

COMPOSITE TECHNOLOGY DEVELOPMENT, INC.
ENGINEERED MATERIAL SOLUTIONS



Leadership Statement

Mission

CTD integrates advanced materials, insightful engineering, and creative manufacturing to provide innovative products offering new capabilities.

Primary Goals of the Company & Vision

The goal of CTD is to realize the full commercial potential of the products and technologies we develop using our unique materials, engineering expertise, and creative manufacturing processes. The fusion of this expertise enables CTD to design useful products that provide a competitive edge for our customers.

Integrated Systematic Approach

An Integrated Systematic Approach (ISA) is fundamental to our success and provides our competitive advantage in introducing products that push the state of the art in current and emerging markets. The development of novel materials is core to this process and is often driven by engineering and/or manufacturing requirements. CTD's ISA enables solutions that improve our customer's business and provide new capability to the market.



Core Competencies

CTD's Integrated Systematic Approach has produced several novel classes of materials, which are engineered and manufactured into products for a variety of markets. The unique engineering methods and manufacturing processes developed by CTD for these products push the state of the art. CTD provides value to our customers by successfully designing, engineering, qualifying, and manufacturing new products that encompass the attributes of these our novel materials.

Provocative Products

NANUQ® High Temperature Insulation for Electrical Equipment

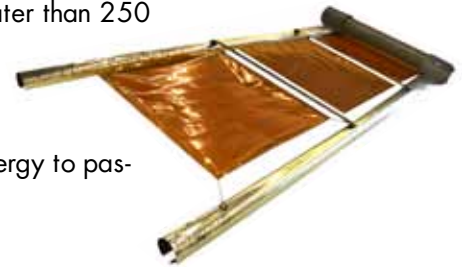
Improved performance and efficiency of electrical components, such as motors, power cables, and connectors are limited by their maximum operating temperature. CTD has developed NANUQ® high temperature insulation that provides superior electrical performance and stable operation up to 300°C - improving the reliability of electrical devices operating at elevated temperatures.



TEMBO Deployable Structures for Satellites

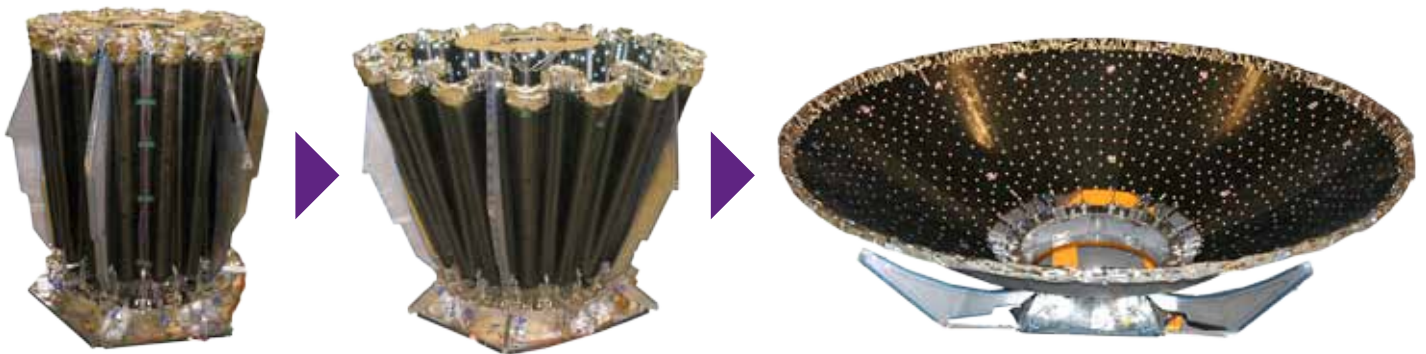
RAPDAR

The Rollout And Passively Deployed Array (RAPDAR™) has been developed to provide solar arrays capable of generating greater than 50 kW of total power, at power densities greater than 250 W/kg, which are required for future satellites. This innovative, patent-pending design takes advantage of the latest advances in thinfilm photovoltaic and TEMBO® Elastic Memory Composite (EMC) deployment technologies to provide higher power and higher power density solar arrays. A key feature of the design is the use of solar energy to passively actuate the TEMBO® EMC structure and deploy the array.



TEMBO® Antenna Reflectors

The size and cost of available antenna reflectors limits capabilities of communications satellites. The value of a satellite is based on the quantity of data it can transmit, and data transmission rates are in a large part proportional to antenna reflector area. Based on TEMBO® shape memory polymer technology, CTD has developed a deployable solid surface reflector that can be packaged into a reduced volume for launch and potentially more than triple the available antenna area on a satellite.



KIBOKO® Linerless (Type V) Composite Pressure Vessels

Robust, lightweight, high-strength vessels are needed for storage and transport of liquids and gases for automotive, space, aerospace and other uses. CTD has developed KIBOKO® linerless (Type V) composite pressure vessels which offer weight savings and improved mass storage efficiency over other types of vessels. Additionally, since there is no liner, thermal issues associated with rapid fill and drain are eliminated. The inherently simple construction can reduce costs and increase the overall lifetime of the vessels.



CryoCoat™ Cryogenic Insulation

CTD's CryoCoat thermal insulation products have excellent thermal and mechanical properties at cryogenic and elevated temperatures, can be tailored to meet a wide range of requirements, and can be applied using a variety of processing methods. CTD's CryoCoat thermal insulation systems are used to:

- Prevent liquid formation on the upper stages of the Boeing Delta IV launch vehicles
- Insulate cryogenic lines at the Kennedy Space Center
- Insulate the liquid helium chamber for the Alpha Magnetic Spectrometer II
- Fuel system piping on aircraft and spacecraft that use cryogenic fuels



KUMBA™ Marine Composites

CTD has developed a new class of strong, tough, and erosion resistant composites for marine rotor applications. In addition to providing the required mechanical performance, CTD's KUMBA™ Lightweight Marine Composite materials provide cavitation erosion resistance that compares to the metals used for today's marine rotors. Composites offer numerous potential advantages for marine rotors that can reduce both life cycle and acquisition costs. The anisotropic properties of composites can provide more efficient structures. This is an emerging product area for CTD under which development and manufacturing is underway for composite propellers for the Navy and other marine rotors and structures in related markets.



Facilities

CTD's 27,000 square foot facility provides capabilities for laboratory research and pilot-scale production as well as unique testing capabilities.

Material development laboratories - a perfect setting for new materials Formulation allowing for the duplication of nearly all composite fabrication methods such as vacuum assisted resin transfer molding (VARTM), filament winding, resin film impregnation, and wet layup

State-of-the-art testing and fabrication laboratories - Used for product development and evaluation as well as extensive material testing and evaluation

High bay fabrication and testing facility - 6000 square foot high bay suitable for fabrication and testing of large structures such TEMBO® deployable structures



Fabrication

CTD Material Sales

CTD manufactures and distributes worldwide about 30 different NANUQ® insulation and CryoBond™ Adhesive and CryoCoat™ Insulation products. These products are used for a variety of applications in several markets including medical, high-energy physics and fusion research, automotive sensors, space, and aerospace

Prototype & Pilot Scale Fabrication

A successful innovation is achieved when a technology is encompassed into a product and the product is accepted in the market. At the time of product introduction, full commercial manufacturing may have not have been developed, CTD has the ability through our Safari Manufacturing Subsidiary to manufacture. CTD has designed, manufactured, tested, and qualified numerous products including satellite solar arrays and antenna reflectors, lightweight composite pressure vessels, robust cold-to-warm supports for superconducting magnets, high voltage electrical breaks, composite propeller blades and many more.



Services

Testing Services

CTD's intimate familiarity with material behavior and test methods ensures high quality testing and accurate results. We have the experience and expertise to test materials in or after exposure to harsh environments including cryogenic and elevated temperatures, in the simulated vacuum of space and after exposure to high levels of radiation. CTD offers standard ASTM and SACMA procedures as well as custom test development and been the sole source test house for several high profile projects

- Optical structures for the James Webb Space telescope
- Composite, cryogenic tank material testing for NASA's Space Launch Initiative
- Insulation and mockup testing for the International Thermonuclear Experiment Reactor (ITER)

Related to testing CTD also offers the additional services:

- Development of cost effective test plans
- Test specimen configuration, selection, preparation, and design
- New test method and/or procedure development
- Design and development of mock-up and/or prototype tests
- Failure analysis and subsequent material/part redesign



Engineering Design & Analysis

CTD offers an array of engineering services that utilize our unique expertise in the design of composite materials to reduce risk for our customer's projects and product development activities. Many of CTD's customers have expertise in areas other than materials and composites design. Therefore CTD provides services to design composite structures, select appropriate materials, and define cost effective manufacturing processes that will help our customers to effectively and efficiently meet their product or customer goals. These efforts are usually anchored by the development of engineering models and the analysis of their performance using finite element analysis. CTD's expertise in micromechanics of composites enables considerable insight into design subtleties that are often not made apparent with conventional laminate analysis techniques. Oftentimes CTD is called upon to validate the results of these analyses by testing material coupons or the designing and testing of prototypes or structural sub-assemblies.



Emerging Products and Technologies

Materials, Structures, and Components for Renewable Energy

CTD is playing an active role in the development of new materials, structures and components required to commercialize renewable energy technologies. We work closely with the Department of Energy, National Laboratories, and strategic industrial partners to ensure these renewable energy resources are practical and cost effective.

Solar Arrays

New developments in thin film and high efficiency solar cells are improving the capture of solar energy with photovoltaic cells. CTD has developed lightweight and efficient structures that enable the lower weight of these new solar cells to be realized in solar array systems used on satellites. Solar arrays in used remote locations by the military, emergency and disaster response teams, and recreationalists can significantly reduce green house gases generated by diesel generators.

Tidal Turbines

Harnessing the kinetic energy of the world's ocean and tidal currents is part of the US's renewable Ocean tidal systems convert kinetic energy of moving tides and currents into electrical energy via underwater turbines that drive generators. CTD is developing composite turbine blades designed to withstand the marine environment and out perform blades made from metal.

Geothermal Systems

Geothermal energy is a key renewable source of energy. Unlike wind and solar power, it is not affected by changing weather and is always available to meet power demands. CTD is developing electrical insulation for down-hole motors, circuit boards for sensors and power electronics, as well as zonal isolation devices that can reliably operate at temperatures up to and exceeding 300°.

Carbon Nanotube Composite Materials

Carbon nanotubes represent a revolutionary technology in the field of materials science and composites. CTD is working to bring the significant possibilities offered by carbon nanotube research into revolutionary new materials, structural composites and practical applications.

Company Profile

CTD was founded in 1988 to develop composite components for the Department of Energy in support of future fusion-energy systems. The first decade of the company was primarily spent exploring new polymer chemistries, manufacturing processes, and test methods.

In 1999, CTD invented TEMBO® Elastic Memory Composites – carbon fiber reinforced shape memory polymers that are used to fold structures that are subsequently unfolded by being heated. This breakthrough ignited company growth and led to the development of additional novel materials and product platforms for various markets. Currently employing about 40 scientists, engineers, technicians, and administrative staff, CTD is capable of providing top performance on Government as well as commercial contracts. CTD is currently commercializing several of the products developed by the company.

Contact Information

Mike Tupper
Executive Vice President

Composite Technology Development, Inc.
2600 Campus Drive, Suite D
Lafayette, CO 80026

Phone: 303.664.0394 **Ext:** 111
Email: mike.tupper@ctd-materials.com

www.ctd-materials.com



