

# Failure Analysis of “Display Does Not Match the Actual Number of Remaining Bombs” After Certain Type Aircraft Cannon Shots

Hengxin Cai, Zhaohui Lin and Peng Jiang

(AVIC Shenyang Aircraft corporation, Shenyang 110850, China)

**Abstract**— Failure of “display number of remaining bombs does not match the actual number of remaining bombs” occurs in powered inspection and shoot of aircraft cannon control system, the principle of aircraft cannon control system is introduced, the reasons of failure of “display number of remaining bombs does not match the actual number of remaining bombs” are analyzed, a solution of this failure is introduced.

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

## I. THE FAILURE PHENOMENON

When a certain type of aircraft cannon electricity debugs and shoots, there is often a phenomenon that the display of the number of the remaining bombs does not match the real number. The most direct performance is that the cockpit displays the number of the bombs is zero, but in fact there are still some in the box or the guide rail. To make things worse, after heat school target shooting of a certain type of aircraft cannon, cockpit display bombs remaining quantity is zero, but in fact there are still a few bombs in the cannonball box and in guide track.

## II. THE WORKING PRINCIPLE

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 break 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.

The error between the shown number of the remaining bombs and the actual number of them within 10% belongs to the normal phenomenon, which is the aircraft cannon design flaws. Its reason can be verified through the analysis of the structure of aircraft cannon itself and the aircraft simulation. The main reason lies in the remaining bombs counter, the impact bar and the mounting holes. Before shooting, there is a certain gap between the impact bar and the lobe on the aircraft cannon tube group, in order to guarantee the accuracy of the impact bar can enter the metal conductive ring of the mounting hole on the contactor, there is a seal gasket on the impact bar with the functions of sealing and soft guiding. Now the impact bar connects the metal conductive ring of the mounting hole on the contactor,

and the remaining bombs counter is also in connected state, namely the pin on the electrical outlet 4 of the contactor connects to the ground. When shooting, the aircraft cannon tube group is backward, and the metal conductive ring on top of which breaks, namely the pin of the contactor outlet 4 breaks with the ground. Now, the management system of object hang up with airplane remarks a shooting.

Accordingly, the aircraft cannon counter conducts count by mechanical contact and disconnect. Due to the gap between the impact bar and the metal conductive ring of the mounting hole of the contactor, there will be hit when the aircraft cannon is pushed to the front during shooting, as well as there will be strong vibration during shooting, under the impact of the combination of several factors, when the impact bar enters the metal conductive ring of the mounting hole of the contactor, there will be the motion of the intense. There might be several times of disconnection and connection during the process of the pin of contactor outlet 4 connecting to the ground. Each disconnection will be considered by the management system of object hang up with airplane as a remaining bombs signal. At this point, the shooting time on the management system of object hang up with airplane is in agreement with the times of disconnection of the remaining cannonball counter. This leads to the management system of object hang up with airplane records more shooting times. On display, management system of object hang up with airplane always shows the number of the remaining bombs which excluded the more remaining ones from the total number. As a result, the number of the remaining bombs of the cockpit is zero, but in fact, there are still remaining bombs. As for the problem that after different aircraft cannon shooting, the remaining number of bombs is not the same has something to do with the real times of the connections and disconnections caused by the movement when the impact bar of the remaining bombs counter entering the metal conductive ring of the mounting hole of the contactor, which cannot be tested in the movement of the aircraft cannon and only has a statistical significance. This is reason that in the introduction of data, the error of 10% between the shown number of the remaining bombs and the actual number of the remaining bombs.

The circuit transmission line of the remaining bombs counter on the aircraft is on the board: the disconnection signal of the impact bar of the remaining bombs counter of the aircraft cannon and the metal conductive ring of the mounting hole of the contactor is transferred through No. 4 pin of the contactor outlet to the cable which is connected with the outlet of the contactor. The signal is transferred through the cable to the front equipment cabin and then to Unit 2 of the weapon interface of centralized installation mount -2 of the management system of object hang up with airplane, which forms the remaining bombs counting signals. The signals are transferred to the management of object hang up with airplane processor by Unit 2 of the weapon interface.

The result which is after the processing of the management system of object hang up with airplane is shown on the display control system. If there is error during the transformation in the line, the disagreement between the number of the shown remaining bombs and the actual number of the remaining bombs.

### III. THE ANALYSIS OF THE CAUSE OF THE PROBLEM

Through analysis, the reasons that cause the disagreement between the number of the shown remaining bombs and the actual number of the remaining bombs are as follow:

(1) The seal ring of the impact bar of the remaining bombs counter is broken. The broken seal ring of the impact bar makes dirt be into the mounting holes, leading the not good connection between the impact bar and the metal conductive ring of the mounting holes, which makes the signals of connection and disconnection cannot be sent and makes the remaining bombs counter cannot work properly.

(2) The deformation of the impact bar of the remaining bombs counter. The deformation of the impact bar can also lead to the poor contact of its conductive parts, causing it cannot work properly.

(3) The damage of the impact bar of the remaining bombs counter on the contactor and the metal conductive ring of the mounting hole. The damage of the metal conductive ring of the mounting hole will lead to more than once connections and disconnections of the impact bar in one cycle of the aircraft cannon, which makes the circuit of the remaining bombs counter cannot work properly.

(4) Poor contactor. The poor contact of pin 2 and pin4 on the contactor influences the signal transmission of the remaining bombs counter.

(5) Component failures. The internal failures of Unit 2 of weapon interface and the external failures of the management processor.

(6) Transmission line failures. There are failures of the transmission line of the circuit of the remaining bombs counter.

### IV. TROUBLESHOOTING

In view of the possible cause of the failures, analyze and take corresponding measures to eliminate.

#### A. *The decomposition inspection to the aircraft cannon*

(1) Decompose the aircraft cannon, inspect the mounting holes, impact bar, seal ring, contactor outlet, clean the mounting holes, replace the damaged seal ring, repair or replace the deformation parts. (2) Repair the deformation parts of the impact bar or replace the new impact bar. (3) Inspect the conductive ring damage in the mounting holes and replace in time the damaged ones. (4) Decompose the outlet on the contactor, and inspect and wash pin 2 and pin 4. Replace the

corresponding failure parts when it is necessary. (5) Change Unit 2 of the weapon interface. (6) Replace the management of object hang up with airplane processor.

#### *B. Rule out the failures using segmented method*

(1) The inspection of the line on the aircraft. Inspect the firing line of the aircraft cannon by the tester. Connect the remaining bombs counter lamp circuit to an oscilloscope and inspect the line on the aircraft. Inspect whether the technical information shown on the aircraft is in accordance with the number of the pulse of the oscilloscope. If it consistent, the possibility of on line failure can be ruled out and the failure can be positioned to the aircraft cannon itself; if it is not consistent, the failure should be positioned to the line of the aircraft and should be inspected segment by segment. The cable of the aircraft cannon guides the plug to the one under the floor of the aircraft cannon, and then the guides to the one behind the concentrated mount and then to the management system of object hang up with airplane. So the line can be measured in two segments. Disconnect from the plug under the floor of the aircraft cannon, inspect the integrity of two lines respectively whether is in accordance with the provisions. If there are failures, the position can be judged and excluded.

(2) The inspection of the failures of the line. If the failure belongs to open circuit failure, the circuit should be connected and wrapped up; if the failure belongs to short circuit or lap joint failure, the circuit should be

connected correctly according to the principle of wiring diagram.

#### V. CONCLUSIONS

Through the analysis of failures, for such failures, in usual maintenance, the following should be done:

(1) Comprehensive inspection. In the inspection of the decomposition of the aircraft cannon, it is necessary to make a careful analysis and inspection to the remaining bombs counter to determine the completion state of the related parts, especially during live firing of the cannon, the inspection to the related parts should be focused on. In the process of maintenance, the relevant provisions shall be strictly implemented. It is not allowed to use kerosene to clean the remaining bombs counter or other pipe connection parts to avoid the poor contact.

(2) Comprehensive analysis. In the process of troubleshooting, the method to introduce the oscillograph can effectively determine whether the remaining bombs counter circuit is working properly or not. It is needed comprehensive utilization of various methods to conduct analysis and judgment in order to rule out of line failures. It is necessary to indeed judge the failure parts to exclude.

#### REFERENCE

- [1] Li Xiangmin, Sun Jin, Xie Xiaofang, et al. Fire control principle[M]. Beijing: National defence industry press, 2007.