I/UCRC Executive Summary - Project Synopsis	**Date**: March 2019

Center/Site: CANFSA/Colorado School of Mines

Tracking No.: 38-L: On Demand Casting of Net-Shape Titanium Components for Improved Weapon System Reliability	**Phone:** (303) 384-2337	**E-mail:** smidson@mines.edu

Center/Site Director: CANFSA/M. Kaufman/P. Collins/A. Clarke	**Type: (New)**
Project Leader: Steve Midson	**Budget**: CSM's portion $200,000 (leveraged)

Project Description: The supply chain for low-cost, lightweight, net-shape titanium components needs to be expanded. There is a need for weight savings in many areas of payload and instrument panels, where strength and lightweight provide an advantage. The current Ti supply chain of titanium-shape castings is fragile, with few molding and melt handling alternatives, which increases cost and lead time. The goal of this project is to extended the die casting process to Ti-alloys. Specific objectives include:

- Expanding the die casting process to high melting temperature casting alloys
- Improve the production of titanium shape castings by leveraging the latest on-demand melting technology
- Explore alloy modifications to improve castability

Experimental plan: The project is being performed at three universities, CSM, Purdue and Alabama. The experimental work to be performed at CSM includes the following three tasks:

- Provide an improved titanium alloy composition for die castability and high-performance properties
- Identify candidate high temperature resistant die casting die materials & coatings for Ti die casting
- Provide a coated tool for the demonstration of on-demand casting of titanium

Related work elsewhere: Previous efforts have been attempted to die cast high melting temperature metals, including GE casting steels in the 1960s and Howmet die casting titanium in the late 1990s. This effort will leverage the results from previous work.

How this project is different: New technologies are now available, including conformal cooling via additively manufactured dies, coated dies that can take the high temperatures associated with casting titanium alloys, and on-demand melting.

Milestones for the current proposed year: Milestones for the current year at CSM include:

- Characterize castability of existing Ti-alloys
- Identify an approach for fabricating dies that will withstand high melting temperature of titanium
- Identify coatings that will prevent reaction between molten titanium and mold materials

Deliverables for the current proposed year:

- Presentation at the Innovative Casting Technologies annual review meeting

How the project may be transformative and/or benefit society: Die casting is normally the lowest cost process for the production of shape castings. The extension of this conventional die casting process to produce titanium castings would have a significant impact on the titanium marketplace.

Research areas of expertise needed for project success: Casting, die casting, coatings, physical metallurgy of titanium alloys

Potential Member Company Benefits: Many of the CANFSA members are involved in the production, processing or application of titanium alloys. A lower-cost approach to producing net-shape titanium castings could be applied by several of the CANFSA members.

Progress to Date: This 5-year project has just started, and current work is focusing on the optimum approach to produce permanent dies that can withstand the high melting temperatures associated with Ti. Data in the technical literature from previous studies suggests that refractory metals such as molybdenum or tungsten alloys may be capable of meeting the project target for die life.

Start Date: Summer 2018	**Estimated Knowledge Transfer Date**: Spring 2023

The Executive Summary is used by corporate stakeholders in evaluating the value of their leveraged investment in the center and its projects. It also enables stakeholders to discuss and decide on the projects that provide value to their respective organizations. **Ideally, the tool is completed and shared in advance of IAB meetings to help enable rational decision making.**