Reduced Explosive-Mass and Damaged Detonator Performance Tests

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ABSTRACT

Delay detonators that are damaged by cross-hole wave interactions degrade blasting work and raise the risk of incidents. Damaged detonators impose risk, because they can retain sensitive explosives that respond to stray energy during recovery, inspection or disposal. Laboratory techniques were developed to rank the ruggedness of delay detonators under replicated field-shooting conditions. The hazards are tremendously magnified if trial detonators are installed directly in secondary explosives to rank initiation strength. Therefore indirect ranking techniques were sought that mitigate the risks without compromising the worthiness of the method. Four types of hardware fixtures, referred to as simulators, were developed to yield distinct forms of transient compression. The shock and rift versions generate compression pulses representative of in situ waveform components. The waiting time, until the trial detonator functions, duplicates typical delay periods. The trial detonator is mounted within water, which has a density and inertial resistance comparable to most blasting explosives. The work output from the trial detonator explosion is registered as fixture wall-expansion. This work output determines malfunction results, regardless of which type of simulator is used.

Undamaged detonators with reduced explosive mass were fabricated to render wall expansions similar to wave-damaged detonators. Their work output correlated rather well with the detonator explosive mass. Since reduced-mass detonators remain undamaged and shoot without malfunctioning, they were used to measure initiation requirements for two coal-mine explosives. Tolerable reaction response was ranked with witness pipes. The minimum masses needed were about a third of that normally used in commercial coal-mine detonators. Ultimately such results will yield the working pressures or damage resistance of the detonators. Unfortunately blasting explosives are themselves usually desensitized during shooting, so our results underestimate the malfunction problem.