

# 171 Experiment and measurement methods for dynamic structural change process of rocket in a blast simulator

Yadong Wu<sup>1a</sup>, Bo Gao<sup>1</sup>, Yanrui Zhang<sup>1</sup> and Ning Li<sup>1</sup>

*Beijing Institute of Astronautical Systems Engineering, Beijing 100076, China*

In the course of rocket flight, the velocity exceeds the speed of sound, resulting in high dynamic pressure in flight. Generally, the scaled model is used to measure the surface aerodynamic parameters in wind tunnel. However, for dynamic processes such as separation and variable configuration, it is difficult to simulate the similarity criterion of scaled model and to carry out experiments in wind tunnel if we want to assess the surface forces and dynamic characteristics of structure in flight. Therefore, in the past, the assessment of structural movements of rockets such as separation was generally carried out in ordinary environments, without considering the aerodynamic effects.

But at present, some new structural designs make us have to consider the effect of air flow in the process of structural change. We propose a new assessment method: using a blast simulator to simulate air flow in flight. By installing multi-point explosives and controlling the initiation time and delay explosion as driving energy, the high-speed airflow with large dynamic load can reach the order of seconds. Through repeated debugging, it can simulate almost the same load as the actual flight conditions. In this kind of device, we can use the rocket structure of equal proportion size, even put the real rocket compartment into it, and carry out the experiment directly. The device is shown in figure 1.

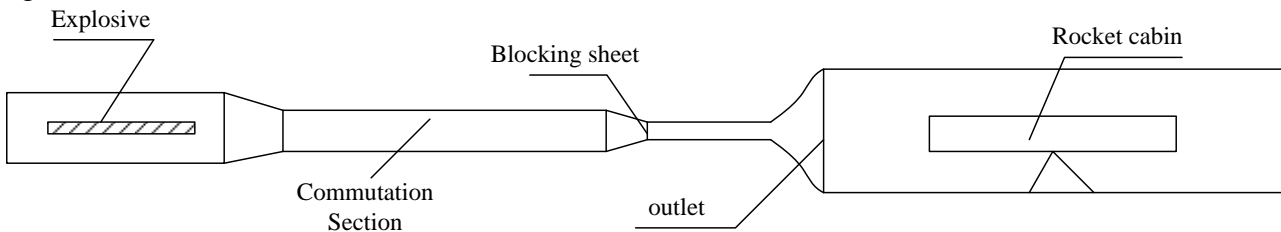


figure 1. structure of the blast simulator

Taking a rocket as an example, we successfully completed the stage separation test in the experimental device using the equal-size model of aluminum structure, and obtained the inlet pressure, strain, impact and separation stroke curves. Compared with the flight test results, it is shown that the blast shock tunnel can be used to assess the inlet flow, intensity and operation process of the prototype rocket, and the results are in good agreement with the flight test data.

At the same time, we have imagined changing the shape and structure of the rocket intelligently during the flight, but it is difficult to simulate in the high dynamic airflow environment because of the limited test conditions. With this device, we successfully carried out experiments and measured the impact value and the travel curve of the rocket with time.

The experimental data are being sorted out and will be presented in the official paper.