

Fire detection and precautions for CFM56-7B engine

Yuan Zhongda, Liu Mingguang

School of Aircraft Maintenance Engineering, Guangzhou Civil Aviation College,
Guangzhou 510403, China

yuanzhongda@caac.net

Abstract. For civil aviation engines, the fire detection system is particularly important, and it is related to the safety of life and property of many passengers. However, because of the line and other hardware reasons, the fire detection system often has faults. This article analyzed the fire detection and troubleshooting of the CFM56-7B engine in detail. Several common failures of the fire detection system are listed, which are of great significance for the quick troubleshooting of aircraft maintenance personnel.

1. Introduction

On CFM56 engine, the engine's overheating and fire was monitored by sensors [1]. There are warning lights on the shading board and P8 board, and there are sound warnings in the cockpit, as shown in figure 1.

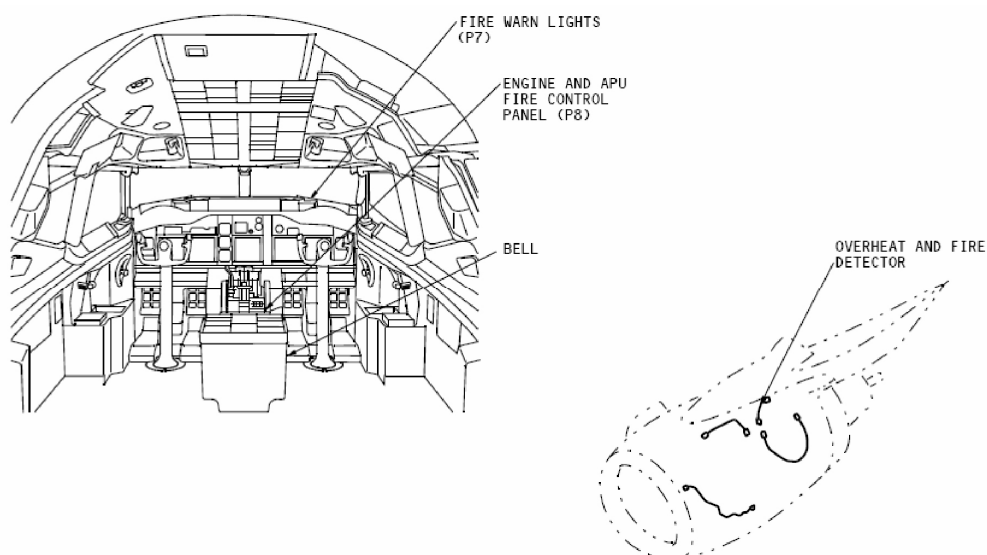


Figure 1. Engine fire detection.

There are 8 sensors on each engine, which are divided into A and B circuits, which monitor the upper part of fan casing, the bottom of fan casing, the left side of core machine, and the overtemperature on the right side of core machine.



The sensor consists of the following components [2]: overheating, fire alarm, fault switch, resistors, terminal posts, and feeler pipes, as shown in figure 2. The pipeline is filled with gas. In normal conditions, the gas pressure will keep the fault switch in the closed position. When the environment reaches a different warning temperature, the gas expands, the overheating or the fire alarm switch is closed respectively, if the sensor fails, the gas leaks, and the fault occurs. The switch is open and it can be seen that the output resistance of the sensor is different under different conditions.

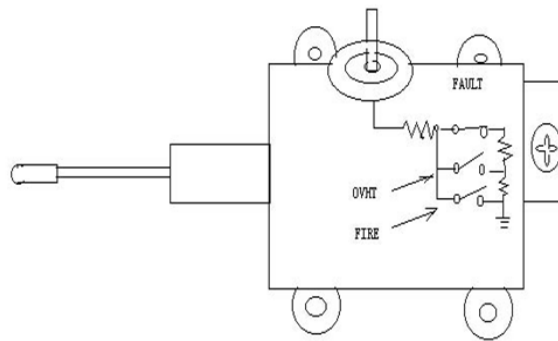


Figure 2. Sensor of fire detector system.

2. Case analysis of fire detection system

The engine and APU fire detection modules sense the signals of all sensors [3]. The panel has fault zone display lights, fault code display lights, and fire alarm self-test switches. Under normal circumstances, all lights are off, and the corresponding lights provide instructions when a fault occurs. When the self-test is performed on the piezoelectric door, all the lights are on if the line is working properly. If a light is not on, it is necessary to perform troubleshooting according to the prompts.

In the cockpit, the P8 board has a fire light, engine overheat light and fault detection light to provide the crew with real-time warning. Then when the sensor is faulty or there is a problem with the line, during the fire test, the fault lamp will light up, and the corresponding engine's fire light and overheat light will not light up. At this time, the fault can be checked according to the indication on the detection component.

2.1. Failure to check fire wire connections regularly

However, in actual work, it is often found that relying on the detection of a component to correct it does not work [4]. For example, when the fault code is an open line, the fault area indicator light will not be lit. In order to troubleshoot, one or more joints must be carefully checked; more complicated, sometimes the fault area code indication is inaccurate. For example, it is displayed as the sensor on the upper or lower part of the fan is not good, but the looseness of the wire joint is found in the C-duct, even if it is disengaged.

To analyze the cause, as shown in figure 3, the detection component senses the resistance of the loop core to ground, and the four-segment components are connected in parallel in the loop. When a component detects a warning or a failure, the resistance to ground changes.

For example [5], in normal conditions, the resistance of the loop to ground is 862 ohms. When the upper part of the fan detects a fire alarm, the resistance of the loop to ground is 103 ohms. When a fire alarm is detected to the right of the C-channel, the loop-to-ground resistance is 105.8 ohms. It can be seen that the difference of less than 3 ohms makes the detection unit identify the location of the warning. In the same way, the probe assembly can identify the location of overheated or faulty detection elements.

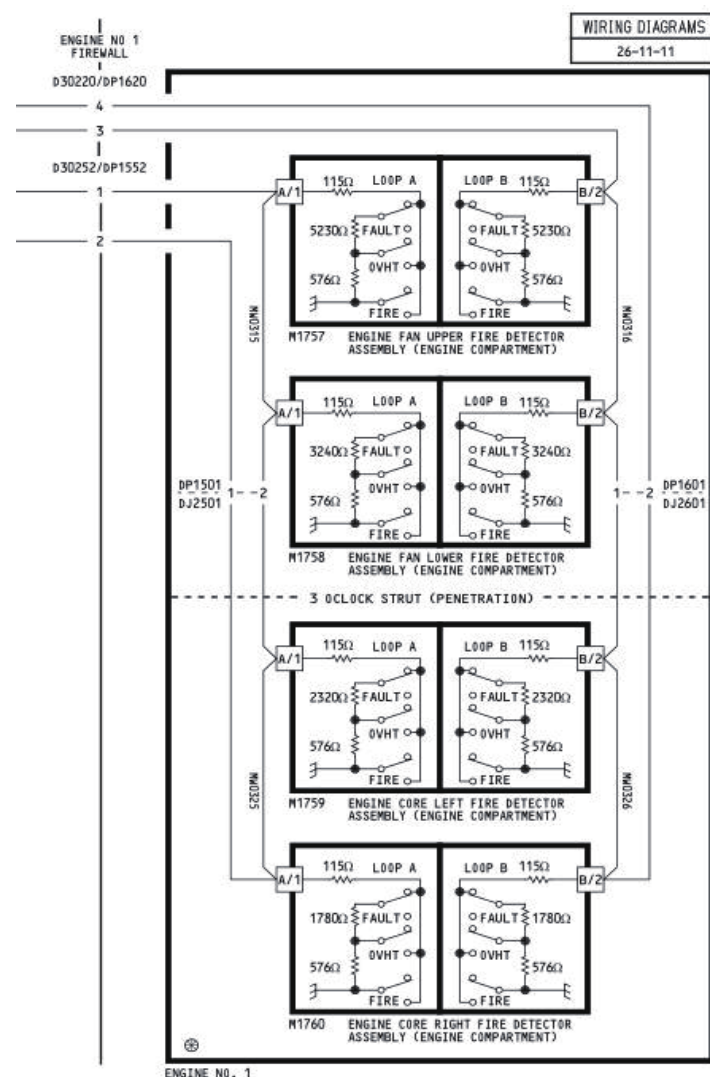


Figure 3. Fire detector system.

If the fire detection element wire connector is not properly crimped [6, 7], or the wire is ablated, there is no cleaning connector when the detection element is installed, or the connector is soiled with oil, a few ohms of contact resistance difference is very easy to detect. There is no way for the component to judge.

For example, it was found that the fire detection on the right side of the A-ring of the engine was faulty, and that the post-flight test fire detection control box was the fault of the lower fan sensor and that there were many oil stains on the lower sensor connector of the fan casing. After cleaning, the test fire detection was working properly [8]. However, there was still a failure on the second day. After another inspection, it was found that the C coupling was disconnected and the fault disappeared after the recompression [9].

At that time, similar failures were raised several times and found to be similar causes after troubleshooting. Later, the engineering department issued a circular to regularly check the fire alarm wire joints, and found that the problems were dealt with in a timely manner. Therefore, such aircraft failure gradually cut back.

2.2. Design flaws of wire harness

In addition, another aircraft was found to have failed the B-Ring fire test. After the flight inspection, it was discovered that there was an ablative disconnection of the lead wire of the left-hand detection element of the turbine. Replace the wire harness and test that the left-fire test was working properly.

The fault was caused by a defect in the design of the wiring harness [10]. After a long working time, due to the vibration and high temperature of the engine, ablation occurred, resulting in a change in the loop resistance, and the fault phenomenon was sometimes absent and many times false. The information, the display of the fault area is lit.

Therefore, when troubleshooting, do not blindly follow the instructions of the detection component, but directly detect it in the C-channel according to the cause of the failure.

3. Conclusion

This paper describes the structure and working principle of the aeroengine fire detection system in detail, and illustrates two misunderstandings in the detection of the fire detection system with examples: failure to regularly check the connection of the fire wire and neglect the design of the wire harness.

These two experiences come from the long-term practice accumulation of front-line engineers. Only with certain knowledge of the CFM56-7B engine fire detection system and its wires, front-line maintenance personnel will be able to do more with less inaccuracy. The correct use of the information provided by the detection components will enable accurate and rapid troubleshooting. This saves a lot of aircraft maintenance time and reduces the airline's operating costs.

Acknowledgements

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