

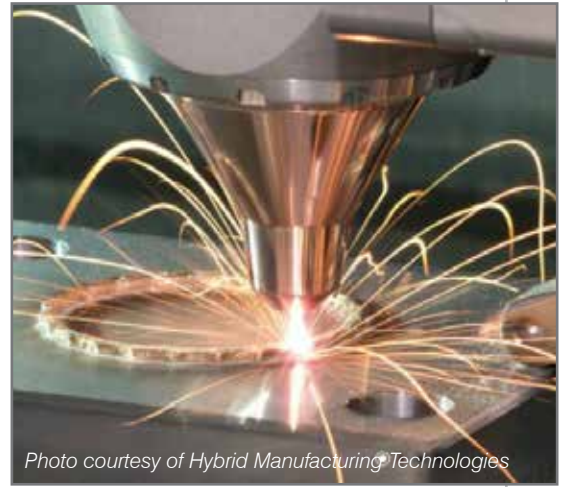
Concurrent Technologies Corporation Metal Additive Manufacturing (3D Printing)

AM Parts and Repairs

Concurrent Technologies Corporation (CTC) currently offers three Additive Manufacturing (AM) processes to provide our clients both complex part manufacturing and the ability to repair worn or damaged high-cost components.

- Laser Powder Bed Fusion
- Hybrid Additive Manufacturing
- Cold Spray

Whether you need specific part geometry for performance enhancements or a cost-effective repair process for high-dollar components, CTC offers the AM process that can get you results in days. Our engineers can move you quickly from concept and design to manufactured product. These processes can also be merged together to provide customized solutions.



Why Choose Concurrent Technologies Corporation?

Building on its 30+ year history in metals and metals processing, CTC is an all-encompassing provider for Additive Manufacturing solutions. All processes are controlled in-house to ensure quality results.

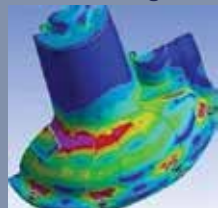
We offer a comprehensive suite of services including reverse engineering, process development, characterization of powder and substrate, surface profile preparation, material application, post processing, final machining, and inspection. CTC also provides services to evaluate, validate, and qualify the part through mechanical and physical property characterization.

What We Can Do For You

Part Identification



Reverse Engineering/Solid Modeling



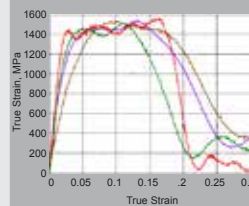
Prototype and Part Manufacturing



Performance/Mechanical Testing



Design Allowables and Qualification



Equipment Selection and Transition



Innovative Solutions such as AM Gaseous Deposition



Concurrent Technologies Corporation's In-House AM Processes

Laser Powder Bed Fusion

To create the highest quality parts, CTC is equipped with the all-in-one SLM 280HL 3D printer. Using various materials—aluminum, titanium, stainless steel, cobalt-chromium and others—we provide versatile, fast, rapid prototyping using double laser beam technology.

The SLM 280HL is an all-in-one selective laser melting machine with a build envelope of 280 x 280 x 350 mm. At almost ten feet tall, the SLM 280HL is used for continuing research and development efforts at CTC, where we innovate and build upon industry knowledge of additive manufacturing, especially for metals.



Achieving greater component quality for complex, delicate, yet fast part builds

Hybrid Additive Manufacturing

Hybrid AM can be combined with CNC machining. Because of this dual nature, hybrid machines can begin producing a part by using either of the two processes. However, beginning production using additive manufacturing is inherently more efficient than needing to mill a form and typically offers broader design freedom.

Our engineers are experienced in the additive production method called laser cladding. Laser cladding is a precision welding process that deposits granular metals onto a surface where they are immediately liquefied into a melt pool by a high-energy laser, and it is important in the hybrid manufacturing process.

Once cooled, the deposited metal becomes a solid. Then we begin CNC milling on the part. We can use a number of tools to shape a surface and add critical features where needed.



Combining additive and CNC (subtractive) technologies to make new parts and repairs

High Pressure Cold Spray

Cold spray is a lower temperature solid-state thermal spray process that deposits metal powder using a heated inert gas through a supersonic nozzle.

Benefits include a greater than 80% high-deposit efficiency, bond strengths greater than 10 ksi, coating strengths greater than 40 ksi, and no real limit on deposition thickness. With porosity commonly below 1%, high pressure cold spray preserves powder microstructure and properties.

We use the Gen III system, which is efficient, mobile, and has quickly become the system of choice for the U.S. military.



Accelerating powders at supersonic velocities to restore hard-to-find parts

Project Examples

Electron Beam Melted (EBM)Ti-6Al-4V AM Demonstration and Allowables Development

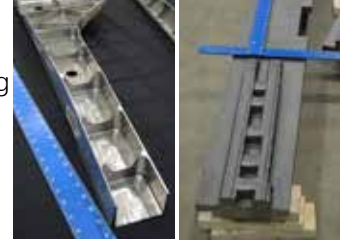
AmericaMakes

- Demonstrate full-scale component fabrication of EBM Ti-6Al-4V titanium alloy components
- Develop complete set of material design allowables
- Validate non-destructive inspection (NDI) methods on full-scale EBM demonstration components

NDI for Electron Beam Direct Manufacturing (EBDM) of Titanium

Navy Metalworking Center

- Identify and optimize traditional and emerging NDI processes for reliably detecting critical flaws of various types and sizes in EBDM manufactured components
- Develop procedures for production inspection of aerospace EBDM structural components

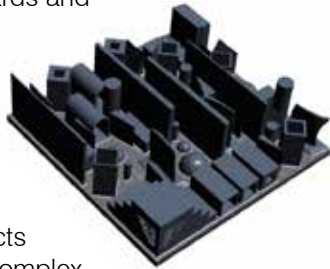


Photos courtesy of the U. S. Air Force, Sciaky and Lockheed Martin.

NDI for Direct Metal Laser Sintering (DMLS) Additive Manufacturing

National Institute of Standards and Technology (NIST)

- Identify methods for optimized NDI of DMLS produced parts, through intentionally seeding and inspecting defects in both simple and complex shapes
- Leverage project findings to influence the standardization process for NDI of DMLS components



Forward-Deployed AM Capability

Army Rapid Equipping Force (REF)

- Unbiased and broad overview of AM technologies
- Current and perceived challenges for future U.S. Army REF deployment scenarios
- Design matrix to identify candidate parts
- Part identification/AM process spreadsheet



Reborn in the USA

America Makes

- Develop specifications and knowledge base of best practices in advancing AM methods to repair aerospace metal components using Laser Powder Feed Directed Energy Deposition
- Identify high value Air Force components (e.g., hard to source or obsolete) for part repair and sustainment applications
- Determine/develop design allowables and guidelines, includes testing



Turbine Support Bearing Housing, After LENS Repair

AM Solutions for the Air Force

Air Force Research Laboratory (AFRL)

- Conduct a baseline investigation on the use of laser powder feed coatings for repair of gas turbine engine parts
- Further investigate viability of using laser-based repair process (OC-ALC)



(continued)



*Concurrent
Technologies
Corporation*

Concurrent Technologies Corporation (CTC) is an independent, nonprofit, applied scientific research and development professional services organization. CTC collaborates with its technology transition affiliate, Enterprise Ventures Corporation, to provide transformative, full lifecycle solutions through research, development, test, and evaluation work. To best serve our clients' needs, we offer the complete ability to fully design, develop, test, prototype and build. We deliver robust, technical, and innovative solutions that safeguard our national security, retain U.S. technological advantage, and ensure the primacy of American manufacturing

CTC's quality management systems are certified to the ISO 9001:2015 (Quality) and 14001:2015 (Environmental) standards, and to AS9100D:2016 (Quality-Aerospace-Related Products).

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