

# Failure Analysis and Troubleshooting of Aircraft Cannon Shot Stopping

During Air-to-Ground Attack

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**Abstract**—Failure of cannon shot stopped occurs after the first firing when aircraft cannon air-to-ground attacking. The working principle of cannon is analyzed, and the reason is found out with reproducing the failure. The correctness of solutions is validated through the ground target experimentation.

*Keywords*—Management system of object hang up with airplane; Aircraft cannon

## I. SOURCE OF PROBLEM

In the process of the air-to-ground attack of an aircraft, after one attack, the aircraft processes the shooting again, the trigger has no response when the pilot presses it. The pilot switches the main mode of the control stick, avionics master template shows no change; when the pilot switches the display control, after restarting the plugin, avionics master template shows no change and the emergency way of the aircraft cannon has no response.

When presses all the shooting buttons on the aircraft cannon, through the electrical outlet of the aircraft cannon contactor. the dc power source of the aircraft provides power to the conductive bar of the auxiliary igniter shell, the electrical contact column and the electric needle of the left side of the end of the cannon, and the electric bottom fire to shoot the cannonball inside the chamber. After being shot, the cannonball produces gunpowder gas with high temperature and high pressure, which, on the one hand, pushes it to be shot to the mouth of the cannon; on the other hand, the insole pressure caused by which makes the barrel group be back, which can manipulate various institutions complete the work automatically.

The back seat of the barrel group, auxiliary igniter shell and the barrel group retreat at the same time to disconnect the circuit of the bottom fire of the cannon and the auxiliary combustion cannonball. The retreat of the barrel group also makes the snug of the impact bar of the remaining bombs counter bring the impact bar out of the mounting hole on the impact bar of the contactor. At the same time, the other side of the impact bar separates from the metal conductive ring in the mounting hole, thus the circuit of the remaining bombs counter breaks. Meanwhile, the management system of object hang up

with airplane accepts the signal that the remaining bombs counter circuit breaks, which is to form count signal inside the system. After each launch of the cannon, the circuit of the remaining bombs counter will breaks once and the management system of object hang up with airplane notates once. The remaining bombs counter always show the number of bombs one less than the total base. In the process of the barrel's setting back, the compression complex spring will make it be full of energy. When the barrel back reaches the final position, the compression complex spring restores the most energy. Under the action of this energy, the barrel begins to be forward. When the barrel is forward to the front, the electric needle of the movement of the cannon connects with the the electrical contact column on the left and connects to the electric bottom fire. The two pins of the electrical outlet of the contactor also connect to the shell of the auxiliary igniter, which again connects the firing circuit of a certain type of the aircraft cannon and auxiliaries the circuit of the bottom fire of ignition. At the same time, the impact bar of the remaining bombs counter is also back to the front led by the snug of the barrel group. The impact bar connects to the conductive ring of the mounting hole, which means the circuit of the remaining bombs counter connects again, after which, the management system of object hang up with airplane does not count but is in the statue of counting. The cycle is a complete technical functionality of a certain type of aircraft cannon. If the cannonball in the chamber is not shot, after 0.15s, the management system of object hang up with airplane automatically provides power to the electrical contact piece which connects auxiliary igniter shell to the bottom fire of the auxiliary ignition to shoot the auxiliary ignition and help it push the cannon out. After a cycle, the circuit of the remaining bombs counter breaks for once, as a result, the cannon should be counted.

## II. SCREENING PLAN FORMULATION

### A. Interpretation of flying parameter and video

- (1) The interpretation of the quick report of flying parameter;
- (2) The interpretation of flight video;

### *B. The aircraft cannon, avionics system inspection*

(1) State of the aircraft cannon and remaining bombs, decomposition of the aircraft cannon;

(2) Inspection of the circuit breaker of the aircraft cannon and the control circuit of the aircraft cannon;

(3) Inspection of the main mode switch function of the stick.

## III. INTERPRETATION OF FLYING PARAMETER AND VIDEO

### *A. The interpretation of flying parameter*

Flying time interpretation shows the effective aircraft cannon shooting time is one during the flight and other situation is normal.

### *B. Record video interpretation*

The firing of the aircraft cannon for the first time is normal, but the second launch of the aircraft cannon is not successful. The external image shows that the number of the remaining bombs does not change. Switch the main mode of the stick without success. Use the third emergency way to shoot, but it is still not successful.

### *C. The interpretation results*

Flying parameter events show that the aircraft made a weapon launch, and video record shows that the pilot processed a second aircraft cannon and a normal emergency way of the aircraft cannon firing operation:

(1) The first launch of the aircraft cannon is normal; (2) During the second launch, there was no response of the aircraft cannon, and the main mode switch function of the stick is failure. And after the operations of display control and switch to restart external operations, the main mode switch function of the stick is still failure; (3) Emergency launch of the aircraft cannon has no response.

Comparing flying parameter time and video recording, the aircraft cannon trigger had no shooting records during the second and the third shooting.

## IV. THE RELATED INSPECTION OF THE AIRCRAFT CANNON STOPPING IN A AIR-TO-GROUND ATTACK

### *A. State of the aircraft cannon and the remaining bombs, and the decomposition of the aircraft cannon*

(1) Inspect the cable plug and the socket of the aircraft cannon. The aircraft cannon plug locking insurance is in good condition. The results are normal;

(2) A visual inspection of the aircraft cannon is normal. The situation of the aircraft cannon's being into the ammunition handling institution is normal, but the the secondary ignition does not work;

(3) Remove the examination of the decomposition of the aircraft cannon, there is no abnormality of each part of the aircraft cannon.

### *B. Aircraft cannon system circuit breaker inspection*

The normal aircraft cannon launch circuit breaker and emergency circuit breaker are all in the on state and the results are normal.

### *C. The main mode switching function*

Display control is normally charging and the avionics control switch is in the collaborative position. After the display control starts, the system is ready for the task. The operators both in the front and back cabins respectively process main mode switch and the display shows no change (under normal circumstances, the display changes as the main mode changes, namely, the pilot reacts fault phenomenon).

During the ground aircraft connection, the problem that the main model of avionics master cannot switch is the same as the pilots describe and the video records.

Because the aircraft cannon control line inspection should be conducted in the image of space 4, it is needed to rule out firstly the failure of the main mode switch function of the stick.

### *D. The main mode switching function failure troubleshooting*

#### *1) Working principle of the system*

Through the analysis of the principle diagram of the display control system, the main mode of the avionics system switches, the avionics control switches and the front aircraft cannon weapon prepares, the launch signals are earthed effectively, that is to say, do not switch, when the trigger is pressed, the signal is under suspended state, while during operation, the signal is grounded.

#### *2) Inspect on the aircraft*

Inspect the main mode of the former and back cabin and the avionics control all conversion phenomenon, according to the ground. Through the analysis of the drawings, it can be preliminary judged that the problem lies in abnormal ground signals. The public part of the main modes of the former and back cabins, and the avionics control conversion signal is XX connector, and the avionics control switch and X225 connector. Measure the line on the aircraft, it is found that the circuit is impassability. Find XX connector and it is found that the plug is in the statue of being out of stock connection.

#### *3) Inspection after troubleshooting*

After confirming XX plug is out of connection, restore the plug installation, to continue the inspection.

Avionics system electricity inspection: the aircraft is in electricity. The performance of the conversion of the

main mode switch, open space, navigation, combat and intercept is normal.

The aircraft cannon control circuit inspection: Inspect emergency launch circuit working condition, and the result is normal. Inspect the control logic of the jettison box of the back emergency box. "Front shot bans" switch should be in the "forbidden" position, namely, the front cabin is not allowed to shoot. The working performance is normal. Inspect the working performance of the normal emission lines, respectively conduct inspections of limited number and unlimited number of bombs and the results are normal. Simulate the failure mode of the aircraft cannon, ignition starts and works normally.

#### V. FAILURE RECURRENCE

Put XX plug in a state of being out of stock, it is found that the main mode switch function is failure, both the aircraft cannon normal or emergency mode cannot shoot, which is in agreement with the flight condition.

#### VI. PROBLEM ANALYSIS

XX plug appearance inspection is normal. Compared to the screwing down and breaking way of the quick-release with the same type and the quick-release plug of the same area, XX plug of the aircraft needs less strength relatively. Review the rolls of many aircraft, XX plug needs more strength in screwing down and breaking relatively.

Through the analysis and inspection of the problems, such as the aircraft cannon shot stopping during the air-to-ground attack, main mode conversion problem, and so on, XX plug is the one which is used by both the main mode switch of the stick and the aircraft cannon trigger ground signal, so if the connection is not reliable, the function of the main mode switch of the stick and the aircraft cannon trigger ground signal will be failure. As a result, XX plug is in normal connection during vibration that is the cause of the problem.

Because XX plug installation location is located in the bottom of the right control console of No. 12 of the back cabin where the vibration is the most serious when the aircraft cannon shoots. In the analysis of the air-to-ground attack flight, during the first air-to-ground attack, because its high vibration will cause the plug be out of stock, which will lead to the failure of the function of the main mode switch of the stick and the aircraft cannon trigger ground signal, which is in agreement with the failure phenomena of the flight.

#### VII. CONCLUSIONS

Based on the fly, video and the inspection on the aircraft, the author thinks that the dropping of XX plug in the aircraft cannon shooting caused by vibration was the main reason of the stopping of the aircraft cannon in the air-to-ground attack and the failure of the main mode switch function of the stick.

#### REFERENCE

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