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RESEARCH ON ACOUSTIC CLOSED-END DEVICE FOR HYDRAULIC EXCITATION TEST OF LRE

Abstract

Abstract: With the further understanding of the dynamic characteristics for liquid rocket engine components, the frequency characteristics test of the main components has gradually become an important part of the component performance evaluation before the engine hot test. In order to accurately simulate the acoustic closed-end boundary condition of the hydraulic excitation test system, the detailed study of the acoustic characteristics of the acoustic closed-end structure is particularly important. A small disturbance linear frequency domain model of the device was established, including the distributed pipeline parameter model, the section expansion model, the section contraction model, the elbow model and the perforated plate model. The frequency characteristics of the original acoustic closed-end device were simulated. The parameters such as reflection coefficient and transmittance that characterize the impedance characteristics of the device were analyzed, and the structural improvement measures were proposed according to the analysis of sensitive parameters. The results show that increasing the length of the thin pipe can increase the inertia, and when it exceeds a certain value, the advantage of increasing the length is not obvious. Reducing the thin pipe diameter or the aperture of flow distribution plate can increase the resistance, where the attenuation effect does not change with frequency. However, limited by the maximum pressure of the test system tank, the pressure drop loss should not be too much. In the low frequency concerned, increasing the number of bends can slightly increase the turning resistance or arrange longer thin pipes to improve the impedance characteristics of the device. In addition, the additional pipeline in front of the closed-end device will have a negative impact on the closed-end device. The resonance characteristics of the additional pipeline make the acoustic closed-end device frequency dependent, and show a poor effect of closed-end vibration isolation at the resonance frequency. By installing this device in the hydraulic excitation test system, it is verified that the acoustic closed-end device with optimized structure has a better isolation effect on the pulsating pressure, and the frequency dependence brought by the additional pipeline can be seen.

Keywords: Hydraulic excitation test, Acoustic closed-end, Boundary condition, Acoustic characteristics, Reflection coefficient