Tripoli Rocketry Association, Inc., et al. v. ATF
Civil Action No. 00-273

ATTACHMENT #2

Test Protocols – Reaction Rate Determinations

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Objective-

The objective of these protocols is to measure the reaction rate (deflagration rate) of a questioned explosive propellant, in this instant case Ammonium Perchlorate Composite Propellant (APCP), in its common use configuration as assembled in a rocket motor, and compare this to the reaction rates of other statutorily defined explosive materials. This test protocol is specifically designed to provide comparative reaction rates between these statutorily defined explosives those which have been designated as explosives by the Director, Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). All materials evaluated in this particular test series have also passed United Nations Test Series 3.

Free Flowing Explosive Powders –

Powder will be poured into inverted 2" by 2" angle (in the shape of a "V") to a minimum length of 250mm. The powder should fill, but not exceed the height of the edges of the angle. The powder shall be initiated by a non-primary explosive containing electric igniter, and the reaction rate recorded using a high speed digital video recorder, or other appropriate means. For slower reaction rates, real time video and a stopwatch will be sufficient. The video shall commence immediately prior to application of energy to the igniter.

If the material does not sustain a reaction at atmospheric pressure, it should be noted, and set aside for further evaluation in confinement.

Pressed or Cast Explosive Propellants –

Solid explosive propellants to be evaluated shall be assembled (if required) in accordance with the manufacturers' instructions.

Solid propellant motors shall be mounted in a fixture to hold the device in a stable position to permit the observation of the complete functioning of the propellant grain with a high speed video camera. The fixture shall be of sufficient design strength to retain the rocket motor during functioning.

The explosive should be initiated using the manufacturer's recommended igniter. The event shall be recorded by high speed video, with the start time commencing at the time energy is provided to the electric igniter. The reaction rate will be the total time of the propellant grain burning minus the measured initiation time of the igniter as measured separately. An identical device should be disassembled for measurement and weighing

of internal components[1]. The delay charge shall be retained for further unconfined reaction rate testing.

Reaction rates shall be calculated for all aspects of the tests in millimeters per second. Results from individual propellant varieties shall be compared to determine average (arithmetic mean) reaction rates for an individual item.

Safety Fuse –

The reaction rate of safety fuse will be measured using pieces of safety fuse no less than 1 meter long, and no more than 10 meters long. Safety Fuse will be prepared for use in accordance with best industry and/or military practices. Safety fuse for testing shall be initiated with an approved fuse lighter. The timing begins as soon as smoke is observed from the initiated end, and stops when a spit of flame exits the opposite end. This rate shall be recorded using real time video and a stopwatch, or other appropriate timing device. The measured reaction rate shall be calculated as the others in mm/sec. All results will be compared to determine an average reaction rate.

Igniters –

Igniters will be weighed both before and after testing to determine total weight of pyrotechnic material contained on the igniter. Igniters will be secured in a clamp behind the bridgewire and pyrotechnic/pyrogen composition. Reaction rate shall be calculated from the time energy is applied to the igniter until all pyrotechnic/pyrogen material is consumed. These events shall be recorded and timed using a high speed video camera.

All results for individual varieties of igniters will be compared to determine the average reaction rate for the igniters. Previously recorded weights will be used for determination of average weights of pyrotechnic materials.

[1] Internal components include propellant grain(s), delay element, and ejection charge, if present.