

# The Effect and Countermeasures on the Missile Equipment in High Temperature and Damp Environment

Wengeng Pan, Tao Li, Hua Wan, Yijun Chen and Yanlei Zhang

Department of Aviation Ammunition, Air Force Logistics College, Jiangsu Xuzhou, China

**Abstract**—Missile equipment maintenance of the security work under high temperature and humid environment is a system engineering, everything is the decisive factor, it directly affect the quality of missile battle and training security. In order to ensure the quality of ammunition storage and safe use, it can adopt scientific effective preventive measures and eliminate the negative influence of high temperature and humidity on the equipment to ensure that missile technology and equipment are in good condition when the security was carefully safeguard missile equipment. It is of important economic value and military significance to the quality and safe use of the missile.

**Keywords**—missile; temperature; humidity; electrical equipment; effect

## I. INTRODUCTION

High temperature and wet climate environment have serious impact on the performance of missile equipment, if do not take measures, the missile equipment failure and affect the battle training to ensure the completion of the task and even cause serious consequences. We must raise awareness and familiar with the missile equipment technical requirements for the environment and take timely measures to ensure the technology of missile equipment in good condition for the missile security[1].

## II. HIGH TEMPERATURE AND WET ENVIRONMENT ON THE INFLUENCE OF MISSILE EQUIPMENT

### A. The High Temperature Effect on the Projectile

High temperature and damp environment can make the missile O-ring seal aging and be easily affected. It can make the missile parts of O-ring seal aging inflation under high temperature and damp environment for a long time and is unqualified caused by missile air tightness, the missile was leakage air and water vapor infiltration inside the missile so that the missile humidity indicator can not meet the specified requirements and even cause missile internal device failure, and affect the performance of missile technology. We found missile performance instability in the electric field and the phenomenon such as light is shining, this usually is affected by missile with damp.

The high temperature and damp environment can make the paint and coating cracking on the surface of the missile. The missiles can raise the surface temperature under the environment of high temperature for a long time because the place of the missile is not the same as the coefficient of expansion, it will result in the crack of the missile surface paint, glue. Especially the ceramic radome and the link between surface parts of missile thermal insulation is the most

likely to happen bulge and cracking of paint and glue or other problems in long-time and high temperature environment.

High temperature and damp environment strengthen the missile corrosion. High temperature and relative humidity is larger under the environment, the missile projectile has strong corrosive if the air contains high salinity. It often cause surface lacquer layer out from the missile body peeling or hang if not maintenance timely and tank connection screw, screw, wing screw surface corrosion phenomenon which appear.

### B. The High Temperature Effect on Missile Launcher

The performance parameters of the circuit and electronic components in the missile launcher changes in hot weather and was easy to malfunction if not to take protective measures. It will burn the equipment or the short circuit inside missile launcher to make missile damage and affect the combat flight on duty when water seeping into the missile launcher and airplane wings inside the missile in rainy weather. In May 1997, launcher was failure when the missile electricity was inspected. After the use of external field during electrical test launcher and found that nearly half of the defective. Through the analysis of the launcher plug into the water and cause a short circuit, there are still 7 launcher there is fault with alcohol to wipe, hair dryer blow dry and troubleshooting by replace the plug and cable.

### C. The Temperature Effect on the Missile Electrical Equipment

Missile "electrical delay" events occur when missile test, the missile test results are lower limit out-of-tolerance "electrical delay" at + 35 °C of the test environment temperature. Normal "delay" electrical test qualified range should be: SD1 = (291 ~ 309), ms SD2 = (1164 ~ 1236) ms. Which SD1 is used to control the missiles from within about 300 ms after beam steering engine output torque manipulation in order to ensure the missile flight during this period will remain zero. SD2 is used to safeguard the missiles off the beam within about 1200 ms and the fuse can't start, namely the missiles off the beam passes through at least 1200 ms, the fuse may have re-explosive warhead.

"Electrical delay" time parameter of the missile SD1 and SD2 is not static, it changes according to the missile engine temperature change. Guided tank sampling engine temperature control "electrical delay" the length of time. When the engine temperature higher than normal temperature, SD1, SD2 time width is relatively narrow, When the engine temperature lower than normal temperature, the time width of SD1, SD2 will be widened relatively. At the same time, the test environment

temperature also affect the guidance cabin temperature sampling so as to change a certain missile "electrical delay time parameter SD1, SD2. The length of time determined by temperature difference of the oscillator frequency, the count by the oscillator frequency pulse as count pulse, in the same under the pulse number of counts, the generator frequency increases and the counting time becomes shorter when sampling temperature was difference. When sampling at lower temperature, the temperature difference reduces the frequency of the oscillator and counting time will be longer. Generally appear "electrical delay" super bad, operators will naturally environmental temperature by formula conversion into qualified criterion. "Electrical delay" qualified criterion formula is as follows:

$$SD1=(291\sim 309)+1/2(25^{\circ}\text{C}-T^{\circ}\text{C}) \text{ ms}$$

$$SD2=(1164\sim 1236)+2(25^{\circ}\text{C}-T^{\circ}\text{C}) \text{ ms}$$

Obviously, when the temperature of the test environment is T at 25 °C or so, acceptable range is not need to be modified. It needs to combine a given criterion formula redrawing the acceptable range when the floating temperature of the test is bigger. Missile diamond tester working environment was normal temperature environment generally, therefore, the factory in the design of "electrical delay" qualified criterion don't need to consider additional correction of environment temperature change and 25 °C is adopted as a criterion of qualified general criterion. The SD1 = (291 ~ 309)ms SD2 = (1164 ~ 1236)ms. When the environment temperature changes, the missile can be dealt with according to reduce or increase to the software cycle count to achieve correction "electrical delay" SD1 and SD2.

#### D. The High Temperature Effect on Missile Testing Equipment

Missile testing equipment is mainly composed of electronic components, the influence of temperature and humidity of electronic components were big. The environment of high temperature can change the missile testing equipment performance parameters such as resistance, inductance, capacitance, it makes insulator soft failure caused by insulation. Active components may be death because of the expansion and make the structure failure, foaming of the coating the surface, oxidation and other chemical reaction speed, lubricant viscosity reducing and the evaporation loss of lubrication, increase the wear of moving parts and its structure strength reduced by the physical expansion, etc.

Missile testing equipment was vulnerable to erosion by moist air in humid environment. It will be a layer of water film condensation of components or material surface and permeate into the material causing the surface of the insulating material conductivity increases, and reduced volume resistivity, dielectric loss increases, parts short circuit in the electrical, leakage or breakdown and other issues.

#### E. The High Temperature Effect on Auxiliary Testing Equipment of Missile

Missile auxiliary testing equipment was mainly power vehicle and GSU missile for nitrogen plant, high temperature and humidity had bigger influence on the missile auxiliary testing equipment of the power:

The influence of high temperature will cause the power loss of power vehicle and diesel engine damage. If the environment temperature is too high and it can cause diesel engine overheat by the power supply conductor in work time, oil pressure was lower when water temperature, oil temperature is too high and the inflation will reduce the volume of fresh air is heated in the cylinder, diesel engine power decrease and output voltage instability, High temperature conditions, due to different parts of the material, size and temperature make their expansion degree is different also, mutual fit clearance are destroyed, lubricating oil viscosity at high temperature drops greatly, does not favor the friction surface oil film formation, exacerbating the parts between the wear and tear even make the connecting rod bearing and crankshaft bearing ablation, it can make parts of mechanical strength and stiffness, deformation cause damage caused by parts yet.

The moisture will cause the loss of generator insulation resistance value. The insulation of the power vehicle condition is good or bad and directly related to the power car can work normally and the personal safety of operators, if the insulation resistance value can not meet the requirements, the operators should take safety measures and stop the power car work because rust wet easy to cause the power car parts. If power car was in long-term and humid environment, the parts will rust in the air of high salt content and affect the power vehicle technical condition.

For nitrogen of GSU missile device: Under high temperature and wet environment, the GSU missile for nitrogen unit air compressor oil pool of infiltration water easily cause oil pool turbid and also can cause the exhaust temperature higher, machine downtime repeatedly, affect the GSU missile device for the nitrogen output nitrogen gas dew point temperature, moist air at the same time also will pollute the nitrogen input and output system[2,3].

### III. MISSILE EQUIPMENT SAFEGUARD MEASURES UNDER HIGH TEMPERATURE AND DAMP ENVIRONMENT

According to the missile equipment management regulations and maintenance management detailed rules, the missile equipment support under high temperature and damp environment put forward the following countermeasures:

#### A. Strengthen Missile Maintenance

According to the missile test maintenance requirements, the inventory, steam, all kinds of missile combat duty test maintenance on a regular basis. it mainly make for appearance inspection and focusing on moisture when inventory missile every quarter for one maintenance. Found damp sand should be replaced immediately and go back to inflatable sealed packaging. Depot every year, the rear ordnance store every 2 years for 1 year maintenance, have special requirements in accordance with the relevant provisions of the maintenance cycle. Annual maintenance, appearance inspection performance testing, dustproof and change to the life of parts and damp sand should be conducted and be inflatable sealed packaging etc. Momentum of missiles, hang on duty and after hang up the flight of missiles in accordance with the relevant provisions of the calendar cycle or landing gear, flight hours for maintenance. No clear provisions, momentum every six months, hang on duty missiles, every 60 days after hang up flying missile every 10 landing gear for one maintenance,

appearance inspection, performance test, dust cleaning, change to the life of parts, etc.

Strengthen the management to missile. Steam room should maintain appropriate for the temperature and the humidity of the missile. Momentum missile should add cover jackets or affix a tarpaulin. Daily maintenance for 1 times a week, it found that the garment of missiles or bombs humidity indicator is unqualified and should be replaced immediately desiccant. Replace desiccant after 24 hours, the humidity is unqualified and the garment of missiles or bombs should stop to use.

Strengthen the combat readiness missile maintenance on duty. In high temperature weather, we should often check missile appearance inspection to see if the seal ring expansion bulge, the thermal insulation layer is there a bulge, paint, coating cracking and whether missile cable rubber break and melt, we shall promptly notify the missile missiles squadron replaced if discovery is unusual. In wet weather, combat duty missiles should add cover jackets to prevent the missile in water. On duty in a hangar missile should increase the number of ventilation and dehumidification, extend the time of heating, unstable missile performance or have a light shining etc., it can be appropriately extend the time of electricity if the phenomenon still exists and should be replaced in a timely manner missiles or launcher.

Missiles should often wipe and clean seeker for the combat duty. Outfield ordnance researchers may use the lens paper to wipe the indelible trace, it is strictly prohibited by hand or not cloth to wipe, the application of clean wool cotton cloth with a little alcohol to wipe, and promptly of the protection cover (cap). If the socket is smudgy, use a brush with alcohol cleaning jack, hanging 15 min ~ 20 min, it is forbidden to carry water to get the socket, do not use alcohol to swab projectile with the part of the logo.

In addition, we should do well in missile antirust processing. If playing in vitro surface lacquer layer peeling or hang appear corrosion phenomenon, it should be timely to rust and use the brush in corrosion protective coating solvent "Jin-Weishi penetration oil (QD/S-I-T), besmear after use cotton cloth to clean up the anti-rust oil on the lacquer layer, the docking of missile compartment connection such as screw, wing surface screw is easy to rust parts coated with a thin layer of anti-rust oil.

#### *B. To Strengthen the Maintenance of the Missile Launcher*

In hot weather, we should avoid missile launcher exposure in the sun for a long time, the plane in time lead to the hangar to park after the flight. In rain weather, we should timely cover plane fabrics and clothing to prevent water flow to hang play, seeping into the launcher plug and play, good application launcher plug waterproof adhesive bandage. We should prevent missile to water flow in the launcher on the projectile due to the nose tip down and rainwater infiltration plays in the body, we prevent the missile launcher be affected with damp to maintenance of missile launchers too.

#### *C. Strengthen Missile Work Room Temperature and Humidity Monitoring*

In high temperature and wet weather, when temperature and humidity in the missile equipment warehouse is not in conformity with the requirements and take timely ventilation,

air-conditioning, dehumidifying treatment measures. At the same time, we must strengthen the missile management such as air conditioner, dehumidifier, dryers and other business facilities maintenance in warehouse or work room to make sure missile in good condition.

#### *D. Strengthen Missile Safeguard Equipment Maintenance*

According to the missile safeguard equipment use requirement, monitor the working status. Insolate missile safeguard equipment is forbidden in the high temperature and the rain. We should look after and monitor constantly the temperature and operation situation in the missile safeguard equipment, and found that the temperature more than a specified value, to stop the work in time, check equipment, ventilation and cooling. Power car engines and GSU missile for nitrogen unit air compressor oil were checked regularly, it should add or replace in a timely manner when found that the lubricating oil does not conform to specified requirements.

Adhere to the missile safeguard equipment routine maintenance on a regular basis. For missile safeguard equipment daily maintenance once a week, visual inspection, dust cleaning, check the temperature and humidity, and the missile testing equipment power-on to self-test, the dehumidification process must take when the missile testing equipment be affected with damp. According to the specified requirements, we completes the missile quarterly maintenance and annual maintenance of security equipment.

We should check the power supply vehicle performance in time and ensure that the insulation resistance is qualified, The methods of improving power vehicle insulation resistance mainly include: (1)The hot air drying method. The air heating method is blowing drying into the generator inside (the temperature is not higher than 90 °C). (2) Strong sunlight ventilation drying method. It will power a car parked in strong sunlight and ventilation on the site and put all the windows open after a long dry to improve the insulation resistance value. (3) Plus heat source barbecue method. Using high-power incandescent lamps, infrared lamps, electric heating wire heater such as heat source placed in generator and line near baking. The temperature of the generator and line is not higher than 90 °C when baking.

To ensure that the GSU missile for nitrogen plant nitrogen output qualified dew point temperature. When found GSU missile for nitrogen plant nitrogen output dew point temperature test is unqualified, the first thing to test whether or not the dew point temperature of the input of nitrogen source qualified, and then take the GSU, leaking test device of missile for nitrogen replacement dryer core, blow-down pipeline system and other measures to ensure the GSU missile for nitrogen plant nitrogen output dew point temperature to meet the prescribed requirements.

Missile test the workplace environment is very important. To meet the requirements of missile testing occasion environment as far as possible in order to reduce and eliminate the mistrial test of the missile caused by the environmental impact. We should have sufficient analysis basis to rule out or are ruled out fault, the reasons of the failure phenomenon was analyzed and put forward the solution to solve the problem, increase the intensity of on-the-job training and master equipment performance. We are familiar with the process of troubleshooting methods to improve the ability of safeguard in

complex conditions and really meet the need of missile protection in wartime[4,5].

#### REFERENCES

- [1] An Zhen-tao. Weapons storage and environmental control [M]. Weapons industry press, 1998.
- [2] Luo Tian-yuan, Wu Bo, Dan Yu-xia. Problems needed to be considered in ammunition environmental worthiness design[J]. Equipment environmental engineering, 2007(2):63~66.
- [3] Wang Wu. Research on the environment adaptability for military electronic equipment [D]. Chengdu university of electronic science and technology, 2005.
- [4] Sun Gui-zhi, Zhang Yu-qing, Qi Li-lei, etc. Research of the temperature and moisture control technique for ammunition in micro environment under field condition [J]. Equipment environmental engineering, 2005(4).
- [5] Zhang Yi-qiao. Brief analysis on the management of the temperature and humidity of ground ammunition depots[J]. Shanxi science and technology, 2007(5).