2	3.5	1.7
	100 %	1.4	1	0.7	0.3
	Oxygen quantity	2000 L (1)	1500 L (3/4)	1000 L (1/2)	500 L (1/4)

3.7\ Radio

The right console is dedicated to everything related to the radios:

- UHF panel (COM 1).
- Radio compass (ADF) panel.
- Sound mixing panel (intercom).
- VOR panel (NAV 1).

Sound mixing panel is inoperative as COM and NAV volumes are already adjustable from UHF and VOR panels.

UHF panel

Originally, UHF box has pre-registered frequencies that can be set before flight and selected with the 20 positions wheel.

In order to be usable in the simulator, you can select any COM frequency from the central wheel.

Left knob allows to turn on/off UHF (HOM position is inoperative).

Right knob allows to set COM 1 volume.

Radio compass

In the CM.170, radio compass panel has plenty of knobs and switches used to connect manually to a station.

This complex operation is not needed to connect to modern NDB transmitters, and thus was not simulated in our aircraft.

You can simply use the top left knob in order to change ADF frequency.

ADF indicator will point to station direction.

VOR panel

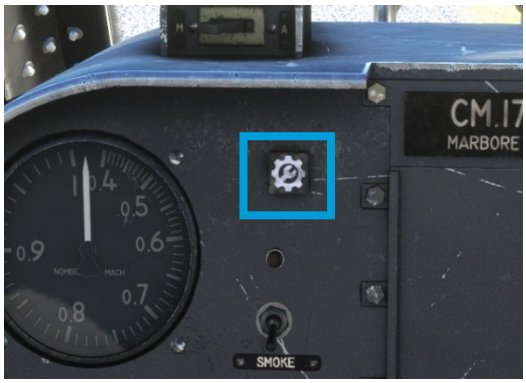
This panel allows to select NAV frequency, thanks to two knobs.

The course deviation indicator shows deviation from the radial that can be set with OBS knob.

The CM.170 is not equipped with ILS.

4\ ELECTRONIC FLIGHT BAG

To help managing all actions related to the aircraft, an EFB has been implemented. It can be opened and closed thanks to a cockpit button.

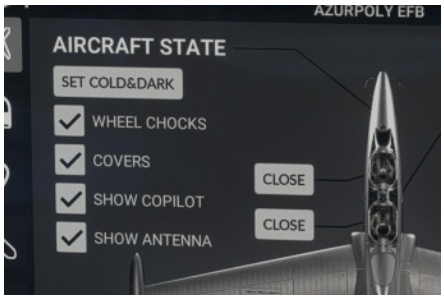


When opened, screen brightness can be set from the top bar.

EFB can be closed with a click on its left border. It can be moved on the seat with a click on its right border.

4.1\ Aircraft menu

Aircraft state



You can put here the aircraft in “cold and dark” mode. Engines will be stopped, systems will be off and ground protections will be put in the aircraft exterior.

Copilot and front antennas can be hidden.

You can also open and close pilot and copilot canopy from here.

Hydraulics

This menu allows to trigger hydraulic failure (main circuit), as this type of failure is not natively supported by MSFS.

You will see main hydraulic pressure drops, which will let you practice emergency procedures in case of hydraulic failure, to maneuver landing gear and spoilers.

Smoke system

Here, you can turn the smoke system on (which can also be done with the switch on the main panel), and choose between five different colours.

Black smoke coming from the engine at high power can be disabled.

Oxygen

This menu shows oxygen valve state, in addition to the remaining quantity.

You can refill the circuit as needed.

4.2\ Radio menu

If tooltips are disabled in your parameters, you may not see COM and ADF frequencies when setting them from the knobs. This menu shows all active frequencies, with current volume for COM and NAV.

As there is no transponder unit in the cockpit, you can also use this menu to set transponder state and code.

4.3\ Map menu

This menu consists of a map showing current aircraft position.

Different controls on the right part allow to interact with the map:

- Zoom buttons.
- Button to stop auto centering to aircraft position.
- Trajectory button to show or hide aircraft path.

4.4\ Weapons menu

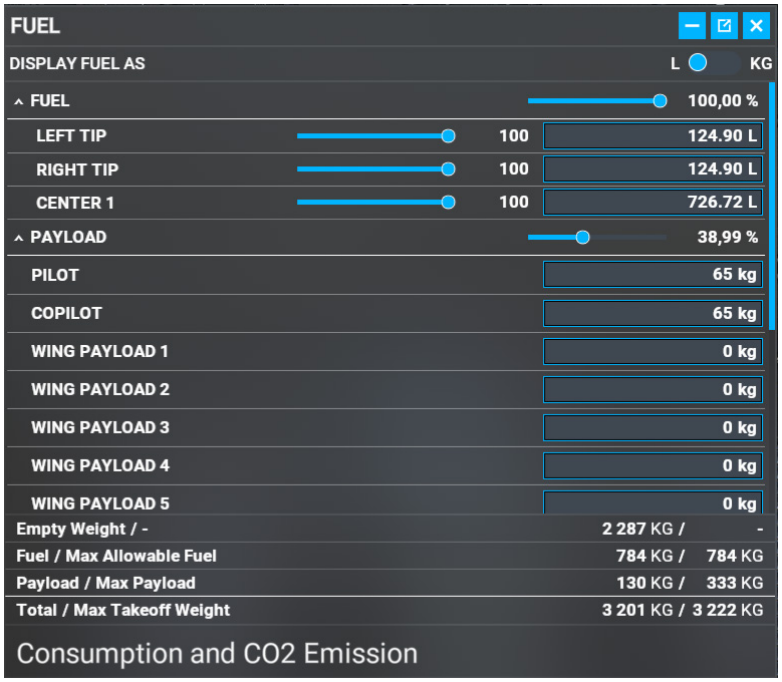
From version 1.1, you can display various weapons on the aircraft from this EFB menu. Those weapons are static and cannot be jettisoned.

You will get the following view with several buttons to display or hide the weapons:

The Fouga was equipped with the following armament:

Ammunition	Caliber	Type	Quantity	Launch equipment	Hard points
Machine guns	7.5 mm		2 x 150	2 MAC 52	
Rockets	68 mm	SNEB	2 X 6	ALKAN LB 52 & MATRA LR 122	1 & 4
	120 mm	T 10	2 x 2	MATRA LR 20	2 & 3
Bombs	50 kg	EG 61 C	2 x 1	ALKAN LB 52	1 & 4
	50 kg	F 1	2 x 1	ALKAN LB 52	1 & 4

As you add armament, payload impact will be computed automatically. Hence, you should not manually change weights in payload menu, especially “wing payload” lines.



4.5\ Autopilot menu

The Fouga is not equipped with an autopilot. However, you will find an autopilot menu in the EFB, allowing you to hold altitude and/or heading as you wish.

When turning ALT or HDG mode on, current altitude/heading will be maintained, and you can change values using “+” and “−“ buttons.

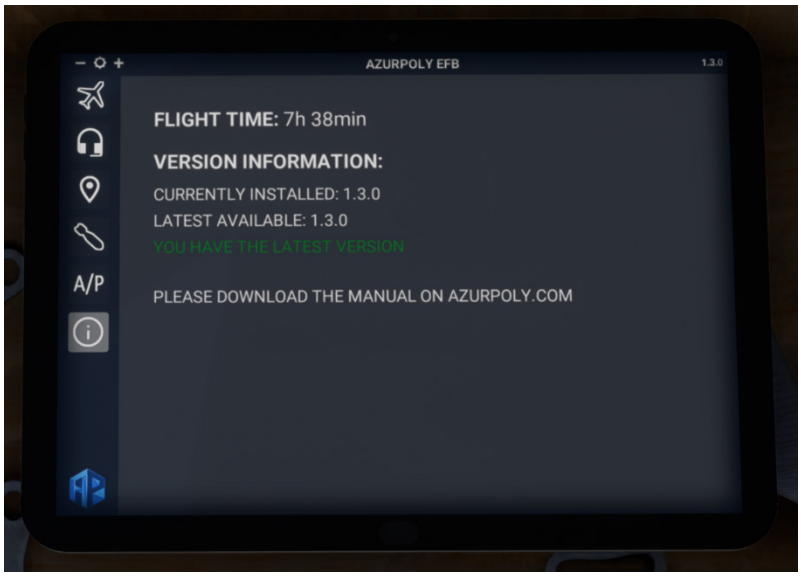
Vertical speed selected for any altitude change can be chosen from the right.

4.6\ Version menu

This menu indicates version of the aircraft currently installed on your machine.

A message will be displayed if an update is available.

You can also see how much time you spent within the aircraft.



5\ NORMAL PROCEDURES

5.1\ Reference speeds

General	
Stall speed (full flaps)	**78** kts
Stall speed (no flaps)	**87** kts
Rotation speed	**90** kts
Initial climb speed	**120** kts
Final approach speed	**110** kts
Maximum speed in turbulent air (VNO)	**250** kts
Maximum gear extended	**215** kts
Maximum speed	**400** kts
Never exceed speed (VNE)	**450** kts
Recommended for aerobatics	
Loop	**280** kts
Roll	**260** kts
Cuban Eight	**280** kts

5.2\ Checklists

In addition to this manual, you can find in-game interactive checklists, with dynamic validation and cameras management to help you complete each step.

STARTING ENGINE

Battery	**ON**
For each engine:	
Throttle	**0 %**
Fuel valve	**CLOSED**
Starter	**ON**
Wait for 1000 RPM	
Ignition	**ON**
Fuel valve	**OPENED**
Wait for 4000 RPM	
Ignition	**OFF**
Starter	**OFF**
Oil pressure	**1 bar**
Alternator	**ON**
Voltage	**28.5 V**

Order of actions is very important for engines. Once starter is running, depressing the button on the fuel handle will initiates ignition, and pushing the handle will cause fuel to flow through the combined injection spark plugs into the combustion chamber.

At this moment, nozzle temperature should increase by approximately 100 degrees Celsius within ten seconds. Ignition button must be released immediately to avoid damaging the engine.

BEFORE TAXI

Canopy	**CLOSED**
Radio (UFH)	**ON**
Attitude indicator gyro	**ON**
Gyrocompass gyro	**ON**
Hydraulic pressure	**OK**
Aileron servo	**ON**
Spoilers	**RETRACTED**

BEFORE TAKEOFF

Flaps	**15 degrees**
Canopy	**LOCKED**
Oxygen	**100 %**
Trim	**NEUTRAL**
Pitot heat	**ON**

AFTER TAKEOFF

Landing gear	**UP**
Flaps	**RETRACTED**
Oxygen	**NORMAL**

BEFORE LANDING

Landing gear	**DOWN**
Hydraulic pressure	**OK**
Landing lights	**ON**
Flaps	**40 degrees**

AFTER LANDING

Trim	**NEUTRAL**
Spoilers	**RETRACTED**
Flaps	**RETRACTED**

SHUTDOWN

Oxygen	**100 %**
Pitot heat	**OFF**
Attitude indicator gyro	**OFF**
Gyrocompass gyro	**OFF**
Aileron servo	**OFF**
Fuel valve (both)	**CLOSED**
Battery	**OFF**

6\ EMERGENCY PROCEDURES

6.1\ Hydraulic failure

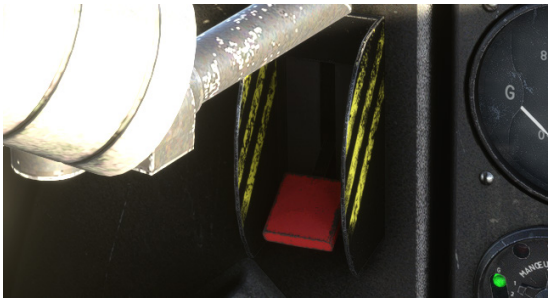
In case of hydraulic failure, you will need to use the emergency circuit to maneuver landing gear and spoilers.

In the real aircraft, brakes also need to be operated with the emergency hydraulic handle. This has not been reproduced because of the difficulty to give a precise input to the hydraulic handle while ground rolling.

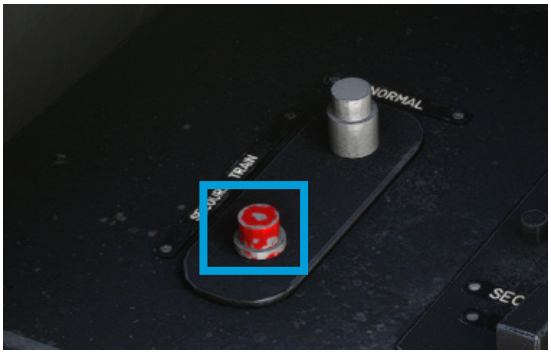
Landing gear

Follow this procedure to extend the landing gear in case of hydraulic failure:

1. Lower landing gear handle.



2. Click on the button to use secondary hydraulic circuit.



3. Use manual pump to lower the landing gear.

4. Stop pumping once the three landing gear lights are green.

It is not possible to retract the landing gear using emergency circuit.

Spoilers

To extend or retract spoilers using secondary circuit, you simply need to set the three-positions switch as wanted.

Then, just use the manual hydraulic handle.

6.2\ Fuel dump

In case of emergency, tip tanks can be emptied with a fuel dump system.

To begin the fuel dumping, use the switch on the right console. A red light indicates the ongoing motion of the dumping valve (lasting only some seconds).

Once draining is in progress, you may wait for approximately 3-4 minutes to jettison the tank completely.

Dumping can be stopped at any time using the switch.

7\ CONTROL ASSIGMENTS

In addition to default control assignments, our aircraft is using custom variables and events to manage all its systems.

Custom variables are called L Vars (prefixed with “L:”) and custom events are called H Events (prefixed with “H:”).

If you have external hardware and you are using specific software like FSUIPC or SPAD, you can assign buttons or switches to those variables and events.

In order to see custom variables related to the aircraft, you need to enable Developer mode (general options) and go to Tools > Behaviors > Local Variables on top menu bar. All custom variables are prefixed with “AZP” keyword.

However, changing those L VARS is not always enough and you may need to call the events described in the next section.

7.1\ Custom events

Here is non-exhaustive list of main H Events that you can use in order to interact with aircraft systems.

NAME	H EVENT	DESCRIPTION
EFB display	AZP_FOUGA_TOGGLE_EFB_POWER	Display or hide EFB tablet
EFB position	AZP_ FOUGA_TOGGLE_EFB_POSITION	Switch between the two EFB positions
Smoke	AZP_TOGGLE_SMOKE	Toggle smoke
Pilot canopy	AZP_TOGGLE_CANOPY_PILOT	Toggle canopy (pilot)
Copilot canopy	AZP_TOGGLE_CANOPY_COPILOT	Toggle canopy (copilot)
Gear hydraulic supply	AZP_HYDRAULIC_GEAR_SUPPLY_NORMAL AZP_HYDRAULIC_GEAR_SUPPLY_BACKUP	Set hydraulic supply for landing gear (normal or secondary circuit)
Spoilers hydraulic supply	AZP_HYDRAULIC_BACKUP_SPOILERS_IN AZP_HYDRAULIC_BACKUP_SPOILERS_N AZP_HYDRAULIC_BACKUP_SPOILERS_OUT	Set hydraulic supply for spoilers: - Retract with secondary circuit - Use normal circuit - Extend with secondary circuit
Fuel dumping	AZP_TOGGLE_FUEL_DUMP_L AZP_TOGGLE_FUEL_DUMP_R	Toggle fuel dumping (left and right tanks)
Oxygen valve	AZP_TOGGLE_OXYGEN_VALVE	Toggle oxygen valve
Oxygen refill	AZP_OXYGEN_REFILL	Refill oxygen