New Mexico Tech
Energetic Materials Research and Testing Center
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A History of Success

The Energetic Materials Research and Test Center (EMRTC) has a well-earned reputation for high quality, responsive, cost effective, technically reliable work. EMRTC has its roots in the very important, successful activities of Dr. E. J. Workman and his team in the development of the Variable Timing (VT) fuze — commonly known as the proximity fuze — during World War II.

In 1946 Dr. Workman relocated his team from what was then known as the New Mexico Experimental Range in Albuquerque to form the Research and Development Division at the New Mexico School of Mines in Socorro, now the New Mexico Institute of Mining and Technology (New Mexico Tech).

To evaluate the effectiveness and proper functioning of the proximity fuze, Dr. Workman's team also had to investigate a variety of related areas such as stress loads, blast damage effects, and fragmentation patterns. Then they were able to more fully examine the nature of various explosive compositions and shapes and to explore means for rendering potential targets more resistant to various explosive effects. So began the science of energetic materials (non-nuclear explosives) testing.

It is significant to note that, since the proximity fuze was essentially a radar system that transmitted electromagnetic energy that was then reflected back from potential targets, Dr. Workman's team also had to develop electronic equipment capable of withstanding being launched in artillery shells.

Thus, the technology developed for the proximity fuze also led to improvements in technology for smaller, pocket sized radios, civilian "walkie talkie" sets, and hearing aids.

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This is typical of EMRTC's history of logical growth and technology expansion: start with a specific problem; identify and explore that problem and its related areas of investigation; find a solution to the immediate problem; and then investigate and share potential impacts for other technologies and practical applications. This approach has led to numerous inventions and many patents.

During it's more than 50 year history, EMRTC has undergone several name changes and has evolved, in part, as the result of mergers with other related organizations at New Mexico Tech and the incorporation of their missions, highly skilled staffs, and technological capabilities.

Moreover, as a major component within the overall complex of research, development, test and evaluation (RDT&E) activities at New Mexico Tech, EMRTC draws upon the assets and capabilities of the other RDT&E activities, as well as those of the various academic

departments, to complement and enhance its technical base and to benefit from the synergism of the entire technical community.

Building on that Success

EMRTC today is a world-class RDT&E complex of more than 30 test facilities located within its 40 square mile field research complex. A close knit team of more than 100 highly experienced, technically proficient multi-talented, professionals perform in-depth scientific investigations and studies in a number of technology areas in conjunction with and/or for the Departments of Defense, State, Energy, Justice, and Transportation; the Environmental Protection Agency; Los Alamos National Laboratory; Sandia National Laboratories; other academic institutions such as Louisiana State University, Texas A&M University, Georgia Institute of Technology, New Mexico State University, and the University of New Mexico; and various commercial entities such as Aerojet, Alliant Techsystems, Applied Research Associates, Honeywell, Lockheed-Martin, Raytheon, and SAIC. EMRTC performs 200-300 field tests per year.

Field Laboratory Facilities

EMRTC's 40 square mile field testing laboratory is located in the mountains adjacent to the New Mexico Tech campus. All weather roads provide access, with the most remote site located only 25 minutes from the main offices.

The Southwestern desert, semi-arid climate allows year round use with very few inclement weather days. The mountainous terrain provides security and natural backstops for containing/shielding the effects of diverse sources such as explosives, propellants, electromagnetic radiation, directed energy, etc.

EMRTC can store more than 500,000 pounds of explosives on site. Appropriate federal and state permits and approved monitoring systems and methods are in place for conducting investigations involving high explosives, flash munitions, x-ray systems, and both conventional and hypervelocity gun systems.


Aircraft Explosives Test

High Performance Magazine

The High Performance Magazine Site, developed for scaled structure experiments requiring a large recovery area, has been used for NATO testing of quarter scale aircraft shelters and for evaluating the survivability/vulnerability of magazine structures. This site has also been used for large detonation overpressure tests involving in excess of 9,090 kilograms (20,000 pounds) of explosives.

Cook-Off Site

At the Cook-Off Site, recently constructed for dedicated use in insensitive munitions test programs, both fast and slow cook-off experiments on large and small items can be conducted according to MIL-STD-2105B.

Sled Track

This 300-meter (1,000 foot) monorail track is used for dynamic testing of warheads, penetrators, and shape charges. It provides a dynamic means of precision impact control for target penetration studies, development of hard target penetrators, and proof of concept testing. Velocities up to 550 meters/second (1,800 feet/second) are achieveable (based on payload).

Rocket Propulsion Systems Test Facility

The Rocket Propulsion Systems Test Facility, developed in 1994, provides a low-cost, liquid propellant rocket engine test capability. The facility currently consists of two thrust stands (8,000 pounds and 80,000 pounds). Both test stands support testing of liquid oxygen/kerosene engines. The 80,000 pound stand also supports testing of liquid hydrogen/liquid oxygen engines.

Shock Tube

EMRTC has a 6 meters in diameter by 30.5 meters long (20 feet by 100 feet) shock tube that allows the blast and shock effects of a nuclear explosion to be simulated using conventional explosives.

The Shock Tube provides overpressure pulses up to 50 pounds per square inch for periods up to 50 milliseconds. The tube is equipped with multiple instrumentation and camera ports.

Gun Ranges

The EMRTC field laboratory contains a number of gun ranges enabling firings from point blank to 5,000 meters (16,400 feet). Several of the ranges also support large- and small-scale explosive experiments, fragment projector experiments, warhead characterization tests, large and small caliber gun firings, fuze evaluations, insensitive munitions testing, target response to single and multiple impacts, vulnerability assessment experiments, fragment or debris distribution studies, tactical rocket firings, and vehicle and running engine experiments.

Countermine Test Facility

The Countermine Test Facility, developed to test and evaluate technologies for detecting and disarming anti-tank and anti-personnel mines and unexploded ordnance (UXO), has recently been expanded to include more test tracks and an unimproved field area.

Standard and Hypervelocity Gun Systems

EMRTC's diverse inventory of gun systems — and its ability to modify these systems to meet ballistic experimental requirements — is a major asset. Various US Army and Navy standard gun systems (5.56 NATO to 8-inch Howitzer) are available on site. EMRTC has also designed and modified a large range of gun systems that are used to fire specialized/ prototype projectiles and fragments at more than 2 kilometers per second (6,500 feet per second) and a two-stage light gas gun with a 1.5-inch diameter launch tube that can accelerate projectiles at velocities greater than 6.4 kilometers per second (21,000 feet per second).

Research and Development

EMRTC's numerous field test sites and laboratory facilities offer a unique complex for conducting research and development (R&D) in areas such as process safety; chemical analysis; explosives processing, formulation, and characterization; computer modeling and simulation; and counter-terrorism.

Process Safety

The EMRTC Process Safety Group has investigated a wide range of industrial accidents and examined a diverse group of issues ranging from thermal hazards to chemical incompatibilities. Several test sites, such as the Little Eagle Firing Chamber, are used to reproduce chemical processing conditions.

Chemical Analysis

With its new state-of-the-art chromatography lab, EMRTC researchers can conduct analyses of anything from low-level explosives contamination to post-blast residue. The lab also houses an array of small-scale thermal analysis equipment. Active research programs in explosives detection, compatibility, forensics, thermal hazards, aging, and mechanistic decomposition are ongoing.

Explosives R&D

One highly unique feature of EMRTC is the Torres Laboratory complex. Its dedicated melt-cast and pour building, 2-ton pilot plant processing structure, remote mix building and extensive wet-lab facilities can be used to fabricate a large assortment of energetic materials, ranging from common pyrotechnics, to isotopically labeled explosives, to a wide variety of improvised explosives (to replicate materials used in actual terrorist attacks). Test charges have ranged from milligrams to tons.

EMRTC scientists are pursuing active research programs designed to understand and better model the energy release of a variety of non-traditional, non-ideal explosives. Tests range from simple air-blast analyses to complex cylinder expansion tests.

A strong contract base in the commercial sector has resulted in an expanding expertise in ammonium nitrate explosives, pyrotechnic mixtures, air-bag propellants, reactive chemicals, and other exotic formulations not traditionally studied by standard explosive research programs.

Computer Modeling and Hydrocodes

EMRTC's Smoothed Particle Hydrodynamics (SPH) — a computational technique with unique capabilities for problem solving — is at the forefront of computer modeling of energetic materials. EMRTC's computational group built the first SPH code suitable for modeling the dynamic response of solids, extending the technique from astrophysical gas-dynamics into new areas of computational continuum mechanics of condensed matter.

Counter-Terrorism

With the increase of terrorism worldwide, the ability of buildings and other structures to resist blast effects is of increasing concern. EMRTC scientists are developing technologies for protecting aircraft and general purpose commercial buildings from terrorist bomb damage and for reducing injuries to passengers and building inhabitants.

Support Services

In addition to specialized modeling and simulation capabilities, fully equipped chemical and materials analysis laboratories, and advanced computer processing systems, EMRTC field investigations and R&D programs are supported by state-of-the-art data collection and processing systems; high speed film, still photography, video, and radiographic collection and processing systems; comprehensive machine shop equipment and fabrication facilities; and a wide variety of heavy equipment that allows for rapid preparation/ restoration of test sites, as well as for the construction of standard/ non-standard structures for testing the ability of building materials and methods to resist the effects of energetic materials.

Instrumentation

EMRTC has more than 30 channels of orthogonal flash x-ray available for use in testing, including 150 and 450 kilovolt and 1 megavolt systems. EMRTC also has a wide range of fixed and portable electronic digitizers that cover needs from very slow digitizer rates up to 1 nanosecond per point.

Numerous computer controlled data collection systems are available for enhancing ballistic analyses. A complete electronics calibration laboratory is used to calibrate digital and analog data collection devices to meet National Institute of Standards and Technology criteria.

Photography

Ultra high speed, high speed, and still photography in both color and black and white, 16 millimeter and 35 millimeter formats at speeds up to 40,000 frames per second are available for test support. Image motion compensation photography in these formats is also available, as are still photography and video Tape (SVHS and VHS). EMRTC processes all film (including x-ray film) in-house. High speed movie film can be processed and available for study within 1 hour (overnight processing is standard). Film can also be transferred to video tape for editing and analysis.

For Additional Information on EMRTC Capabilities, Facilities, Programs, and Training Schedules, Visit the EMRTC Website or Contact

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Training Programs

EMRTC draws upon its extensive experience and expertise to conduct training for US and friendly foreign government entities in the following subject areas:

- *Domestic Counter-Terrorist Training Program*
  - *Incident Response to Terrorist Bombings*
  - *Bomb Threat Training*
- *Explosive Firing Site and Laboratory Safety Course*
- *Anti-Terrorism Assistance Program*
  - *Rural Border Operations*
  - *Hostage Negotiation*

Expanding Technical Horizons

As was the case more than 50 years ago with the development of the proximity fuze and all of the technologies and applications that resulted therefrom, EMRTC stands poised to extend its military, space, and commercial systems capabilities and to better meet the diverse and complex challenges of its rapidly growing customer base.

As such, active planning is now underway to expand EMRTC's capability to investigate the implications and applications of electromagnetic environmental effects, explosive energy induced electromagnetic radiation environments, and microelectronics survivability, all of which are logical outgrowths of EMRTC's past and current RDT&E efforts.

"EMRTC—Finding and Sharing Solutions to Technology Challenges"