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Title
Analysis of performance dispersion in pyrotechnic igniters employing BKNO3 pellets

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Abstract

In highly loaded pyrotechnic igniters for solid rocket motors, the peak pressure has been found to have a very large dispersion around the nominal value. Despite this dispersion does not provide a significant impact on the system, a deeper understanding of the igniter performance and the associated uncertainties is deemed necessary to improve the robustness of modeling. In the present work, particular attention is focused on the performance response of BKNO3 pellets within their acceptance properties range in a cup-like highly loaded pyrotechnic igniter with the aim to better understand intra-lot and inter-lot dispersion observed experimentally.
BKNO3 pellets are accepted for flight use following the spec MIL-P-46994B, for which several tests on samples extracted from the production lot are foreseen to provide a full characterization in terms of chemical composition, geometry, thermochemical and mechanical properties.
Relying on a wide range of experimental data in terms of pressure inside the pyrotechnic igniter during its functioning, the following aspects are evaluated and quantified within the same lot (inter-lot dispersion) and within different lots (intra-lot dispersion): geometry and weight, chemical composition, ballistic properties (burning rate and heat of reaction), mechanical properties (crush strength), storage and handling (aging and humidity impact), pellets packing and arrangement inside the basket.
In addition, the impact of different grid configurations is also analyzed to identify its effect on peak pressure and pressure curve trend.
A simplified numerical model for the pyrotechnic igniter is presented with the aim to reduce the difference between prediction and experimental data considering the specific acceptance properties of each pellets lot available before test.
The model is based on the evidence provided in Ref [1] for what concern the effect of the ballistic properties, the configuration (grid) and the initiation device. Mechanical properties effects are accounted as discussed in Ref [2]. Aging and humidity effects are modeled on the basis of Ref [3] findings.

References

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