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2006 R&D 100 Award Winner

# Green Primaries: Enviro-Friendly Energetic Materials

*A metaphor for a green—or environmentally friendly—explosive, the sunflower growing from a bomb casing is backdropped by crystals of one of the green primary explosives that form the basis of this entry.*

### Features

Green Primaries are designed to replace the ubiquitous lead-based primary explosives that are currently polluting human tissues and the environment with neurotoxic lead residues and have been doing so for nearly 400 years. Not only nontoxic both in their manufacture and detonation products, Green Primaries are also superior to lead primaries and all other current experimental substitutes in that they are insensitive to spark and can be manufactured in several variants. These chemical variations exhibit differences in explosive energy and in impact and friction sensitivity, making Green Primaries adaptable to diverse explosive and transportation requirements. In addition to being more environmentally friendly through the elimination of heavy-metal residues, Green Primaries are safer to manufacture because they pose no danger for explosion during the manufacturing process.

### Applications

- Civilian ammunition—both hunting and law enforcement
- Military ammunition and explosive devices
- Mining, excavating, and demolition detonators
- Projectile propellants
- Industrial motors, actuators, and valves
- Gas generators
- Pyrotechnics
- Miniaturized explosive systems

### Benefits

- Nontoxic detonation byproducts: iron, nitrogen gas, water vapor, carbon dioxide, and carbon monoxide.
- Protection of human and environmental health through elimination of lead: a neurotoxic/metabolic poison with a half-life of approximately $10^{17}$ years.
- Range of chemical-synthesis products: products with a range of explosive energy and adaptable to miniaturization; and with varying impact and friction sensitivity.
- Safe manufacturing: water-based with no harmful organic solvents or heavy metals; no danger of explosion during manufacture.
- Less-expensive manufacturing: no elaborate crystallization schemes; no added waste-disposal costs.

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### Los Alamos 2006 Winners

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