

Analysis of Results of Scaled Parachute High Altitude Deployment Test

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Abstract

The parachute subsystem is an important part of rover. The function of the parachute is to decelerate the rover further, for providing good initial conditions for the later process of powered descent. High-altitude parachute opening test conducted on Earth can obtain the test data closest to the real conditions and verify system performance closest to the real conditions. The purpose is to verify the correctness of the technical scheme and obtain the test data. It is necessary technical reserves for future full-scale parachute test.

The test objectives are to verify the inflatable and drag performance of the scale parachute under supersonic and low density conditions, and to provide data support for parachute simulation.

Five flight tests were conducted totally in the test. The test data of Mach 1.3 to 2.4 and attack angle $0\sim 10^\circ$ of parachute deployment were obtained. This paper describes the test briefly, and analyses the test results mainly, including the curves of the height, speed, Mach number, dynamic pressure, parachute ejection load, parachute deployment load, angle of attack and other parameters along with time. The parachute drag coefficient and deployment dynamic load coefficient are calculated. The results show that the dynamic model used by parachute design is correct, and the technological scheme of probe parachute deceleration system is feasible.

The test process is shown in Fig.1. The carrier platform is a rocket launcher. The rocket is fixed on a launcher, adjusted to the angle of launch. The measurement and launch control device checks the rocket and sends launch instruction. After firing, the rocket flies according to scheduled trajectory, and carries the parachute and the ejecting gun to high altitude. Then the rocket head is separated from the booster. When it comes to the supersonic, low-density and low-pressure conditions, the parachute is

ejected. Then the parachute inflates, be filled, descends and lands carrying the rocket head. During flight, the measuring devices on the rocket measure and record test data in real time, and transfer the data to the ground telemetry receiving equipment. In the meantime, the trajectory of the rocket head is measured.

The scale parachute is a disk-gap-bank parachute with nominal area of 30 m². Because parachute is made of special textile materials, it is impossible to realize geometric similarity strictly, but only to extremely. Compared with the full-size parachute, the scale parachute has the same type, the same area ratio of disk, gap and bank of the canopy, the same length ratio of line, and the same structure air permeability.

The scale parachute is placed in the ejecting gun, which is designed according to the space of the platform and the volume of the parachute. The basic structure and design scheme are the same as those of the full size. The length-diameter ratio is similar to the full size. The ejection velocity is calculated by the same method. In addition, compared with the full-size parachute, the Mach number can cover the Mach number of the full-size parachute, and the Reynolds number and the ballistic coefficient are similar to the full-size.