

AN INVESTIGATION INTO FUTURE ROCKET MOTOR BLASTPIPE AND NOZZLE INSULATION MATERIALS

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PROJECT OVERVIEW

Project Background

The project is required for two reasons:

1. Future Requirements: Larger rocket motors may be needed to achieve longer ranges or carry heavier payloads. Improved insulation materials are critical to achieve this.
2. Obsolescence: Phenolic resin materials are classed as Carcinogenic, Mutagenic, Reprotoxic (CMR) 1A/B materials. Many European suppliers are declaring this category of material obsolete. Phenol and formaldehyde, the components of phenolic resin, are both being monitored under EU REACH.

Literature

Historically phenolic resin composites are the preferred choice for blastpipe and nozzle components in modern space launch systems and at Roxel UK. The space sector also uses carbon-carbon composites in some applications.

Project Task

Identify insulation materials for testing on Motor A through small scale testing and a full-scale firing of Motor C.

SMALL-SCALE TESTING

Requirements

A list of technical requirements were compiled using available data for materials currently in use. Samples required were derived from the testing planned. Tests were derived from a recent Roxel UK insulation downselection and qualification programme.

Suppliers

Technical requirements were put into a statement of work which was sent to seven suppliers. Of these, quotations were received from two suppliers.

Compatibility Testing

10% admixture testing of the insulation materials was conducted with Cast Double Base (CDB) and composite propellants. All were compatible with composite propellant, and two were with CDB.

Other Tests

Tensile testing, Dynamic Mechanical Thermal Analysis (DMTA), hoop strength testing, and oxyacetylene torch testing were underway at time of writing. The results have not been received at this time.

HEAVYWEIGHT BLASTPIPE

Drawbacks of Motor C Firing

Firing a single motor would not allow for detection of outlying data. Firing with a lightweight blastpipe risked a failed firing and loss of data and equipment. It was decided to consider a heavyweight blastpipe and other test vehicles.

Test Vehicles and Propellants

Three test vehicles were available: Motor C, the Erosion Test Vehicle (ETV), and the Generic Test Vehicle (GTV). Four propellants were available for use in the ETV and GTV. Two were composite and two were CDB propellants.

Calculations

Knowing the charges available for each vehicle, the propellant properties, and the targeted properties (pressure and burn time), blastpipe characteristics could be calculated such as nozzle diameter.

Decision

It was decided to use the GTV for cost reasons and due to the flexibility of propellant selection for this vehicle. A heavyweight blastpipe is being designed for the GTV.