Research on the Ventilation Condensation Experiment of the Aircraft Equipment Cabin

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Abstract: This paper theoretical analysis the reason and solution of ventilation condensation problem of aircraft equipment cabin. The air supply experiment of aircraft air conditioning ground support equipment in summer is carried out, and the relative humidity of supply air shows a trend from rise to decline, that the maximum value almost is 100% and precipitate water droplets.

1. Introduction

At present, aircraft equipment cabin ventilation condensation problem has not been in-depth theoretical and experimental research, many stations in dealing with such problems, still do not know the reason for the ventilation condensation. In order to make up for the above shortcomings, this paper firstly analyzes the problem of ventilation condensation, then carries out the ventilation condensation test of aircraft equipment cabin, and finally carries on the test verification, which has certain practical reference significance to the solution of the ventilation condensation problem of the troop equipment cabin.

2. Air Conditioning System for Air Conditioning Equipment

The working schematic diagram is shown in Figure 1.

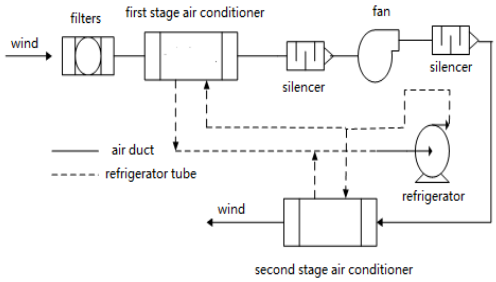

Figure 1 Working principle diagram of vapor compression air-conditioning support equipment.

At present, aviation ground air-conditioning equipment is mainly aircraft air-conditioning vehicles, the air conditioning system is mainly vapor compression air-conditioning system, which is composed of two-stage air-conditioning system.

3. Air Conditioning System for Air Conditioning Equipment

3.1. Test Equipment

The test equipment selected in this paper is mainly air-conditioning equipment simulation load and aircraft air-conditioning vehicles, air-conditioned air-conditioning equipment selected aircraft air-conditioning vehicles, air-conditioning support equipment simulated load and aircraft air-conditioning vehicle docking test [1].

Aviation ground air conditioning support equipment simulation load can directly with the aviation ground air-conditioning support equipment docking, simulation of different aircraft air-conditioning support needs, for the teaching and training of the aviation ground air conditioning

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equipment air conditioning gas flow, airflow, temperature, humidity and other parameters to ensure the process of change, and check the aviation ground air conditioning equipment operating procedures are accurate, mainly by sampling lines, control equipment, recording device and control Panel.

3.2. Fundamentals of the Test

Due to the large volume of aircraft equipment cabin, and the small volume of simulation load of air conditioning equipment, the ventilation condensation test in this paper is a model test based on the similarity principle of fluid mechanics. In the air-conditioning vehicle air-conditioner, the main function is pressure *P*, so the similarity criterion is the Euler Criterion. Pressure *P* and pressure scales λ_P are:

$$P = pA \tag{1}$$

$$\lambda_p = \frac{P_p}{P_m} = \frac{p_p A_p}{p_p A_p} = \lambda_p \lambda_l^2 \tag{2}$$

Due to the air-conditioning, the force *F* only consider the pressure *P*, thus *F*=*P*, namely $\lambda_f = \lambda_p$. Simplification can be done by:

$$\frac{P_p}{p_p \nu_p^2} = \frac{P_m}{p_m \nu_m^2} \tag{3}$$

The euler number is

$$E\mu = \frac{P}{p\nu^2} \tag{4}$$

$$(E\mu)_p = (E\mu)_m \tag{5}$$

If the power of two air blowers is similar, their euler numbers are equal. On the other hand, the two air to the euler number is equal, then the two flow must be under pressure action similar to the power. Through the use of air conditioning equipment simulated load pressure regulation device to adjust the pressure is equal, simulating aircraft equipment cabin air Change process.

3.3. Measuring Instruments

Aviation ground air conditioning support equipment simulation load of the relevant performance parameters of the measurement and recording are through the sensor, wherein the use of strain-type pressure transmitter, vortex flowmeter, thermocouple temperature sensor and humidity sensor, is arranged in the sampling pipeline in turn [2].

The measuring range of the air-feeding parameters is determined by the 110% of the measured upper limit, the accuracy is greater than the accuracy of the wind-up parameters, and the simulation load measurement parameters are shown in Table 1.

Table 1 Aviation ground air conditioning support equipment simulation load.

Measurement parameters	Measuring range accuracy	Measurement parameters
Airflow volume (kg/h)	140~14300	1%
Air Supply pressure (kPa)	0~40	0.5%
Air Supply temperature (ºC)	0~60	0.5%
Air Supply humidity (g/kg)	0~10	1%
Relative humidity (%)	5~100%	0.5%

4. Test Results and Discussion

This paper selects the aircraft air-conditioning vehicle and aviation ground air-conditioning support equipment simulated load docking test on May 23, 2018, set the air-conditioning vehicle ventilation capacity is 1870 kg/h, the wind pressure is 35 kPa, the temperature is 15 ºC, the same day ambient temperature is 30º, the relative humidity is 81.6%, Atmospheric pressure is 101,326 Pa. The ventilation hose is connected with the simulated load to observe the simulated load recording device, and the time of the aircraft air-conditioning vehicle from starting to the load requirements of each parameter is observed, and the real-time change of the sending air condition is observed, and the changes of the parameters are recorded and stored by the paperless recorder supporting software [3,4].

The specific parameter changes in the test process are shown in Figures 2 and 3, respectively:

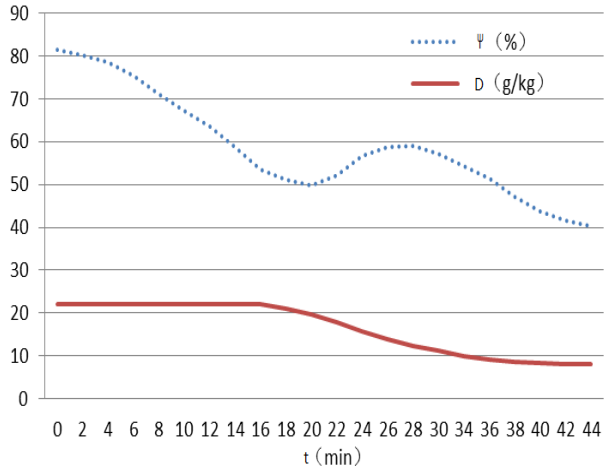

Figure 2 Air volume wind pressure diagram of aircraft floor.

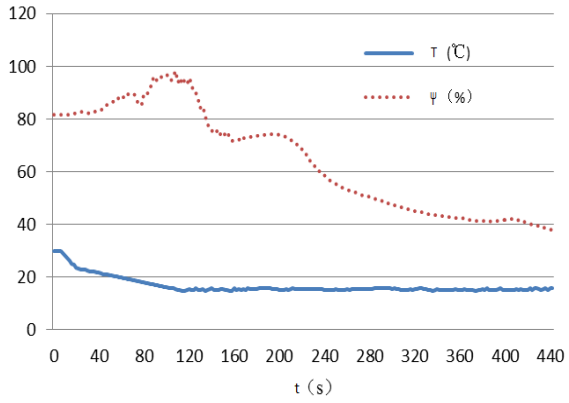

Figure 3. Temperature and humidity diagram of air conditioning on aircraft ground.

Figure 2 shows that the aviation ground air conditioning equipment after the start of a minute wind pressure to meet the requirements, the air volume in two minutes to meet the Requirements. From Figure 3 it can be seen in two minutes to 15ºC, and humidity changes slower, eight minutes after the requirement (relative humidity is less than 50%, absolute humidity is less than or equal to 8 g/kg dry air), and the relative humidity is first risen and then down to the specified standard, in the 120 s or so its rise to the maximum almost fast to reach 100%, therefore, in the process of air-cooled aircraft equipment in the cabin of water vapor easily reached saturation and precipitation droplets.

If the first hot air, and then through the cold wind of the way to test, the specific parameters of the change process as shown in Figure 4. From Figure 4, it is necessary to pass the hot air 20 min or so, only to reduce the relative humidity in the aircraft equipment cabin, not to reduce the moisture content of the air supply, and then through the cold air 15~20 min, to reduce the moisture content in the aircraft equipment cabin, while the relative humidity is first increased and then lowered. Due to

the hot air first, reducing the relative humidity in the aircraft equipment compartment, and then through the cold air, the relative humidity of the aircraft equipment compartment will not increase to 100%, but also avoid the problem of ventilation condensation.

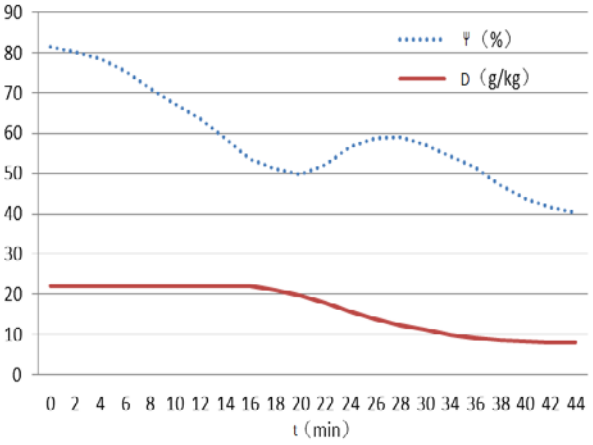

Figure 4 Plane air conditioning protection humidity change chart.

5. Conclusion

In view of aviation ground air conditioning protection equipment in the summer flight protection, aircraft equipment cabin in the ventilation condensation problem, put forward specific measures: summer high humidity area, aviation ground air conditioning support equipment for flight protection, need to first pass 30-50ºC hot air, and then in the aircraft ground power check through the cold wind to achieve temperature control. At the same time, summer air conditioning should pay attention to the change of humidity parameters, to prevent the air humidity in the cabin to reach 100% and precipitation droplets, to achieve safe and efficient aircraft ground air conditioning Protection.

References

[1] Li Li, Tao Tiuhua (2008) Simulation of air conditioning energy consumption in residential buildings and indoor temperature setting in summer. Building Thermal ventilation Air conditioning, 27(6), 78-80.

[2] Miu Xiaoping, Jiang Feng, Sui Luyan, et al. (2012) Research on energy-saving Operation management of underground engineering air-conditioning system based on wind-feeding condition. Hvac, 42(9), 13-18.

[3] Li Yunpeng, Ouyang Ti, Lin Yuhui, et al. (2015) Test and analysis of air-conditioning vehicle ventilation system in an aircraft. Refrigeration, 34(1), 51-55.

[4] Mortensen, D.K., Walker, L.S., Sherman, M.H. (2011) Optimization of occupancy based demand controlled ventilation in residences. Internal Journal ventilation, 10(1), 49-60.