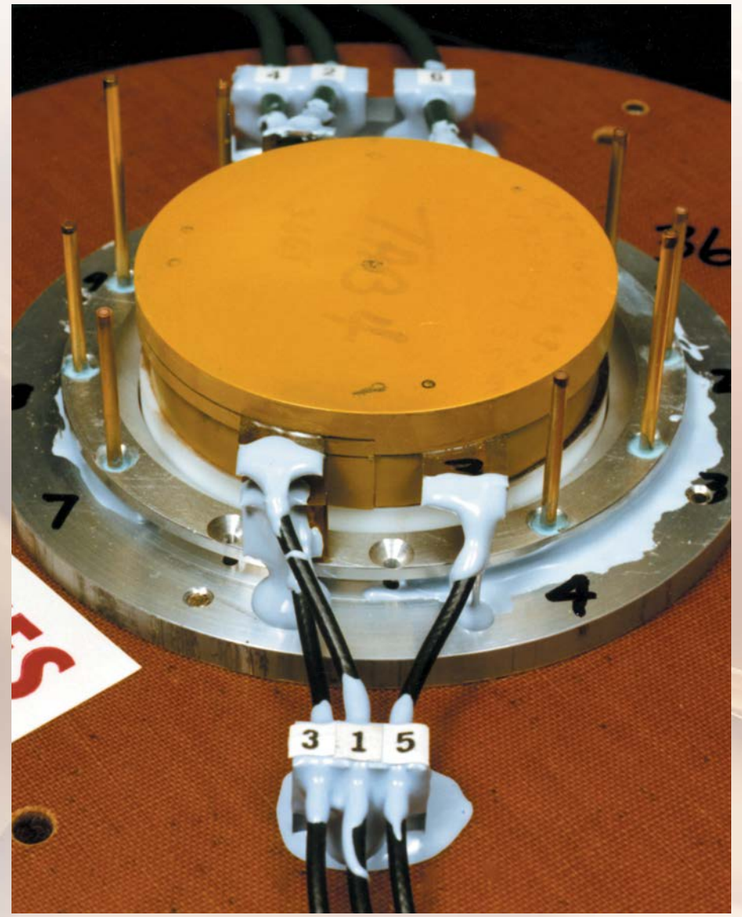
1976 Enhanced Safety

TATB Makes Nuclear Weapons Safer

In 1975, Laboratory researchers published their first report on investigations of an insensitive high explosive (IHE), TATB (triamino-trinitrobenzene). Further work to characterize the material and find improved ways of producing it has led to widespread use of IHE in nuclear weapons. Use of IHEs is one of the many important advances made over the past five decades to improve the safety and security of nuclear weapons. Its development is a demonstration of the expertise in energetic materials that resides at the nation's nuclear weapons laboratories.

First synthesized in the 19th century, TATB qualifies as an IHE because of its inherent insensitivity to shock.



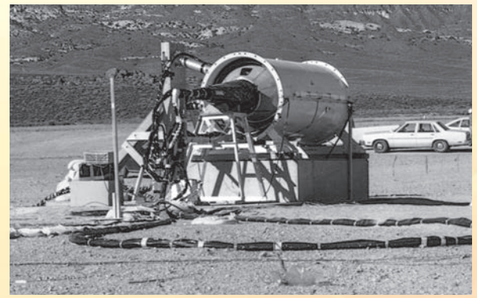
Research on energetic materials at the Laboratory has led to the formulation, detailed characterization, and development for weapons use of extremely safe high-explosive materials for weapons.

The material is virtually invulnerable to significant energy release in plane crashes, fires, or explosions, or from deliberate attack with small arms fire. In fact, TATB is so stable that researchers had to discover how to reliably initiate an explosion of the material. They also had to find a ready and affordable way to produce the material. Building on advances made at both nuclear design laboratories, Los Alamos researchers made a key improvement in 1967 by finding a way to prepare TATB as a molded, plastic-bonded explosive at close to theoretically maximum density.

Subsequent experiments at Livermore by Richard Weingart and his colleagues included shock-initiation, heat, and fracture tests to define the safety characteristics of plastic-bonded TATB. Other experiments helped researchers to understand how to initiate TATB reliably even in the extreme conditions that a nuclear weapon might face. A team led by physicist Seymour Sack made design advances that enabled TATB's reliable use in nuclear weapons. The first nuclear weapon systems to include TATB were a variant of the B61 bomb and B83 strategic bomb. The W87 ICBM warhead (see Year 1986) was the first design to use TATB for the explosive detonators as well as for the main explosive charge, further enhancing safety.

Use of TATB has been largely limited to nuclear weapons because it is costly to manufacture. For nuclear weapon applications, the legacy stock of this material will be depleted before production begins for the W80-4 life-extension program (LEP). Engineering development (Phase 3) of the W80-4 warhead for the U.S. Air Force's Long-Range Standoff missile is scheduled to begin in 2018. Requalification and remanufacture of the IHE to be used as the warhead's main charge is critical for program success (see Year 2016). This major undertaking is a collaborative effort involving involving Livermore, Los Alamos, the Pantex Plant, the Holston Army Ammunition Plant, the 3M Company, and the Department of Defense.

Crystals of TATB (triamino-trinitrobenzene), which are shown magnified in the background, are examined under a microscope.



A mock W87 warhead with IHE in a Mk21 reentry vehicle is mounted on simulated upper stages of the Peacekeeper missile (in a canister) in preparation for an explosive test to determine accident environments and warhead response.

TATB requalification and remanufacture will draw heavily on the outstanding experimental capabilities at Livermore to synthesize, formulate, process, test, and evaluate newly manufactured explosive materials. The Laboratory has also greatly advanced the fidelity of simulations of high-explosive performance and is exploring the feasibility of additively manufacturing high-explosive materials.