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NASA TECH BRIEF

Ames Research Center

Economical Technique for Fragmentation Testing

It is important to know the extent fragments can penetrate into critical subsystems should there be an explosion of primary systems such as steam boilers, storage tanks, rockets, etc. Ordinarily, a shrapnel or fragmentation penetration test is conducted with a form of high-velocity sled that drives a typical fragment into the subsystem. However, this technique is very costly, and so it is expedient to determine whether another type of test can be substituted; thus, during investigation of fragment penetration effects on a spacecraft radioisotope heater in the event the launch vehicle exploded within 1 to 30 seconds after ignition, it was found that a test could be performed accurately and at greatly reduced cost by using a rifle to project a specially-formed bullet. The main concern was whether an encapsulated radioisotope heater unit could withstand a shrapnel barrage of high velocity fragments resulting from the explosion of a rocket-motor casing.

A 50-caliber automatic rifle was modified for remote, single-shot use. To simulate a statistically-determined fragment size from the rocket-motor casing (1.3-mm thick, 5.33-cm square) a blunt-nosed bullet was made of the same alloy (Ti-6A1-4V) with dimensions of 12.85-mm diameter by 30.99-mm length and a weight of 17.69 grams. The cartridge was loaded with enough powder to make the bullet reach the target at the same estimated velocity (562 m/sec) as shrapnel from the rocket casing.

The rifle was situated about 4.5 m from the target, which was suspended by nylon monofilament to minimize restraining forces; two grids placed in the intermediate region were connected to an electrical chronograph. The chronograph was started as the bullet pierced the first grid, and stopped when it passed through the second; bullet velocity was calculated from the time of flight.

Note:

No additional documentation is available. Specific question, however, may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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Category 04