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Ignition Mechanisms of Polymer Bonded Explosives during Drilling

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The drilling behavior of polymer bonded high explosives (HE) is investigated by varying drilling parameters and analyzing resultant forces and thermal response. A modified drill press enables remote operation and precise control of cutting speed, feed, and depth. To acquire temperature at the cutting interface a K-Type thermocouple is inserted in the coolant holes of thru-coolant drill bits and epoxied flush with the drill's flank face. The signal is amplified and digitized with an AD8495 Thermocouple Amplifier and MSP430G2553 Microcontroller with a sensing accuracy of ±1℃ and a resolution of 0.48℃. Temperate data are relayed real time via blue tooth link to the control computer. Cutting forces and torques are acquired with an ATMI MC3A Force and Torque Sensor up to a sampling speed of 2,000 Hz. The comparison of downward directed forces across cutting operations is indicative of which speed and feed rate combinations limit excessive stressing of the HE, while cutting axis torques give indication in the case of drilling obstructions such as insufficient chip clearance. Drilling conditions in excess of the existing DOE-STD-1212-2012 limitations are tested to determine safe but efficient machining limits for these materials. Drilling speed, feed rate, and peck depth are varied for drilling cycles with a 5 mm diameter drill bit, and further cycles are performed to determine the effect of increasing cut diameter. In peck drilling, clearance of chip from the drill flute is crucial and governs the drill' s temperature rise.

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