METALWORKING TECHNOLOGY Update

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In Use in Industry

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What's New

Six Projects in Support of CVN 21

21st Century Metalworking Solutions for Ships that Must Go in Harm's Way

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Concurrent Technologies Corporation (*CTC*) operates the National Center for Excellence in Metalworking Technology (NCEMT) for the U.S. Navy Manufacturing Technology (ManTech) Program. The NCEMT serves as a national resource for developing and disseminating advanced technologies for metalworking products and processes. The NCEMT applies these technologies to solve productivity problems in support of the Navy and Department of Defense needs.

CTC is committed to assisting industry and government achieve world-class competitiveness. Through a unique concurrent engineering framework, *CTC* provides comprehensive solutions that improve our clients' product quality, productivity, and cost effectiveness. The professional staff of *CTC* has the requisite experience, knowledge, and resources to rapidly and effectively meet the diverse needs of our clients by transitioning appropriate science, technology, and management applications.

For further information about topics in this publication or about *CTC*, please contact 717-565-4405.

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Mark Your Calendars

NCEMT-Facilitated Events

ShipTech 2005, Beau Rivage Resort, Biloxi, Mississippi
March 1–2, 2005

Low-Cost Titanium Workshop, Rosen Centre Hotel, Orlando, Florida
February 1–2, 2005

Watch for Our Exhibit

Defense Manufacturing Conference (DMC '04)
Bally's, Las Vegas, Nevada, November 29–December 2, 2004

Stay tuned for more information.

The cover computer image of the CVN 21 is courtesy of the U.S. Navy.

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Project Profile

NCEMT Improves LW155 Howitzer

Developing, optimizing, and transferring novel manufacturing approaches are some of the things that the NCEMT does best. The most recent example is the NCEMT's effort to reduce the part count, manufacturing cost, and waste for the M777 Lightweight 155mm Howitzer (LW155). The M777 Program is a joint effort between the U.S. Marine Corp and Army to replace aging, steel-intensive M198 155mm howitzers. Titanium is the replacement choice, but is significantly more expensive and much more complex to manufacture.

Under the Improved Affordability of Titanium Components for Marine Corps' M777 Lightweight 155mm Howitzer project, the NCEMT is developing single-piece investment cast spades for the LW155 in collaboration with the Lightweight Howitzer Joint Program Management Office (JPMO) of Picatinny, New Jersey; BAE Systems of the United Kingdom; and a titanium foundry. The spades that stabilize the LW155 during firing were previously fabricated by machining and welding 60 individual pieces, which is labor-intensive and expensive. The NCEMT project team, under the direction of Mehmet Gungor and Wm. Troy Tack, has worked with its partners to successfully reduce the part count from 60 to 1 by producing a near-net-shape spade casting. A similar challenge was reducing the 110 individual subcomponents of the LW155's saddle. The NCEMT is also working with the JPMO, BAE Systems, and a titanium foundry to create a single-piece investment cast saddle. To reduce the production cost of the LW155's cradle tube, the NCEMT is pursuing novel manufacturing methods, such as flowforming, to replace the current machining-intensive approach.

The Joint Defense Manufacturing Technology Panel recently recognized this NCEMT project for "significant contributions to the DoD ManTech Program." The project was cited as having "all the elements in place to have a significant impact on future production of our weapon systems." ■

Change	Benefit
• Single-piece investment cast spade	• Expected $27M cost savings
• Single-piece investment cast saddle	• Expected $5M savings over 5 years
• Use of flowformed tube	• Cost is 68% less than baseline production
• High-strength Ti-6Al-4V vs. steel for a major portion	• 16,000 lbs vs 9,000 lbs (44% weight reduction)

NCEMT Responds to Industry Request with Creation of Low-Cost Titanium Database and Web Site

As part of the effort to promote the use of low-cost titanium alloys, the NCEMT is developing the Low-Cost Titanium Database and Web Site. The Web site, which will be accessible via www.ncemt.ctc.com, will enable secure public access to material properties information on low-cost titanium alloys. The NCEMT's creation of the database is in response to a request that such a database is needed, which resulted from discussions at the Low-Cost Titanium Workshop that the NCEMT facilitated on December 10–11, 2003, in Baltimore, Maryland (see p. 6).

Weight reduction is an important goal for ground vehicles that are currently under development and also for ship structures. Titanium alloys may help to accomplish that goal; however, their relatively high cost as compared to steel and aluminum alloys has limited their usage. Consequently, the NCEMT has performed significant work related to low-cost titanium applications for the Marine Corps and Army (work sponsored by TARDEC) and is starting a titanium components project in support of CVN 21 (see p. 4).

The Low-Cost Titanium Database will be a compilation of materials testing that is performed by the NCEMT, *CTC*, major titanium producers, and established research and testing institutions such as the American Society for Testing and Materials. Also included are previously published results from respected trade journals.

The Web site will require users to register for user names and passwords to gain access. Registrations will be verified by the NCEMT for any necessary security issues and users will then be granted access to all approved data. A robust search feature will enable searches by "attribute" and "keyword." Search results can be viewed, printed and exported, all via users' Web browsers. Users can create charts and graphs from Search results with a charting/plotting feature on the Web site. These plots can be printed from the browser or downloaded to users' local PCs. A data import feature will allow users to submit their own test data for inclusion on the Web site following data approval by an NCEMT administrator/information owner.

The Low-Cost Titanium Database and Web Site development team began the project in January and plans to have the Web site ready for a beta release to the public this summer. Questions or comments can be directed to Greg Hafer at 717-565-4402 or haferg@ctcgsc.org. ■

Screen capture of the NCEMT's Low-Cost Titanium Database and Web Site.

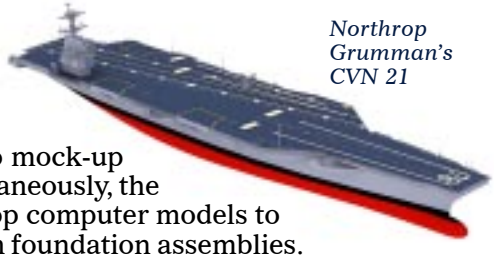
The NCEMT is working with many organizations as part of Integrated Project Teams (IPTs) to accomplish project goals associated with the CVN 21. They include the PMS 378 Program Office; the Naval Surface Warfare Center, Carderock Division; the appropriate NAVSEA Technical Codes; Northrop Grumman Newport News; electrode, steel, and LASer-welded corrugated-CORe (LASCOR) manufacturers; the Institute for Manufacturing and Sustainment Technologies; and the Navy Joining Center.

Availability of SMAW Electrode (MIL-10718-M) Required for Ballistic Performance Requirements

Phase One of this project will optimize 1/8-inch diameter and develop 3/32-inch diameter MIL-10718-M shielded metal arc weld (SMAW) electrodes, thus having two diameters of MIL-10718-M electrodes that consistently meet the required ballistic performance in welded HSLA-100 and HY-100 steels. These same goals will apply to 5/32-inch diameter MIL-10718-M electrodes to be developed in Phase Two. The NCEMT will work with two electrode manufacturers to optimize MIL-10718-M manufacturing and testing practices for the two electrode diameters. The electrode manufacturers will provide multiple lots of each size electrode to two shipyards for verification of operating characteristics, weld metal mechanical properties, and welder appeal.

Manufacturing Process Development for Elimination of Weld Distortion of CVN 21 Heavy Plate Erection Units

The new CVN 21 aircraft carriers will use different grades and gages of steel than the CVN 68 class of aircraft carriers, so new fabrication parameters must be established to achieve requirements for flatness in foundation assemblies. This 38-month project will develop, calibrate, upgrade, and validate fabrication parameters that will produce CVN 21 innerbottom assemblies that meet flatness requirements by measuring the distortion during construction of two mock-up assemblies. Simultaneously, the NCEMT will develop computer models to predict distortion in foundation assemblies.



Northrop Grumman's CVN 21

High Strength and Toughness Naval Steels for Ballistic Protection

As a lead Center of Excellence to oversee the optimization of new high-strength, high-toughness steels, the NCEMT will develop and test the new material while supporting certification and implementation efforts. This material must meet manufacturing specifications and meet or surpass the ballistic, material, welding, and structural performance of comparable steels used in similar applications. NAVSEA is interested in utilizing this new material to attain a reduced thickness of at least 1/8" in its intended application to achieve a weight savings of over 400 long tons per ship and significantly lower the center of gravity.

Development of Cost-Effective, Low-Manganese, Flux-Core Welding Electrode for Joining High-Strength Steels

This project will develop a modified MIL-101T-"X" low-fuming, flux-cored welding electrode for use with 95% Ar-5% CO_2 shielding gas. The modified electrode will minimize welder exposure to manganese and other fumes without increasing porosity or diffusible hydrogen content while still meeting NAVSEA Technical Publication requirements and shipyard operability characteristics. The expected benefits are improved productivity and reduced welder exposure to hazardous fumes.

Issues Associated with the Fabrication of Titanium Components

The CVN 21 ship class is the next generation of aircraft carriers in the design stage, and an important design consideration and key factor in optimizing aircraft-carrier ship performance is weight reduction. A possible solution is the use of titanium. The high specific strength, high fatigue strength, good corrosion resistance, reduced magnetic signature, and good fracture toughness properties have always made titanium attractive to the Navy, but until recently it has been too cost-prohibitive to use. Recently, improved processing and melting techniques have reduced manufacturing costs for titanium components. The NCEMT is working with IPTs to develop, demonstrate, and implement titanium naval components for use as CVN 21 ship structures. The three-phased approach involves identifying candidate components, manufacturing methods, benefits, and risks; demonstrating the ability to manufacture and evaluate demonstration component(s); and addressing ship producibility and ensuring that the components meet the required service performance specifications.

Application Development for Use of LASCOR Panels

This project will optimize the development and implementation of an enabling technology, which may include roll-forming of specialized sheet metal designs and automated CNC-controlled laser welding with YAG or CO_2 laser systems for the manufacture of LASCOR panels in ship construction, reducing the ship's weight and lowering its center of gravity. LASCOR is a sandwich panel of thin sheet metal with specially designed corrugated metal cores in between. Design and fabrication of LASCOR is too underdeveloped for critical applications. Also, methods of attaching LASCOR panels to the ship structure, addition of attachments, methods of accounting for the directional properties of the panels, and repair issues have yet to be established. Manufacturing methods will be developed to accommodate these and other construction realities. The NCEMT will focus on design details for LASCOR and define processes and procedures for panel repair and/or maintenance, which will allow LASCOR to be substituted for the plate-stiffened structures that are currently used for decks, bulkheads, and other applications. The project consists of a phased series of tasks to develop manufacturing methods for attaching panels to the ship's structure, attaching features to the LASCOR panels, and joining these panels to dissimilar materials and to each other. ■

"Together we are committed to developing and deploying the most agile, lethal and survivable ships—fully prepared to go in harm's way."

Daniel L. Winterscheidt

"Individual commitment to a group effort—that is what makes a team work, a company work, a society work, a civilization work." While teamwork is not a new practice for the U.S. Navy, Vince Lombardi's words accurately embody the concept and the spirit of the ManTech Integrated Project Teams (IPTs) that were established for two new ships that are currently under development by the U.S. Navy.

Serving as both a leader for and a member of the IPTs, the NCEMT is providing direction and specific metalworking technology expertise for the construction of the next-generation aircraft carrier CVN 21 and the new surface combatant DD(X). Our participation in the IPTs enables the NCEMT to collaborate with outstanding individuals and organizations, to ensure that stakeholder needs are met, and to develop and optimize innovative metalworking applications.

As a member of the CVN 21 IPTs, the NCEMT has worked closely with the Naval Surface Warfare Center, Carderock Division (Carderock), the Naval Sea Systems Command Technical Codes, the Navy Joining Center (NJC), the Institute for Manufacturing and Sustainment Technologies (iMAST), Northrop Grumman Newport News, and the Carrier Program Office (PMS 378) to successfully develop several new projects in support of CVN 21. These projects, which are intended to achieve significant weight savings for the carrier, include High Strength and Toughness Naval Steels for Ballistic Protection, Application Development for Use of LASCOR Panels, and Issues Associated with the Fabrication of Titanium Components. Several other projects have also been undertaken to provide the joining technology required to construct CVN 21 (see p. 4 for details).

In addition, the NCEMT is working to address the manufacturing needs of the DD(X) Program, as prioritized by the Surface Strike Affordability Initiative Leadership IPT. We are teaming with the NJC on two projects in support of DD(X): Automated Thermal Plate Forming, which is led by the NCEMT, and Manufacturing of Large Marine Structures, which is led by the NJC. Moreover, we are currently developing a new project—Advanced Bonding Methods for Steel Structures—that will be a cooperative effort among Carderock, the NCEMT, the NJC, Northrop Grumman Ship Systems, and Bath Iron Works.

Our Navy deserves nothing less than the best. IPTs ensure that the Navy attains the best organizations, the best technology and the best solutions. Each team member brings a unique skill, resource and perspective to the IPT. Together we are stronger, more effective and smarter than our individual organizations. Together we are committed to developing and deploying the most agile, lethal and survivable ships—fully prepared to go in harm's way.

Daniel L. Winterscheidt

Daniel L. Winterscheidt, Ph.D.
Program Director
National Center for Excellence in Metalworking Technology

Achievement Award

NCEMT Program Director Creates NCEMT Achievement Award Program

To recognize NCEMT staff and project teams for exceptional performance and results, NCEMT Program Director, Dan Winterscheidt, has created the NCEMT Achievement Award. The first award was presented on February 26 in Johnstown, Pennsylvania, to the Advanced Thermal Battery Production (ATBP) Project Team comprised of Tim Freidhoff (Project Manager), Al Baum, Hao Dong, Dan Markiewicz, Lonnie O'Baker, Ken Sabo and Michelle Zeglin.

The ATBP Project Team was recognized for attaining or exceeding all manufacturing process improvement goals, and successfully implementing automated battery manufacturing processes in a production environment for a leading thermal battery manufacturer. In addition, the project ranked in the top 10% of projects reviewed by the Joint Defense Manufacturing Technology Panel in 2003. ■

NCEMT staff receive the first NCEMT Achievement Award for their meritorious achievement on the ATBP Project. L to R: Al Baum, Lonnie O'Baker, Tim Freidhoff, Michelle Zeglin, and Hao Dong. (Team members not pictured: Dan Markiewicz and Ken Sabo)

NCEMT's *Low-Cost Titanium Workshop* Develops Working Relationships throughout the Defense Industries

On December 10–11, 2003, the NCEMT conducted its first *Low-Cost Titanium Workshop* to bring together industry and government organizations to discuss low-cost titanium initiatives for ship and ground vehicle structure applications. Over 150 representatives from a wide range of organizations attended this two-day workshop at the Sheraton Inner Harbor Hotel in Baltimore, Maryland, including the Departments of Defense and Energy Program Offices, research laboratories, metal fabricators, titanium producers, and universities, to explore the designers' viewpoints in order to make low-cost titanium a feasible material choice for weight reduction and performance improvements. The workshop also afforded an opportunity for attendees to exchange information on current technology status and future research and development needs. Participants are touting the workshop as a success in promoting collaboration among industry and government organizations. (See the May issue of *Advanced Materials & Processes* for complete article.)

Low-cost titanium products are defined as useful titanium alloy products whose production path involves processing that lowers costs, including reduction processes, electron beam and plasma arc single-melt processes, optimized thermo-mechanical processing, and near-net-shape fabrication.

Relationships will continue long after the workshop, with the anticipation that significant advances will be the feature of the next *Low-Cost Titanium Workshop* slated for spring 2005. ■

L to R: Richard J. Henry, *CTC*/NCEMT; and Dr. Charles D. Milligan, George L. (Larry) Becker, Richard Neely, and Jim Murphy, all of NAVSEA

ShipTech: Great Place to Network

On January 27–29, 266 attendees gathered at the Beau Rivage Resort in Biloxi, Mississippi, for *ShipTech 2004: A Shipbuilding Technologies Information Exchange* to share information on modern shipbuilding technologies—a 35% increase in attendance over *ShipTech 2003*. The NCEMT established this information exchange in 1998 to highlight successful technology development and implementations, promote discussion on current and future technology needs of Navy/DoD Program Offices, and identify opportunities to jointly implement new technologies. ONR Navy ManTech and the National Shipbuilding Research Program (NSRP) sponsor the event. Attendees at this year's exchange commented that *ShipTech* provides a great place to network. Most comments received support the fact that not many single-location venues exist that provide access to various Navy Program Executive Offices, naval officers, shipbuilding industry executives, key members of the ManTech community, the Centers of Excellence, and critical industry technology developers who are represented within NSRP panels. The format was comprised of plenary speakers, a panel discussion, and several technical sessions: production processes, business processes, product design and materials, and system technologies

ShipTech 2005 is scheduled for March 1–2 at the Beau Rivage Resort in Biloxi, Mississippi. ■

For information about free proceedings, visit www.ncemt.ctc.com or contact Tricia Wright at wright@ctcgsc.org or 814-269-2567.