

3M Technologies for Defense
Energy and Advanced Materials Division



Enhancing
Mobility, **Power**
& **Protection**



Materials science for the changing face of warfare

Rising global tensions; the emergence of boundary-less, asymmetric conflicts; and the increasing sophistication of non-traditional combatants is changing the way military planners are responding to today's constantly-evolving security threats.

A new generation of weapons systems and vehicles – offering greater mobility, lethality and battlefield survivability – is a key element of that response. In turn, this has led to a growing need for innovative materials – combined with applications development expertise – to make these new systems practical and cost-effective.

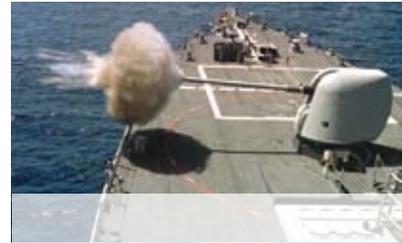
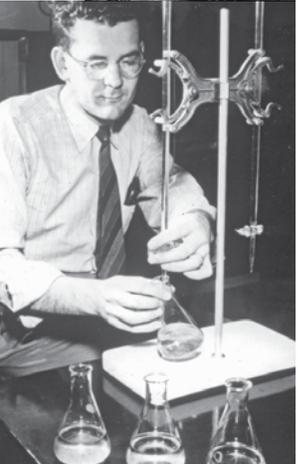
3M is helping to fill that need. For over 60 years, 3M Energy and Advanced Materials Division (EAMD) has been a developer and manufacturer of technologies used in a wide range of industrial and military applications to improve productivity; enhance product quality; protect health and safety; and control costs.

For the most part, our products are “ingredients” used by our customers in manufacturing their own high performance products. This kind of business is characterized by a high degree of customization and extended developmental lead times. As such it requires the establishment of close, long-term cooperative relationships between customer and supplier, which is how we have done business for the past 60 years.

In these pages, we hope to demonstrate that 3M Energy and Advanced Materials Division represents a unique resource of technology and talent – dedicated to finding better, more cost-effective ways to ensure tactical superiority, while protecting our men and women on the battlefield.



3M Energy and Advanced Materials Division's involvement with the aerospace and defense industries goes back some 60 years, to our very beginnings. In those years immediately following World War II, 3M worked with the U.S. military to develop a new generation of high-performance synthetic rubbers for use in rockets and jet aircraft.



Lighter, stronger aircraft & vehicles

3M EAMD Technologies for Defense

High-Performance Fluoropolymers

3M, through Dyneon, a 3M company, offers a broad range of fluorinated elastomers and plastics. The outstanding temperature and chemical resistance of Dyneon™ Fluoropolymers makes them ideal for many demanding aircraft and aerospace applications, such as fuel system seals, hoses, gaskets, wire and cable jacketing and much more.*

Energetic Materials

3M polymeric binders and additives are used to enhance the performance of propellants, ordnance, pyrotechnics and gas generants. They are also being used in applications ranging from reactive armor to decoy flares.

Glass Bubbles

3M™ Glass Bubbles are strong, lightweight hollow glass spheres that have long been used as weight reducing additives in aircraft polymers, and to add buoyancy and insulating properties to syntactic foam.

Our newest glass microsphere, 3M™ Performance Additives iM30K, combines light weight with high strength, and is capable of surviving injection molding pressures up to 30,000 psi.



More
powerful
fuels &
munitions

Ceramic Fibers, Textiles and Composites

Another EAMD technology with a long defense pedigree is 3M™ Nextel™ Ceramic Fibers. These unique materials can withstand temperatures up to 2500°F, and can be sewn or fabricated into a limitless number of configurations to protect vital engine and airframe components. For example, Nextel Woven Fabrics are used in the Delta II rocket to protect the engine from the plume of the solid boosters. And blankets of Nextel fabric are widely used as firewalls aboard military and civilian aircraft.

3M™ Nextel™ Fibers are also the basis of 3M™ Metal Matrix Composites – aluminum composites that offer the stiffness of steel at half the weight. Other properties such as outstanding fatigue performance and compressive strength, low creep rate, low thermal expansion and corrosion resistance make this material unlike any monolithic metal in existence today.

3M™ Nextel™ 610 Structural Fibers are also used in the manufacture of high-performance polymer composites, for lightweight, high-strength components such as aircraft radomes.

Air Filtration Media

EAMD offers a variety of high performance filtration products for commercial HVAC systems, used in office buildings, hospitals and other large structures, as well as in room air purifying devices and filtration systems for vehicle cabins. Depending on the application, systems can be configured to remove dust, smoke, odors and many common allergens. And we are working on the development of advanced biofilters with the ability to remove many kinds of pathogens and toxins.



Increased
protection
of personnel
& equipment

3M™ Glass Bubbles for Cryogenic Insulation

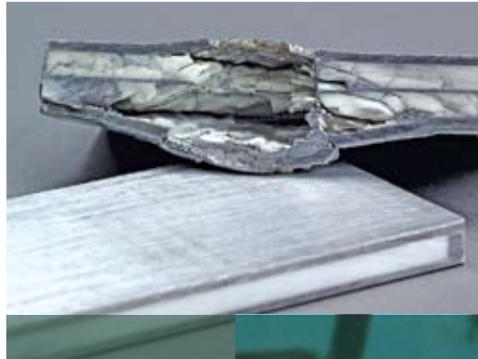
In a wide-ranging series of tests sponsored by the NASA Kennedy Space Center, 3M glass bubbles have demonstrated their effectiveness as alternatives to conventional insulating materials, such as insulating powder, spray foam and multi-layer insulation (MLI), in cryogenic vessels and transfer lines.

Unlike insulating powder, 3M glass bubbles remain in a fluidlike state, so they don't become continually compacted at the bottom of the tank. This not only results in consistently-high thermal performance, but also eliminates the need for "top off" insulation maintenance. Compared to foam, 3M glass bubbles offer improved thermal performance and will not degrade, helping to reduce maintenance costs.



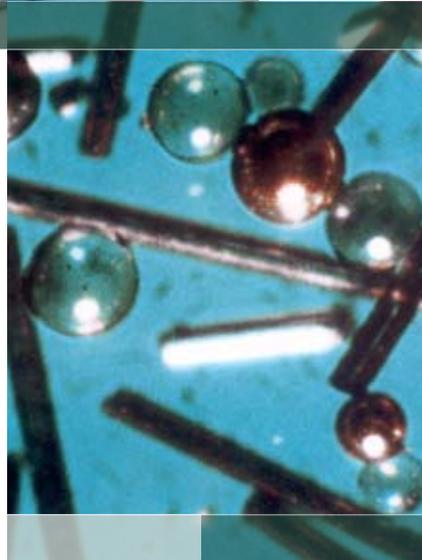
Taking the Next Step

EAMD technologies are widely used in their basic forms to address a broad range of defense and aerospace industry needs. In addition, many of these same products are being combined with other 3M technologies to develop new materials with unique high-performance properties and attributes. Some examples of these new combinations are included here.



3M expertise in ceramic composites and thin film technologies are the basis for a new kind of lightweight armor tiles currently under development. The material is designed to offer improved survivability after multiple hits.

Microscopic metal-coated particles, developed through proprietary 3M nanotechnology processes, are being evaluated for use in advanced composite materials, for applications including radar-attenuation and IR reduction.



3M technologies including glass bubbles and specialty adhesives are the basis for a new kind of durable, spray-on thermal insulation for military vehicles that offers improved crew comfort with less weight and greater durability than conventional insulative materials.

Enhanced protection

3M Defense Technology Offerings

Listed below are just a few of 3M's defense technology offerings:

- Structural fibers for advanced composites – metal matrix composites (MMC), polymer matrix composites (PMC) and ceramic matrix composites (CMC)
- Glass bubbles that reduce weight, maintain dimensions and provide other special properties
- Rugged Multi-hit MMC ceramic armor tiles
- High-performance fluoropolymers from Dyneon with outstanding temperature and chemical resistance*
- Durable, sprayable performance coatings for insulation and physical protection
- Nextel ceramic fibers and textiles – fire resistant, ultra-high temperature textiles for extreme environments
- Stealth materials
- Radar-transparent materials
- Energetic materials – polymeric binders, additives and process aids used to enhance the performance of propellants, ordnance and pyrotechnics



Make the uncommon connection today

West – Larry Mize

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503-975-4711

- **3M™ Glass Bubbles**
www.3M.com/microspheres
- **3M™ Metal Matrix Composites**
www.3M.com/mmc
- **3M™ Performance Coatings**
1-800-223-1687
- **Dyneon™ Fluoropolymers**
www.dyneon.com
- **Energetic Materials**
1-800-223-1687

East – Bill Gibbons

bwgibbons@mmm.com
734-779-5178

- **Nextel™ Ceramic Fibers and Textiles**
www.3M.com/ceramics
- **Radar-Transparent Materials**
1-800-223-1687
- **Stealth Materials**
1-800-223-1687

* Dyneon™ Fluoropolymers are made and manufactured by Dyneon LLC, a 3M company, and/or its subsidiaries and affiliates. Please contact Dyneon for information about or to buy Dyneon products.

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