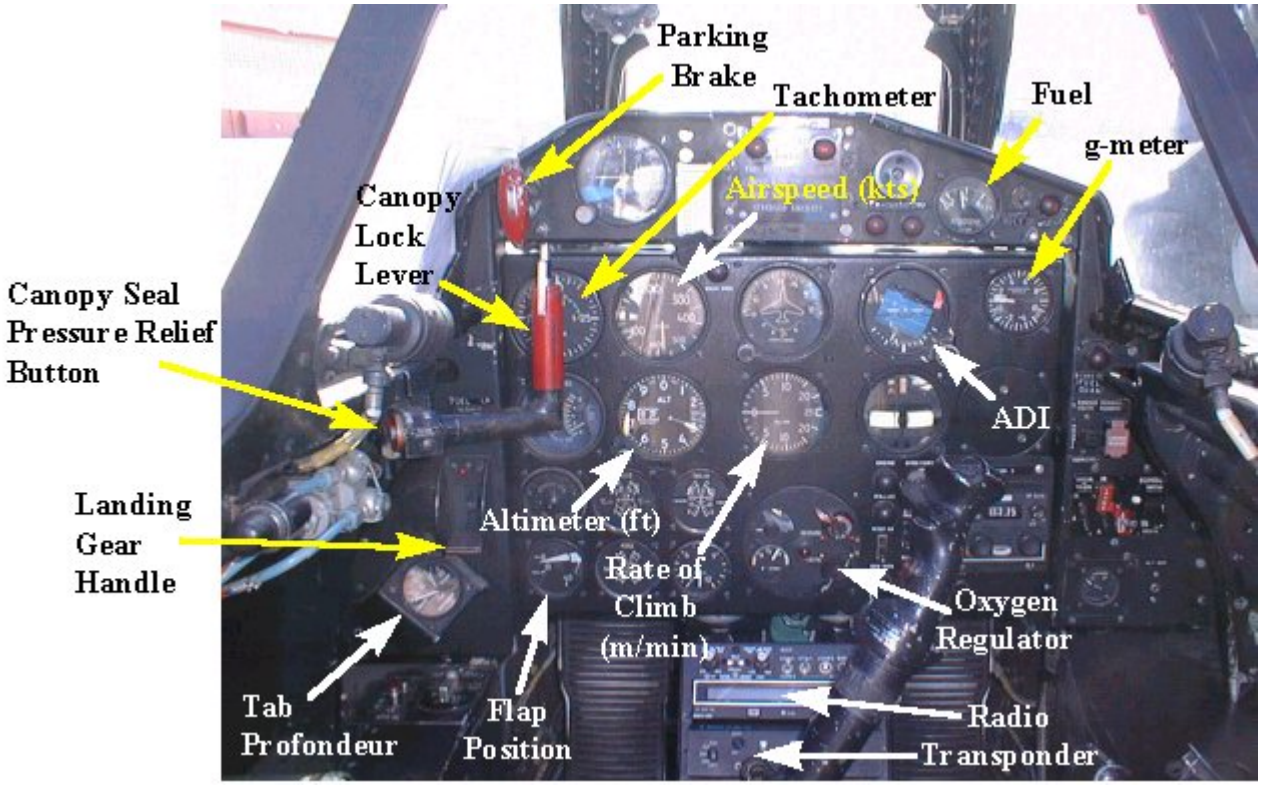
Fouga CM-170 Magister Pictorial Tour

Created by Maj Russ Erb

NOTE: This page has extensive large graphics, as the primary target audience is the students at the USAF Test Pilot School, who have a high-speed Internet connection to view them with. Anyone is welcome to look at this page--just be patient if you a viewing this over a modem...

The Fouga Magister (French for school house) was designed in France as a light two-seat twin-jet trainer for the French Air Force. Etablissements Fouga was a limited liability company formed by Breguet, Dassault, Morane-Saulnier, Sue-Est Aviation and Ouest-Aviation. This particular airplane was built under license in Finland.

Cockpit and Systems



As it was designed in France, built in Finland, and brought to the United States, this example of the Fouga Magister sports an interesting array of instruments, placards, and labels in French, Finnish, and English. This photo shows the front cockpit instrument panel.

The airspeed and altitude are in knots and feet, just like you're used to. Rate of Climb, however, is in meters/minute. Rough order of magnitude conversion: Multiply by 3. Hence 1000 m/min indicated would be about 3000 feet per minute.

The engine tachometer reads in actual rpm, not in percent rpm. Additionally, the instrument turns through 450° full scale. Be sure you know the proper settings for each phase of flight. For instance, take-off is done at 22,500 RPM, but climb power is reduced to 21,700 RPM.

Only one fuel gauge and one g-meter are installed in the Fouge, both here in the front cockpit. Both are easily visible from the rear seat by looking over the front seater's right shoulder.

A VHF radio (civilian bands) and a transponder are installed in the front cockpit between the pilot's legs. These can only be operated from the front seat, although the rear seater can transmit and receive radio calls.

The oxygen regulator has two basic positions--normal and emergency. A separate regulator is installed in the rear cockpit. An adapter tube is supplied with the aircraft to allow use of a standard Air Force helmet and oxygen mask. Similarly, an adapter cord is supplied for the

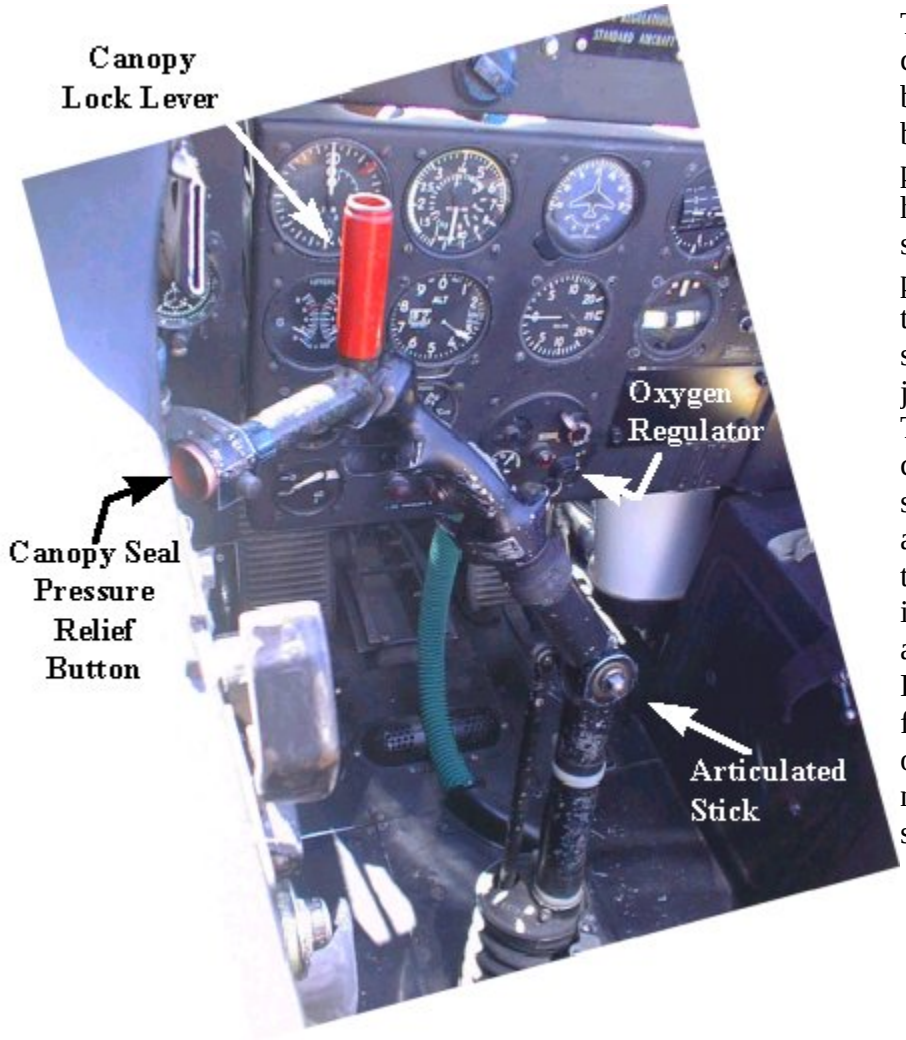
intercom connections. Bring your helmet, mask, and gloves from life support for this flight. You won't need your G-suit, and there's no place to plug it in anyway.

The canopy lock lever is pushed forward after lowering the canopy. The canopy seal is automatically pressurized when the canopy is closed under normal conditions. If it becomes necessary to deflate the canopy seal, press the Canopy Seal Pressure Relief Button on the canopy locking lever.

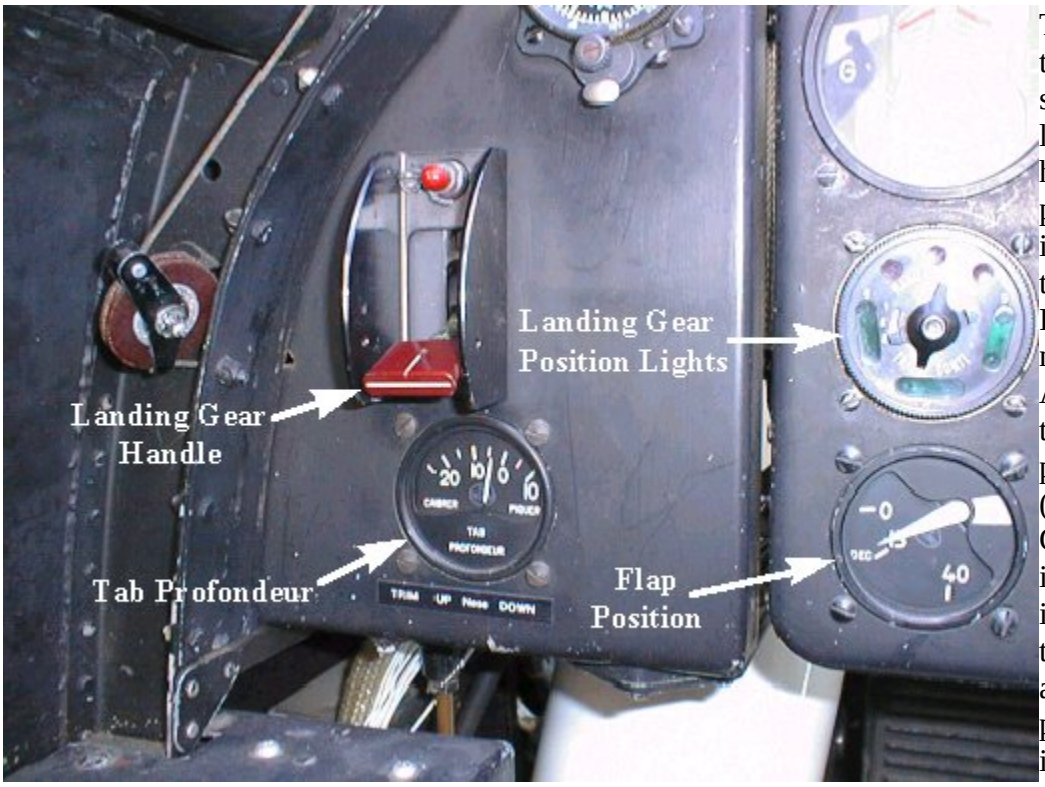
The landing gear lever does not have a standard U.S. wheel to identify it, but otherwise works the same. Move up to raise the gear, move down to lower the gear. The rear cockpit landing gear lever is mechanically connected and will move with it.

Two position indicators are worthy of note. The flap position indicator shows the current position of the flaps. The flaps do not automatically move to pre-defined positions, but are commanded up or down by the pilot. When the flaps reach the desired position, the switch is released.

The second position indicator is the ever-popular "Tab Profondeur," which, for those of you who don't read French, is the elevator trim tab position. Elevator trim is controlled by a two-position center-off switch on the control stick, functioning in the same sense as the traditional coolie-hat.



This photo shows the rear cockpit, which is quite a bit like the front cockpit, but totally different. The primary thing to notice here is the articulated stick. The fore-and-aft pivot (i.e. elevator) is at the floor, but the side-to-side pivot (i.e. aileron) is just above your knees. The stick in the front cockpit is jointed similarly. This arrangement addresses the problem of thighs interfering with full aileron deflection. Evaluate during your flight if you find it objectionable, if you never notice it, or somewhere in between.



This photo of the rear cockpit shows the landing gear handle, the flap position indicator, and the "Tab Profondeur" more clearly. Also shown are the landing gear position lights ("Three Green"). An identical display is installed in the front cockpit above the flap position indicator.

Unlike many U.S. two seat fighters/trainers, the rear seat is not raised to allow the back seater to see over the front seater. In fact, looking straight ahead would give a great view of the front seater's helmet. Great, that is, if it wasn't for this periscope in the way. The periscope is designed to be used from the normal seated position (Don't be leaning up to it playing "Hunt for Red October"). The resulting view looks something like a hole in your front seaters head that you can see the taxi line through. The periscope is useful in ground maneuvering (taxi, initial takeoff) and for seeing the runway

on final approach. Up and away, it's just full of blue sky. Back seaters--evaluate if this is a bonus or just an annoyance. You may find you see a clearer picture if you lean slightly one way or the other, depending on which eye you favor.

Another view of the periscope. As you may guess, it's not very useful until the front canopy is lowered.

Both canopies are held open by struts with over-center actions and springs. The right side strut has a locking tube (seen here in red) which must be lifted up to release the canopy strut. Hold on to the canopy before you release it lest it FALL into place. Canopy opening and closing is all manual. The canopy is lowered down and then locked into place with dogs controlled by the canopy lock lever.

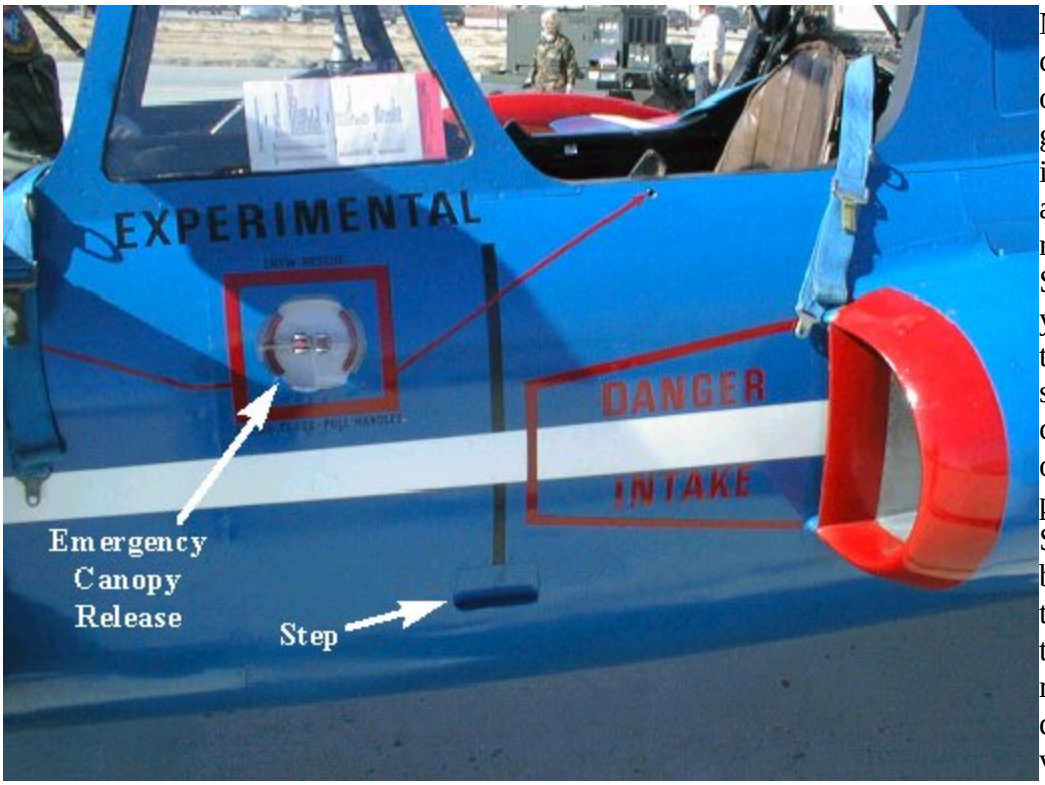
The Fouga is not equipped with ejection seats. Then again, neither was the P-51 or any other World War II fighter, which were in about the same speed and altitude class. Each aircrew wears a backpack style parachute (provided with the aircraft). For semi-automatic operation, the D-ring is attached to the airplane with a static line. If it became necessary to leave the aircraft in anger, release the canopy by pulling the canopy locking lever and the canopy should open and blow away (push it a little if necessary). Then get up and dive over the side (your IP will brief you on the best way to do this). When you get to the end of the static line, it will pull your D-ring, deploying the parachute.

CAUTION

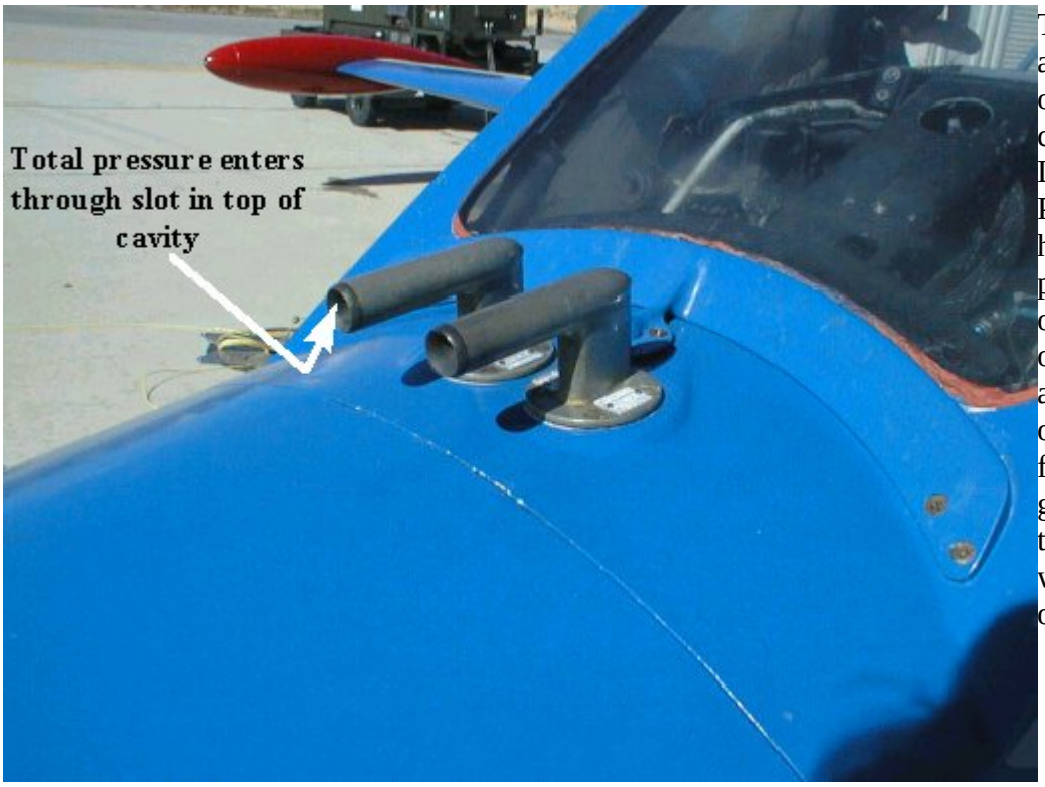
You will lose massive cool points if, at the end of your flight, safely back in your parking spot, you get out of the jet without first disconnecting the static line. Pulling out part of the static line is bad. Getting far enough to deploy the parachute is...well, you don't want to think about it.

Part of the success criteria for a good mission is never finding out how long that static line is.

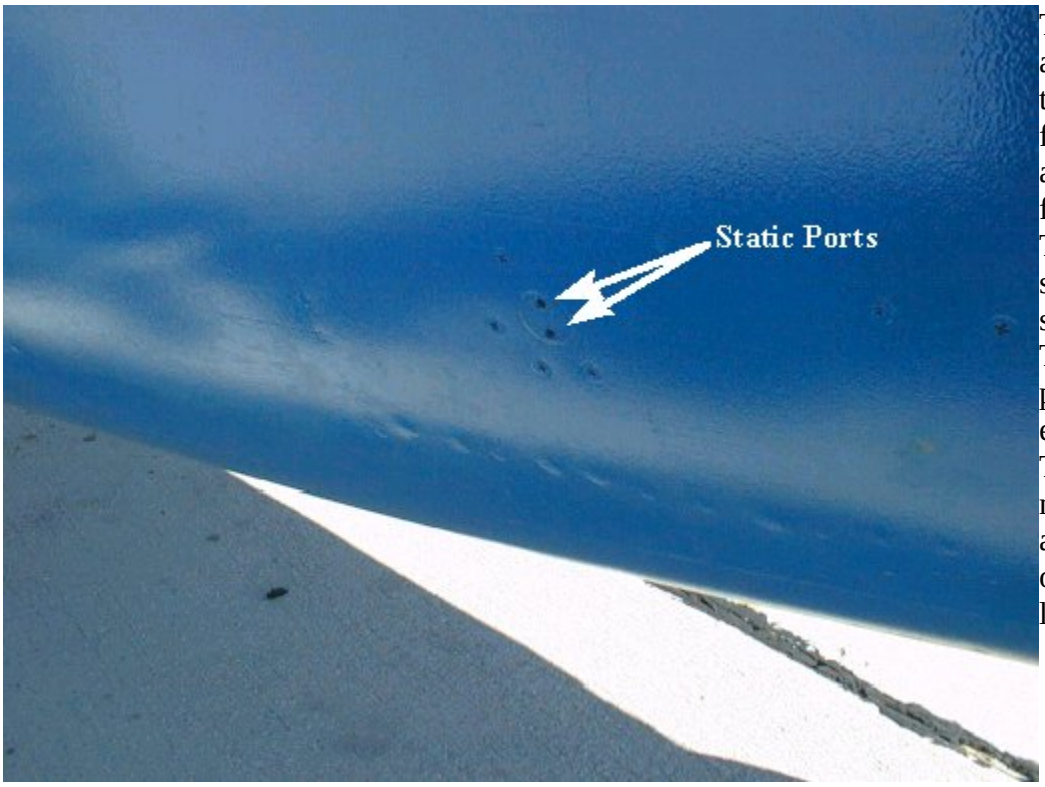
Also shown here behind the rear seat is the rear pressure bulkhead. While some Fougas make it appear that you can see through the rear canopy, you can't--this bulkhead is in the way. The aft glass just allows the radio antennas to see the world. Here the aft canopy is painted over. The radios haven't complained yet.



Now that we've covered getting out, we'll cover getting in. Entry is very simple, and doesn't even require a ladder. Simply stick your left boot toe into the step shown here and climb in. To get out, reverse the procedure. Since you won't be able to see the step from the cockpit, just run your left toe down the vertical black line and you'll eventually get to the step.

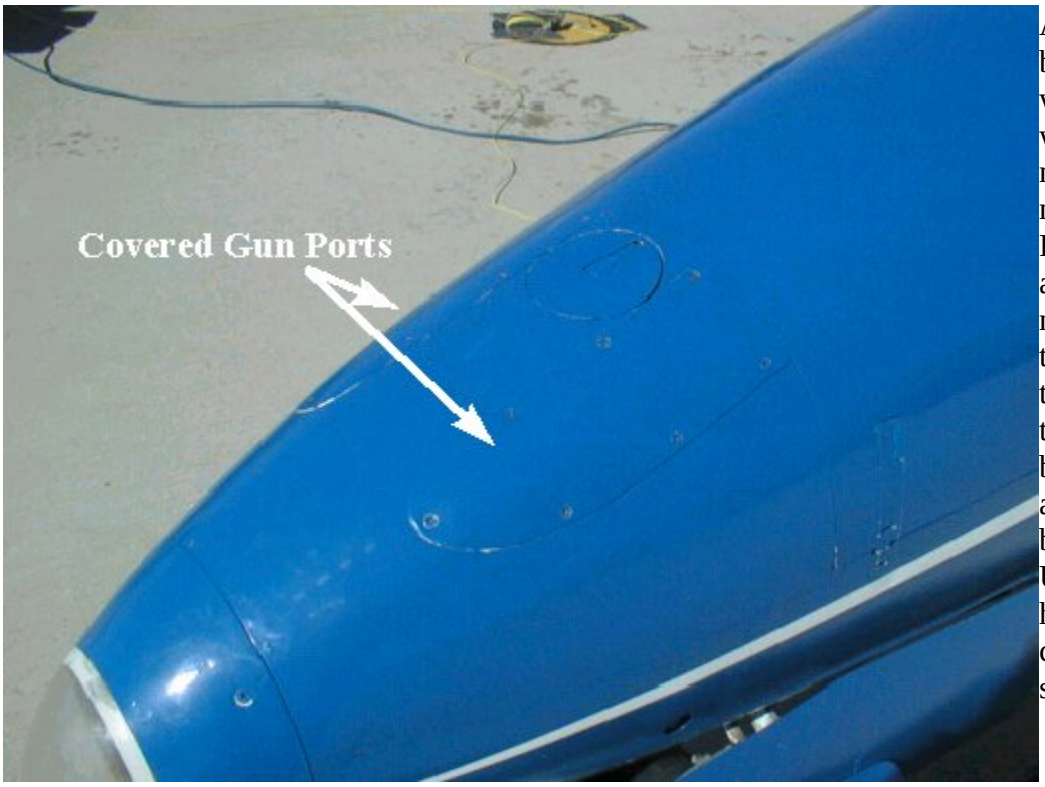


Twin Pitot tubes are installed, one for each cockpit. Looking into the Pitot Tube, the hole for the total pressure is not obvious. The only opening is a slit in the top of the forward facing cone. I'm guessing this is to help keep water or ice out of the system.



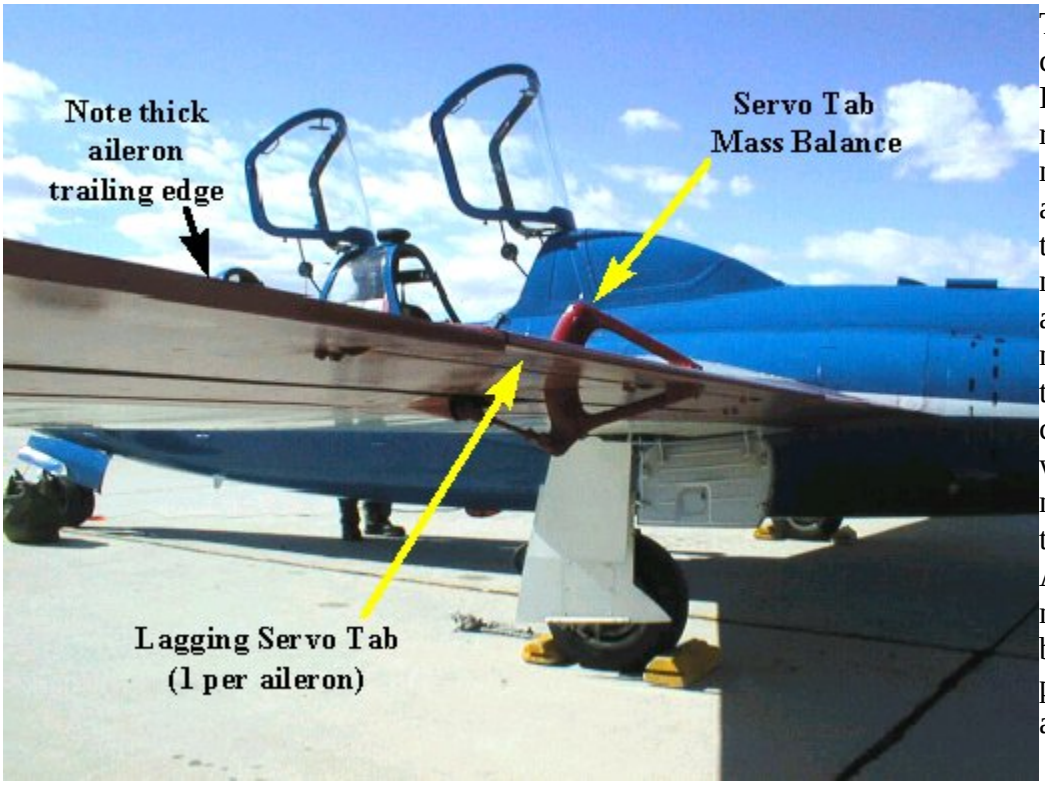
The static ports are located on the lower fuselage just ahead of the front cockpit. This photo shows the right side static ports. There are two ports, one for each cockpit. These ports are manifolded with an identical set of ports on the left side.

The Fouga cockpit is pressurized, but if it becomes necessary in an emergency to vent the cockpit, such as to eliminate smoke and fumes, a vent can be opened on the right side of each cockpit. Normally this will be left closed for the entire flight.



As originally built, the Fouga was equipped with two 7.5 mm (30 caliber) machine guns. For reasons that at this point must seem all too obvious, these guns had to be removed before the aircraft was brought to the U.S. The ports have been covered, as shown here.

Flight Controls



The flight controls of the Fouga are fully reversible, meaning they are connected to the stick mechanically, and any movement of the flight control surface will result in a movement of the pilot's stick. As such, certain measures must be taken to prevent flutter and reduce

control forces at high speeds. The blunt trailing edge of the aileron increases its resistance to flutter by creating a sharp, defined point for the flow to separate at. This type of trailing edge will also increase the stick force necessary to deflect the aileron. Because of this effect, and the higher dynamic pressures of high speed flight, steps must be taken to reduce the stick force back down to a tolerable level. Both ailerons are fitted with lagging servo tabs, which are connected to move opposite to the aileron. That is, when the aileron deflects up, the tab deflects down, reducing the hinge moment in the same way that a trim tab reduces the hinge moment. Likewise, if the aileron deflects down, the tab deflects up.

A large mass balance for the servo tab can be seen here. This circular arc of weight moves through the aileron as the tab moves. Mass balancing the tab improves its flutter resistance.

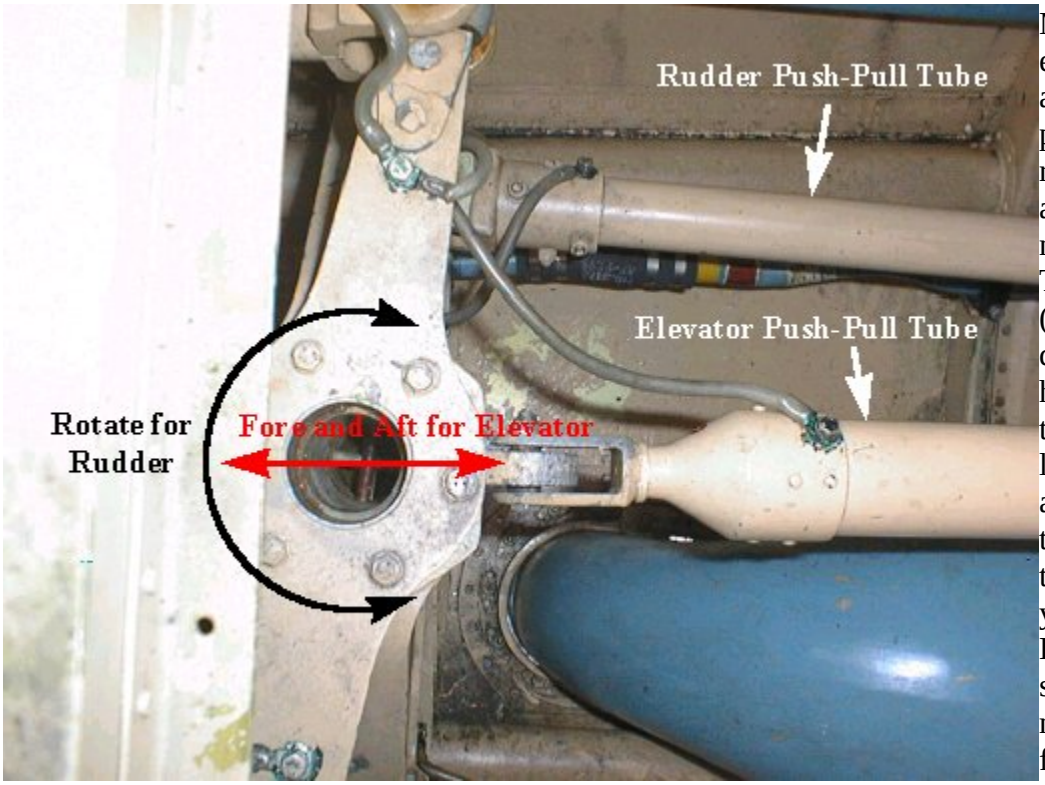
Each wing has two flaps. These flaps are electrically controlled and hydraulically activated.

A significant difference between the Fouga and most U.S. aircraft is the V-tail. The Flight Manual refers to it at the "Butterfly Tail." The ruddervators (control surfaces) move up and down together for longitudinal control. Directional control is achieved by moving the ruddervators in opposite directions. For instance, left ruddervator up and right ruddervator down give the same effect as right rudder on other aircraft.

Sections of the ruddervator trailing edges are thickened for flutter resistance. Each ruddervator has a trim tab, which are controlled by a switch on each control stick. Mass balances can also be seen,

which improve flutter resistance as well.

An Anti-Over-Rotation Device (aka "tailwheel") is supplied in case you get a little too agressive on that initial pull for take-off. You should not exceed 5° of pitch during take-off rotation. You'll know you're off to a good start if this wheel never touches the ground.



Mixing of the elevator stick and rudder pedals into the ruddervators is accomplished mechanically. This mixer (shown looking down into a hole on top of the fuselage) is located just ahead of the tail. Ask your IP to show it to you. Longitudinal stick inputs move this mixer fore and aft. Pedal inputs rotate the mixer. These movements are transferred to the ruddervators by push-pull tubes.

During your flight, evaluate if you can tell any difference between flying with a V-tail versus a conventional tail.

Like many jets, the Fouga is slippery enough that it needs some help to slow down. These speed brakes, shown here in the fully open position, are electically controlled and hydraulically activated. They do not have any set positions. You just look out the canopy, push the switch, and release it when they get to where you want them. They'll stay there until you move them again.

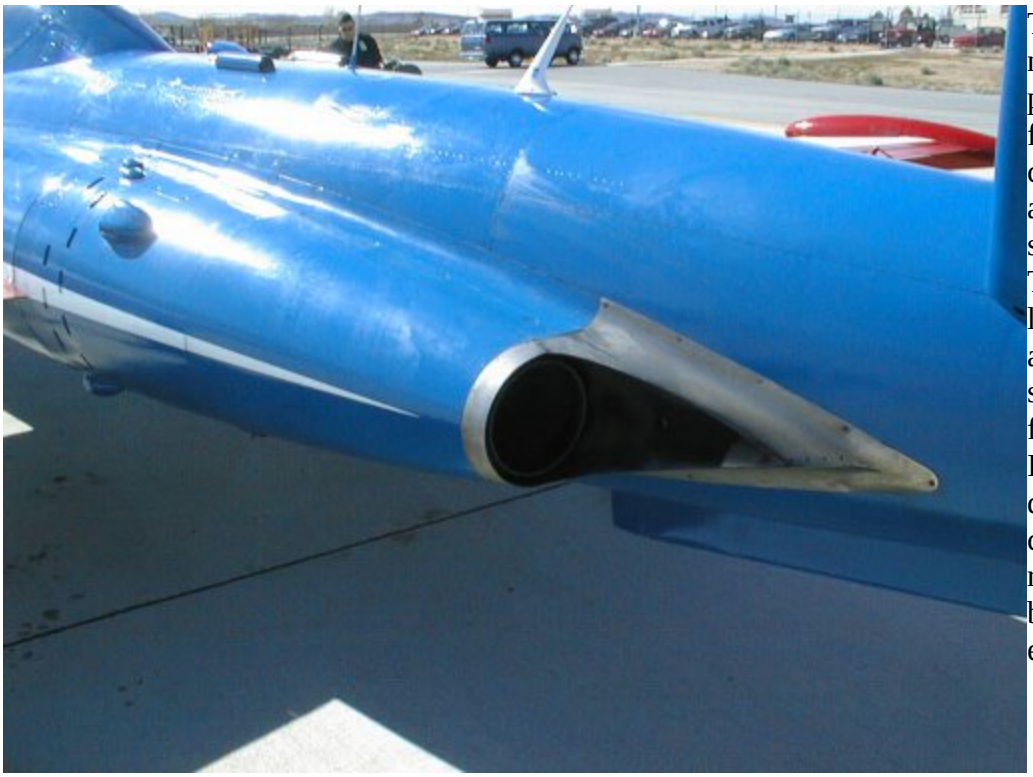
Just like the T-37 has thrust attenuators, the Fouga uses the speed brakes to compensate for the slow spool-up of its centrifugal flow engines. The approach is normally flown with the speed brakes deployed halfway (shown here) and the throttles at a higher power setting. This procedure allows responsive glide path control by modulating the speed brakes instead of the throttles. If a go-around is required, the speed brakes are retracted and the throttles advanced. Engine response is improved since the engines are already at a higher thrust setting.

Propulsion

The Fouga is powered by two Turbomeca Marboré II turbojet engines of 880 pounds static thrust each. The inlet, just below the rear cockpit, includes a boundary layer splitter plate.

You're probably more familiar

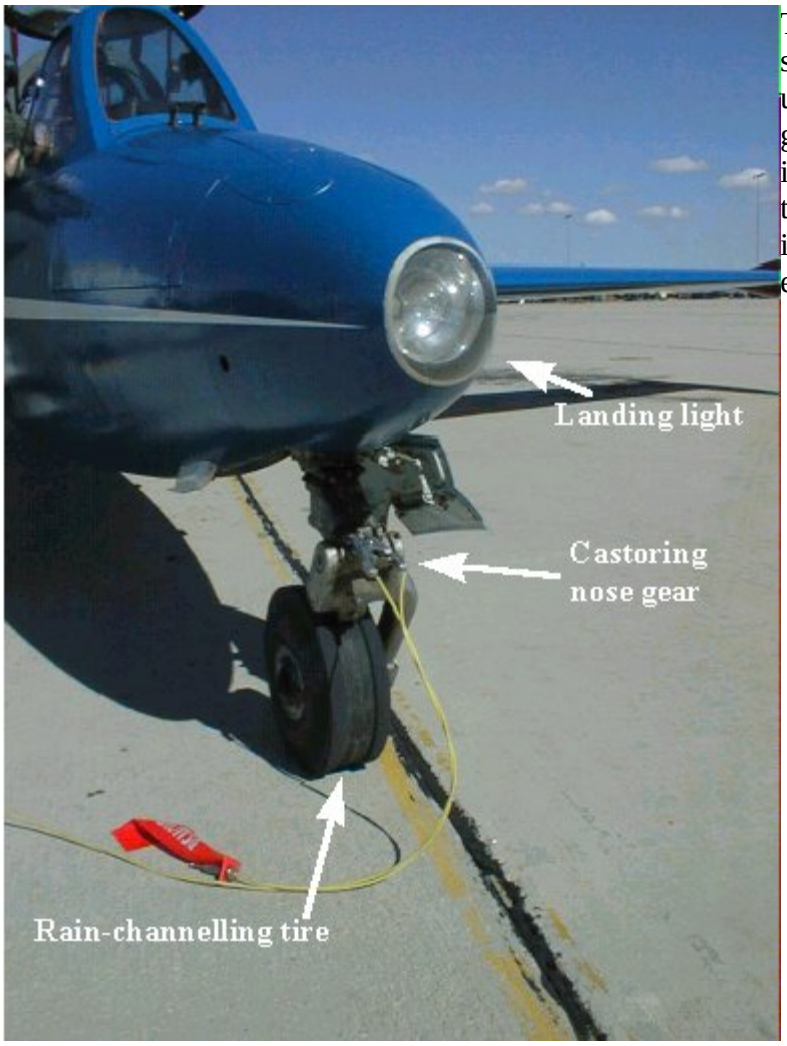
with these engines than you might think. The Turbomeca Marboré II engine was licensed by Continental and built (with a few modifications) as the J-69, installed in all of those T-37 trainers used for eons at USAF Undergraduate Pilot Training. You'll probably recognize some of the same types of throttle response. You'll definitely recognize that high-pitched "tweet."



The engines are not installed parallel to the fuselage centerline, but actually thrust slightly outward. This results in less thrust asymmetry in single engine flight. Investigate any directional control changes required when bringing one engine to idle.

192 gallons (total) of fuel is carried in two fuselage tanks. An additional 32 gallons is carried in each tip tank. Fuel in the tip tanks is burned first, and does not register on the fuel gauge. Indicator lights show when the tip tanks are empty. The tip tanks must be empty before spins are attempted. Each tip tank is equipped with a fuel dump valve to ensure that the tanks are empty.

Landing Gear



The nose gear is castored and not steerable. Differential braking is used for directional control on the ground. The unusual tire shape is intended to to channel any water on the runway through the middle instead of throwing it up into the engine inlets.

The main landing gear retracts inward into the wing.

Your Host

Paul Grieshaber, your friendly Fouga host and instructor pilot.

EAA Chapter 1000 Home Page

E-Mail: *mailto:erbman@pobox.com*

URL: http://www.eaa1000.av.org/pix/fouga/fouga.htm

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