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COMBUSTION INSTABILITY OF SOLID ROCKET MOTOR WITH COMPLICATED GRAIN SHAPE

Abstract

Combustion instability, or oscillation combustion in a solid rocket motor chamber with complicated grain shape was discussed in this paper. The reasons of the acoustic combustion instability were also discussed, including low frequency, intermediate frequency and high frequency combustion instability. Six engineering methods that can help to eliminate combustion instability in solid rocket motor chamber with complicated grain shape were proposed and discussed. In this study, the result shows that combustion instability mainly depends on propellant grain shape, nozzle structure that can damp the acoustic energy, and the combustion gas flow rate. Static test results of the redesigned rocket motor indicate that the proposed methods can significantly eliminate the combustion instability and improve the motor internal ballistic performance. Combustion chamber pressure variances of motors before and after the redesign were compared.

Keywords Combustion instability, solid rocket motor, grain shape design, test result

Fig.1 Combustion chamber P-t curve, test results before the redesign

Fig.2 Combustion chamber P-t curve, test results after the redesign

Table 1. Pressure frequency and amplitude, test result Before redesign Frequency(Hz)/ Amplitude(MPa) 406/0.0788 838/0.1149 1222/0.0171 After redesign Frequency(Hz)/ Amplitude(MPa) 338/0.0010