

# NDI Strategy Will Enable Inspection of EBDM Flight-Critical Titanium Components

**Status:** Pending Implementation

## PROBLEM / OBJECTIVE

Emerging additive manufacturing technologies such as Electron Beam Direct Manufacturing (EBDM) are considered vital to improving affordability, reducing lead time, and reducing industrial shortfalls inherent in traditional manufacturing technologies. Lockheed Martin Aeronautics Company-Advanced Development Programs (LM Aero-ADP) is considering the EBDM process for fabrication of several F-35 Joint Strike Fighter (JSF) components. One of the major obstacles associated with introducing additively manufactured components into the F-35 supply stream is the development and acceptance of adequate non-destructive inspection (NDI) methods and standards to ensure the product meets quality and design requirements. In this Navy Metalworking Center (NMC) project, an Integrated Project Team (IPT) evaluated the effectiveness of traditional and advanced NDI techniques for detecting critical flaws in EBDM components.

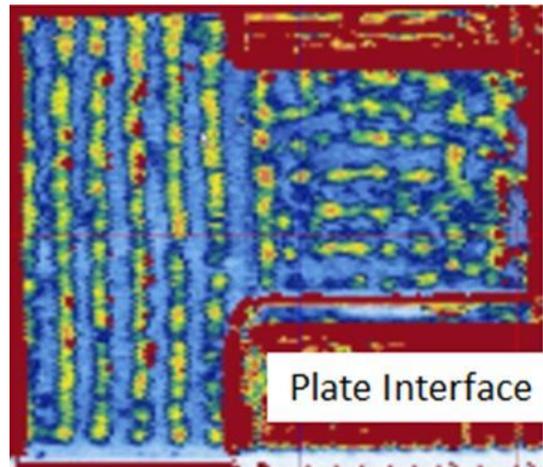
## ACCOMPLISHMENTS / PAYOFF

### **Process Improvement:**

The IPT demonstrated that defect seeding techniques can be applied to prototype JSF components to evaluate NDI detection capabilities on realistic part geometries. Applied NDI methods included ultrasonic, phased-array ultrasonic testing, X-ray, computed tomography and fluorescent penetrant inspections. Destructive (metallographic) inspection confirmed the NDI results.

### **Implementation and Technology Transfer:**

The IPT developed a multi-step NDI process consisting of ultrasonic, computed tomography, X-ray and fluorescent penetrant inspections for EBDM components. LM Aero-ADP is developing specific procedures for applying those inspection techniques to EBDM material, and will submit those procedures for approval by the cognizant Air Force and Navy NDI technical authorities. When approved, these procedures will govern the NDI of targeted airframe components that will be produced using Sciaky's EBDM manufacturing process. The recommended multi-step NDI procedure will be performed at approved NDI vendors under the guidance of LM Aero-ADP. Implementation is planned before the completion of low-rate initial production (LRIP).



A combination of NDI techniques, including ultrasonic testing (pictured), will allow the use of components fabricated by EBDM on F-35. LM ADP photo

### **Expected Benefits and Warfighter Impact:**

This project demonstrated the capability of traditional and emerging NDI techniques to ensure reliable quality assurance of EBDM components. It demonstrated which methods were appropriate for parts of various types, and estimated cost effectiveness of the NDI methods. This technology is a prerequisite for implementation of the EBDM process which is under consideration for usage by multiple program offices including F-35.

## TIME LINE / MILESTONE

Start Date: September 2012  
End Date: April 2015

## FUNDING

Navy ManTech Investment: \$617K  
Cost Share: (IBIF) \$1M

## PARTICIPANTS

JSF Program Office  
AFRL  
NAVAIR  
LM Aero-ADP  
NMC  
Sciaky Inc.  
ONR Navy ManTech

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