

FUNDAMENTALS OF ENERGETIC MATERIALS FOR TECHNICIANS At Picatinny Arsenal, offered by HERE, LLC

OVERALL OBJECTIVES: This two-day course is intended to help technicians understand basic behaviors of energetic materials, with major emphasis on explosives. It will address how they burn or detonate, the effects of detonation, and how they may respond to extreme environments, so that class members will be better prepared to perform their jobs effectively in a safe manner. It provides terminology that describes the materials and behaviors, which may serve to clarify communication with staff members. The course is a broad discussion of explosive behaviors and handling issues intended to prepare a hands-on worker for more detailed discussion of processing, fabrication and testing aspects of explosives work, which is the subject of a second training course. Class members will be encouraged to bring up points for discussion in the context of Picatinny Arsenal operations, because that helps the entire class to see how the information applies to their assignments.

LEARNING OBJECTIVES: At course completion, each student should be able to:

- know differences between pyrotechnics, propellants and explosives
- identify the main explosives in military use
- understand differences in sensitivity, hence in handling practices, between primary and secondary energetic materials
- name three essential characteristics which make a material an explosive
- recognize differences between detonation, deflagration (“low-order”) and combustion
- know what some products of combustion or detonation are
- name some common industrial explosives and some typical improvised explosive fillers
- understand what shock and detonation waves are, and how material flows behind a shock
- understand how shocks die away, and the role of sound speed in that process
- appreciate how material stiffness affects shock and impact coupling into other materials
- identify the reason for detonation failure in small columns of explosives, and know how that relates to the size of a detonator or booster required to initiate a given explosive
- recognize that shock initiation of detonation in military explosives requires a finite time and shock travel distance
- understand how thermal explosions may develop
- distinguish between high-power vs. low-power explosive components, and know of safety issues with both
- learn something about how fragmentation, shaped charge and EFP warheads operate
- know basic characteristics of air blast and how it loads structures
- appreciate how certain mechanical and electrical environments may accidentally ignite explosives.

IMMEDIATE BENEFITS:

Students who complete this course will have a more thorough understanding of how explosives operate than most people can gain through on-the-job training. Added depth of understanding will enhance the communication among staff members and technical support personnel, resulting in better, and perhaps safer, explosive handling and fabrication, test assemblies and operations. It may place the technician in a position to offer suggestions on how to improve certain operations such as test fixture design and material processing steps. Last but not least, better understanding

of energetic materials and their behaviors may be expected to increase the level of involvement and enjoyment of technicians in the work they do.

INSTRUCTORS: Instructors for this introductory-level course will be Prof. Jimmie Oxley of the University of Rhode Island and Dr. Jim Kennedy of HERE, LLC. At URI, Prof. Oxley is head of the Forensics Science Center in the Chemistry Dept. and she co-chairs the DHS Academic Center of Excellence on Explosives Detection, Mitigation and Response. Her research has been on thermal stability of explosives and she has taken part in investigations of many explosions that have occurred in civilian settings. She recently established an explosive test-firing range at URI to support her projects on energetic materials. Dr. Kennedy has over 50 years of experience in explosives work, including field projects, explosive hazard studies, detonator design, mathematical modeling and shock initiation of explosives. He teaches a course on Detonation at New Mexico Tech. Both instructors have taught related courses at Picatinny for over four years, and through their work they are accustomed to bringing new staff up to speed on how to safely handle explosives and perform experiments with them.