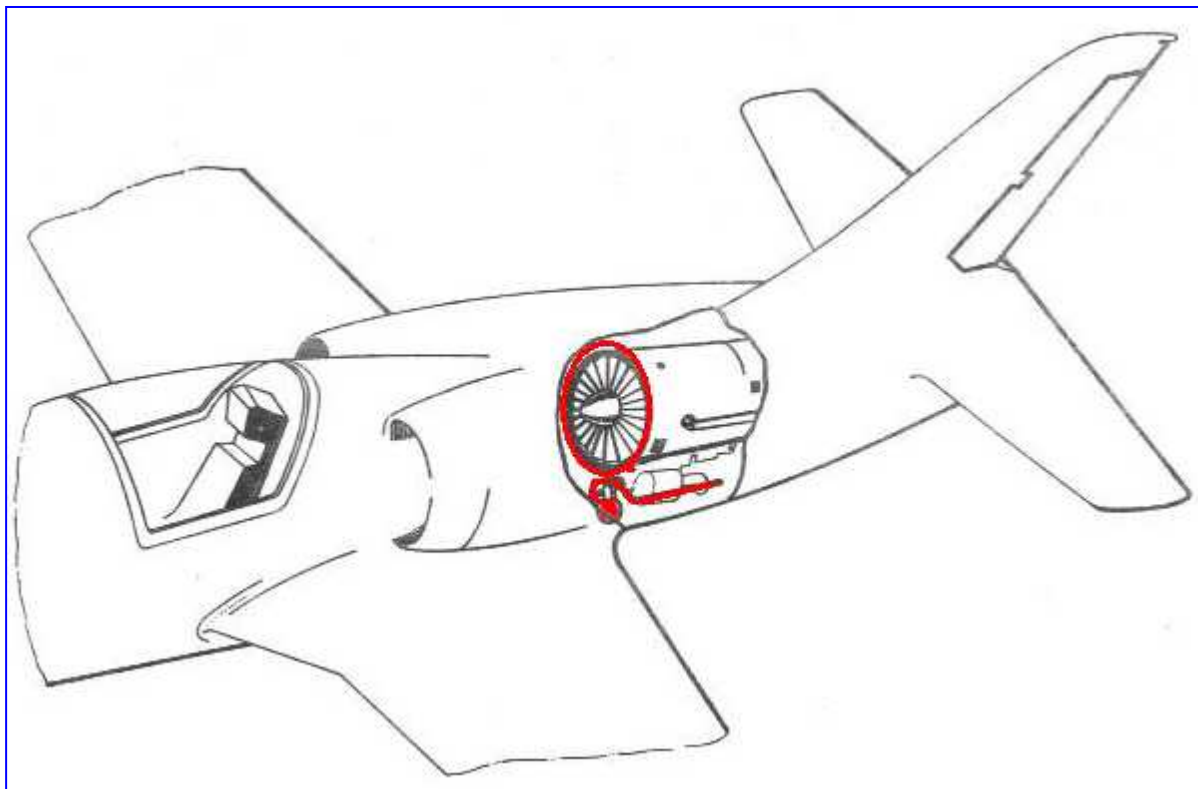




The fire extinguisher installation of the L-39

Some theoretical aspects why to use the OEM equipment as it was designed by Aero Vodochody and some concerns about changing the OEM fire extinguisher equipment against other products.

1) General layout



Installation in the aircraft

The fire extinguishing system of the L-39 consists of the fire detecting system SSP-FK and the fire extinguisher OS-2 (L-29.8121-8 or 72.6600-20).

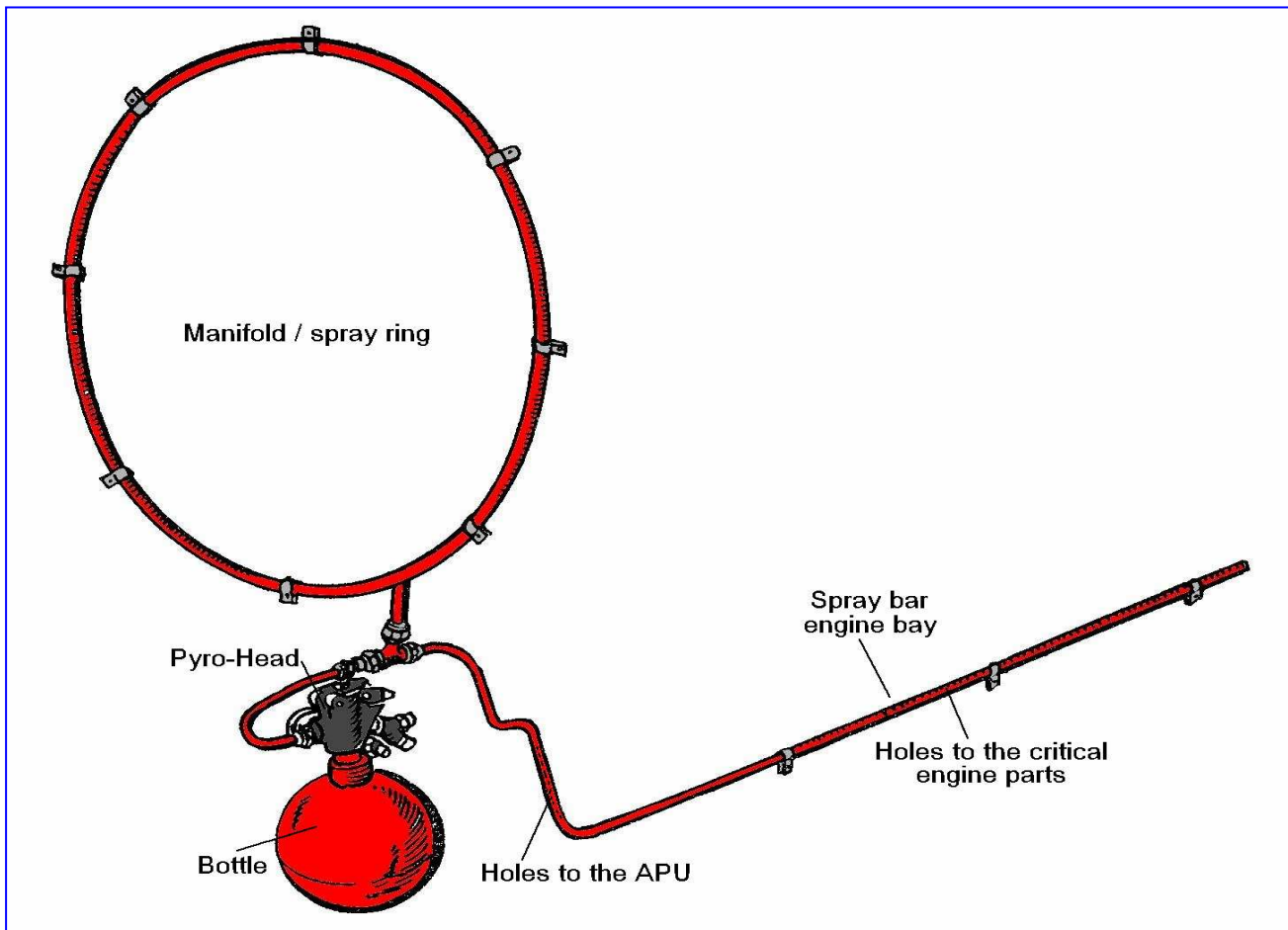
The detecting system consists of the electronic box BI-2I, with 6 sensors in two loops with 3 sensors each. The electronic box is placed in the RAT well above the retracted RAT and the sensors are located in the engine bay.

The fire extinguisher bottle is located in the lower part of the room between bulkhead 29 and 32 (in front of the fire wall), the extinguishing medium is led by a pipe through the fire wall and then distributed in a manifold around the engine's air intake, mounted direct on the fire wall (Blkhd32) and a spray bar underneath the engine.

The efficiency of the complete fire extinguishing system of the L39 was verified during the development tests in 1971. A real fire was set inside the engine bay with the engine installed. The center of the fire was supplied with a stream of fuel in the quantity equal to maximum engine fuel consumption. The initial time of burning the injected fuel



was 22 seconds. After that the fire was extinguished by the onboard fire extinguishing system. The measured temperature in the engine bay reached 800°C. The fire didn't move forward into the bulkhead 29-32 area.



The layout of the spray assembling has been made in that kind, that with the number of little bores which are intentionally located in special areas of the spray system in direction to the critical items in the engine bay, a high efficiency is reached. The number of bores in the spray assembly allows a certain extinguishing medium “flow”, over a defined period, to extinguish a fire. For this reason the DTBG fire sensors have been also located in the engine bay in areas where fire may occur.

The fire bottle has been placed in the RAT well for good reason. It should stay away from the engine itself, its vibration and mainly away from the temperature of the engine to keep the pressure at a constant level and to avoid that the pressure inside the bottle increases under the influence of the additional temperature of the engine or other equipment.

The amount the extinguishing medium inside the bottle is calculated in accordance with the volume of the engine compartment **and** the volume of the RAT well!



2) Airframe matters

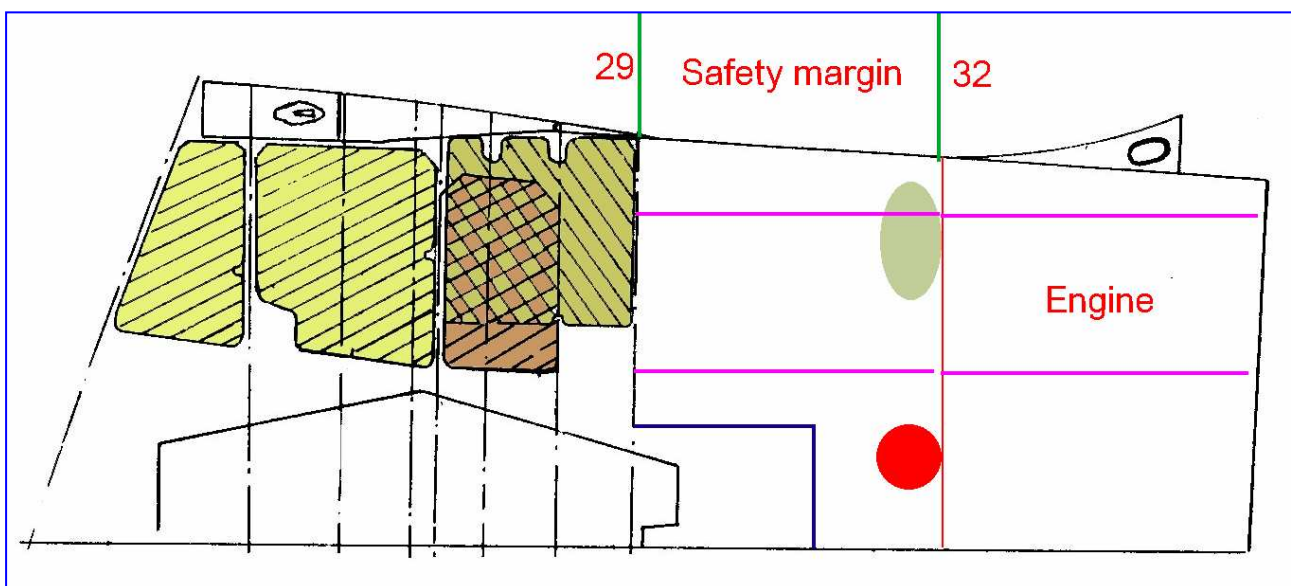
The installation of the fire extinguisher system has been made intentionally in the way as it can be found in L-39.

The fire wall (bulkhead 32) is made from aluminium and coated with a heat resistant paint and protects the forward section of the airplane up to 500 °C.

The forward facing part of the fire wall is protected and cooled by the two NACA inlets that allow the outside air flow to go into the airframe section between bulkheads No. 29-32 and this air cools the whole area including the hydraulic tank. On ground the cooling air flow is supported by ejection effect of the engine nozzle during engine run.

On the bulkhead No. 32, around the engine inlet channel is a blast hole located, which allows the cooling air entry from the section 29-32 to the engine bay and prevents the possible flame spread forward from the engine bay. The cooling air stream in the engine bay leads the fire backward, away from the bulkhead No. 32.

The space between bulkhead 29 (rear part of the fuel tank installation) and bulkhead 32 is also known as "RAT well", and is your safety margin between the engine and the fuel cells.





So any installation of auxiliary fuel tanks or smoke oil tanks, in the size/volume exceeding the former radio equipment installed in this section:

A) Disturbs the cooling air flow and reduces the amount of air going through the blast hole around the engine inlet.

B) Your safety margin (fire protection between engine compartment and fuel tanks) is almost ZERO!

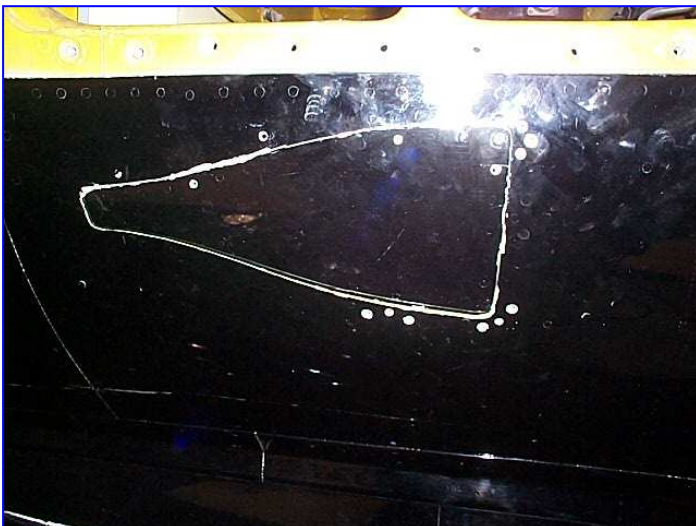
C) In case of a fire propagation forward of the bulkhead No. 32, the overheating of the extinguishing bottle evokes an increase of the extinguishing medium pressure. When the bottle temperature is above approx. 160°C, the safety valve is initiated and the extinguishing medium is spread into the area between bulkheads No. 29-32. The extinguishing medium expansion causes the absorbing or extinguishing of the fire.

This is also calculated for the volume of the section between bulkheads No. 29-32 and the amount of hydraulic fluid in the reservoir.

It is not calculated for any additional **Fuel** or **Smoke Oil!**

D) Closing your NACA inlets, to make the airplane more aerodynamically, is also a bad idea. The cooling air is missing at all and beside of the fire problem, you will burn your hydraulic pump, due to the increasing temperature of the hydraulic fluid in the tank. At a temperature $> 85^{\circ}\text{C}$, your pump will start with cavitations on the suction side.

We have seen it, even in the cold of Alaska!

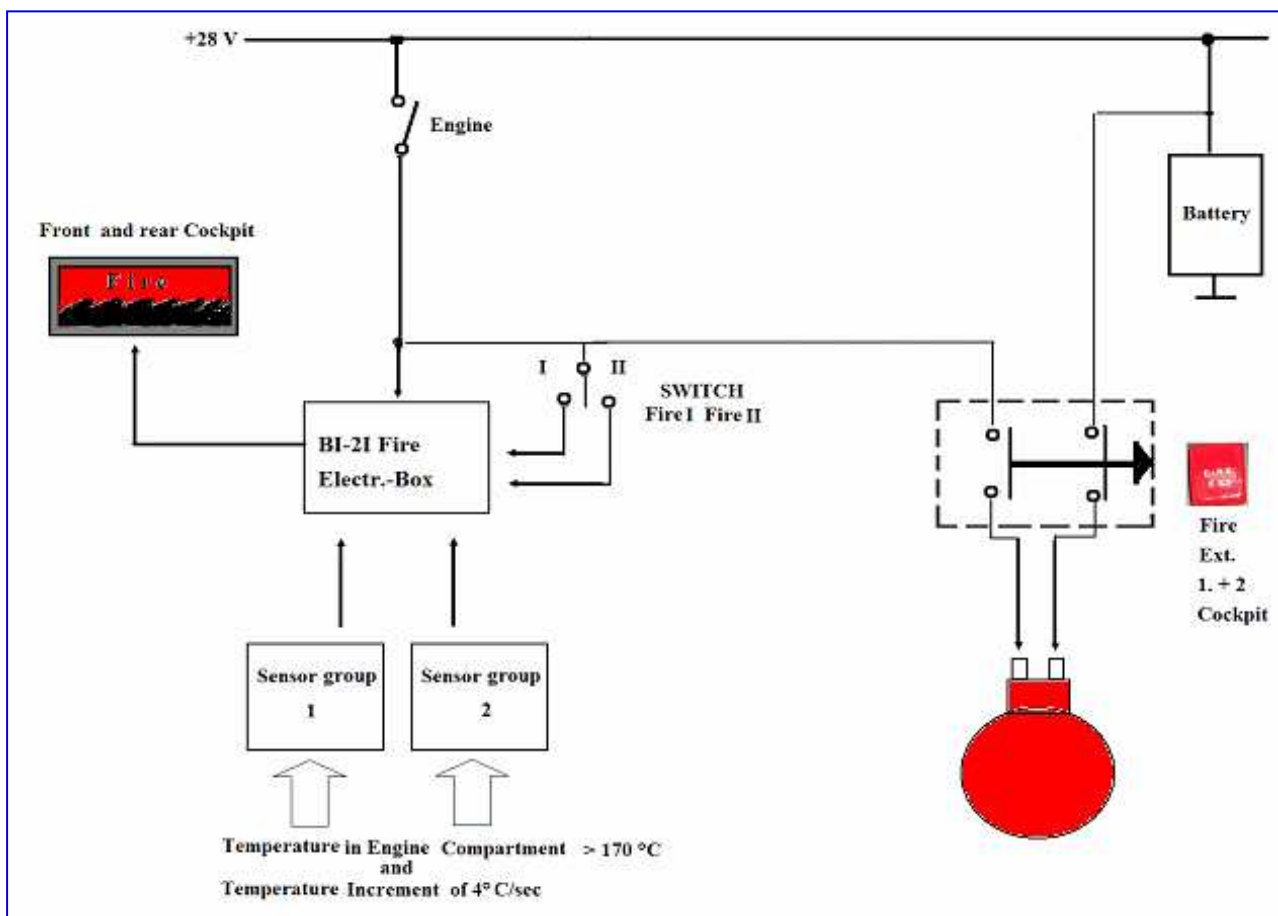




The Bulkhead # 32 “Fire wall”

The bulkhead has undergone several modifications during the time of the L-39 production. The main goal was to make it solid but also to keep it flexible, to avoid cracks in the bulkhead. Any modification by drilling additional holes in the bulkhead makes it weak, or attaching other equipment (let's say another fire bottle!) direct on the bulkhead, leads to a stiffening effect in this particular area and over the time may lead to cracks in the bulkhead.

3) The fire detecting system of the L-39



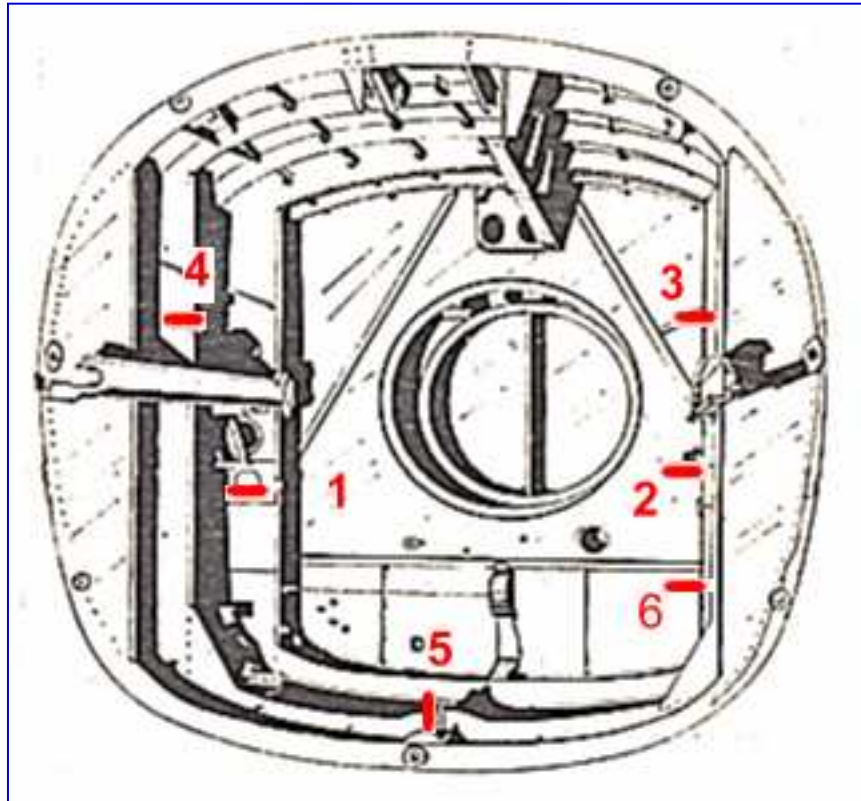
The detecting system mainly consists of the BI-2I electronic box in the RAT well, the two groups of sensors (3 each) and the fire extinguisher bottle.

The system can be activated by two push buttons in the front and rear cockpit. The electrical power supply is provided in two ways, from the electrical board network (main) and direct from the battery (back up). Both are simultaneously activated for safety reasons.

Note: The fire test switch Fire I and Fire II conducts only the test of the sensor groups to ensure that all sensors are in a closed loop and are not interrupted.



The activation threshold of the electronic box (Temperature of 170°C in the engine compartment with a temperature increment of 4°C per sec) can only be tested with a special tester.



The sensors are located on the most dangerous places in the engine compartment!

- | | |
|----------------|--------------------|
| 1) APU | 4) L/H Igniter |
| 2) Generator | 5) Waste can/FCU |
| 3) R/H Igniter | 6) Air-Starter/FCU |

Attention: The last 3 engine fires (hereof one in flight/in France) have not been recognized by the pilot due to the inop fire detecting system.

So what's the condition of your sensors and the BI-2I box?

4) Summary

1) Only the originally installed fire extinguishing system of the L-39, without any modification, allows the safe killing of a fire.

2) The spray system is designed to deliver the extinguishing medium into the whole engine bay and especially to extremely dangerous places. This is carried out by the manifold/spray bar bores and supported by the air stream coming from the area between bulkheads No. 29-32.



3) A modification like installing another bottle on a “free place” on bulkhead 32 and spraying the medium just somewhere into the engine compartment **is not an option!**

This does not allow the extinguishing function of the fire bottle for the space between bulkheads 29-32!

4) Fire extinguisher bottles, fresh tested, with calibrated gauges, charged with the more environment-friendly Halon 1301 or Halon 2402 medium are readily available and far below the cost of a modification.

5) According to the Mfr’s Life Limited Item List, the OEM fire extinguisher bottles are good for 10 Years TBO, if filled with Halon 1301 or Halon 2401. This might be reduced to 5 years, if welded bottles are delivered for overhaul or the thickness of the vessel wall during the inspection is found to be below a certain limit.

6) Halon 1301 or Halon 2402 has been certified for military and civil use, including the LET 410 turboprop aircraft.

The main goal was to replace the Russian “Mixture -7-“ and the Freon 114V2 with a more environment-friendly medium.

Please do not hesitate to ask us for more details or even for a fresh overhauled and re-charged fire bottle! Also ask us about “**How to ship a bottle as dangerous goods?**“.

So what’s the current situation?

It’s assumed that some of the bottles are far over their life time limit but show still some pressure. If the gauge shows something around 90 - 110 kp/cm², it looks okay, depending on the temperature and on the first glance.....





But some gauges may show something different:



Just 50 kP/cm² (Freon 114 V2)



Impressive 190 kP/cm² (Mixture 7)

(Both bottles found installed in US airplanes.)

The system limits are given below:

Fire extinguisher system:

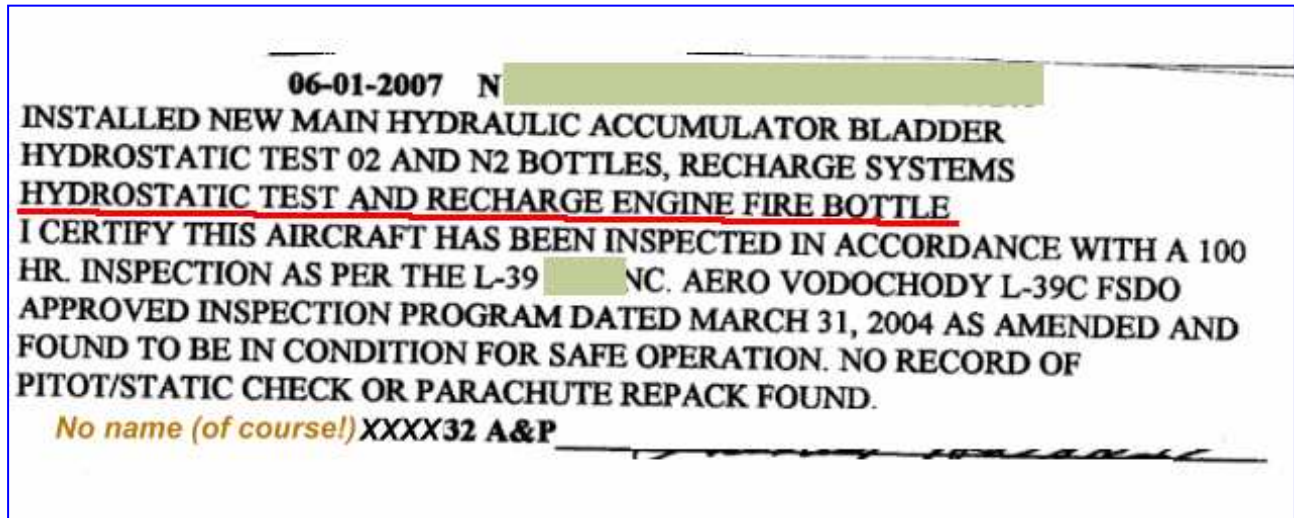
Fire bottle	L-29.8121-8 or 72-6600-20
Pyro head	20 s 2 M.1S
Cartridge	PP-3 (2x)
Medium	2 Liter Freon 114 V2 (old) or Mixture 7 (1,8 kg) (old)
Max. Pressure	150 Kp/cm ²
Test pressure	225 kP/cm ²
Safety Valve	<u>200 +/-20 kP/cm²!!!</u>
Min. Voltage	12-14 V

A bottle showing 190 Kp/cm² on its gauge (like above on the right) may discharge (explode) at any given moment (without asking you).

Please see below what causes a pressure drop or increase



Another point of concern is, if you find a log book entry like this:



This should raise the questions: How did they do that? What technology has been used?

The solution for L-39 and L-29/MiG-21 operators

We now have about 44 fire extinguishers that are undergoing the overhaul and recharging process step by step.





Fire bottles are delivered to the certified and especially equipped shop for incoming inspection of fire extinguishers and their passports.



Next, the bottles will be discharged, that means the old extinguishing medium is to be sucked out of the bottles, will be cleaned and recycled.
For the old "Mixture 7" or FREON 114 V2 no further use is possible.
The big machine below does this job:



The bottle will be dismantled (pyro head and manometer removed) and a boroscope inspection of the vessel is performed.

If the boroscope inspection was satisfying, the bottle undergoes the hydro-static test and all fire bottle accessories will undergo their individual overhaul.

However, sometimes the inner life of a fire bottle looks not too impressive!



If the gauge shows too low or even "Zero" pressure **OR** **it shows far too much pressure, ...**





The bottle may look inside like this:



This is the influence of the old extinguishing medium on the bottle's steel wall over the years. If bottles are evacuated incompletely during the last overhaul or refilled with incorrect technology, where air can get into the bottle, a chemical reaction will start. It's just a matter of time until something goes really wrong.

The rusty fire bottle above didn't have a chance for a 2nd or 3rd life....

If everything goes well with the fire extinguisher, the bottle will be reassembled, fresh painted and finally refilled with the new extinguishing medium by the same Equipment/Machine as shown above. The refilling process takes place on a scale to ensure that the right amount is filled into the bottle. During refilling, the bottle is frequently and automatically tilted on the scale. The table with the scale can be seen on the left side of the picture. After some rest a final weighing process takes place and finally the paper work (Passports and Form-1) are issued for the overhaul process.

With our stock of fresh overhauled bottles we can ensure a very short turn around time for your fire bottles in exchange. Please ask for details!

info@aero-contact.com



The fire extinguisher is just one part of the whole system installed in your airplane. The other part is the fire detecting and warning system!

L-39 Fire Detecting System SSP-FK (2 I)

- Tests are normally performed after every 2 years or 200 hrs.
- Operating the FIRE test switch in the cockpit tells you only that both channels are electrically working.

FAQ: Why should I do that?

- The test from the cockpit tells you nothing about the correct setting of the activation threshold for each channel of the box (That's when your "Fire" light comes really ON).
- The test ensures also that your detecting system resets correctly after a fire was extinguished.
- Can I do the test of the DTBG sensors with a heat gun? ...Not really!
- The sensor also has an "activation point" which will be tested under imitated condition by the tester.

BI-2I box testing



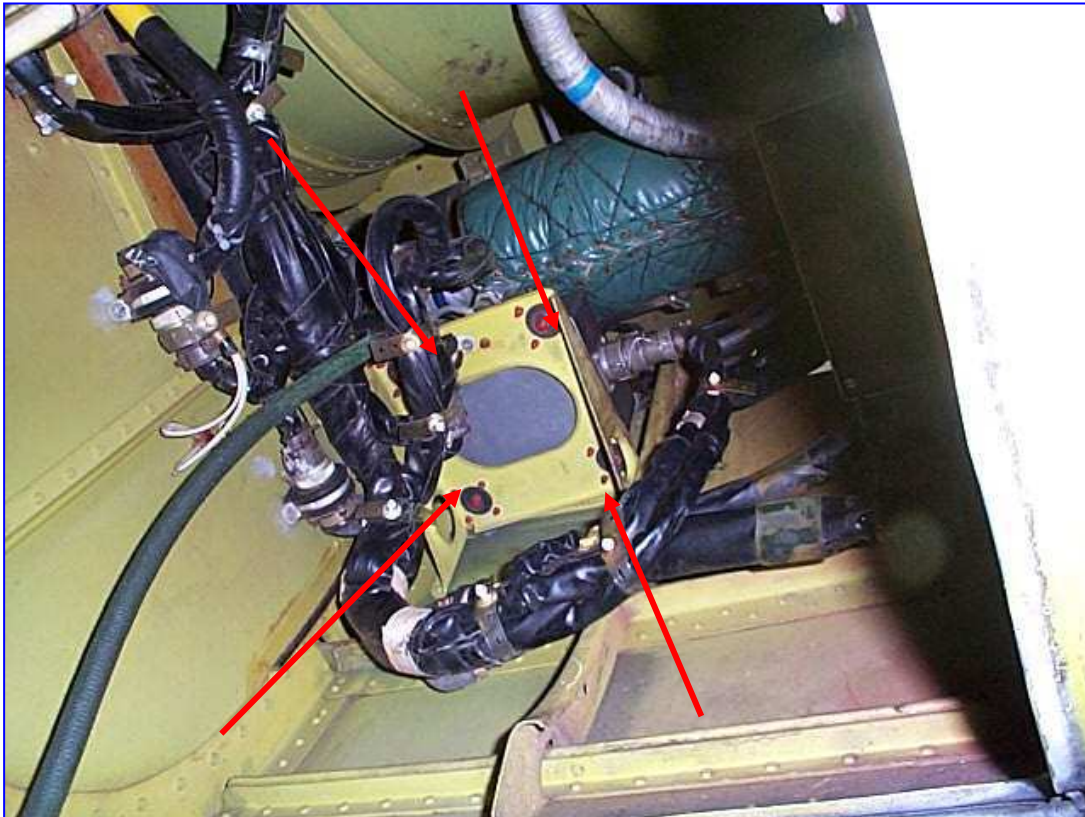
Sensor testing

(Of course a test protocol will be issued for the box and the six sensors.)



Please note that a correct installation of the BI-2I electronic box in the RAT well is necessary. The box must be mounted on 4 perfectly working shock mounts. The shock mounts absorb the touch down shock during landing. Any hard touch down with insufficient shock mounts is like poison for the polarized relays inside!

From the distance it may look OK.....



---but you need to push the box up to see the real condition of the rubber mounts. They may look like this:





We have also found some very special things like BI-2I boxes strapped to the console with tie-wraps or lock wire, or even “hard mounted” with steel washers.



This is not aviation standard !

New ones look like this:



Please ask for details and fly safe!

info@aero-contact.com