

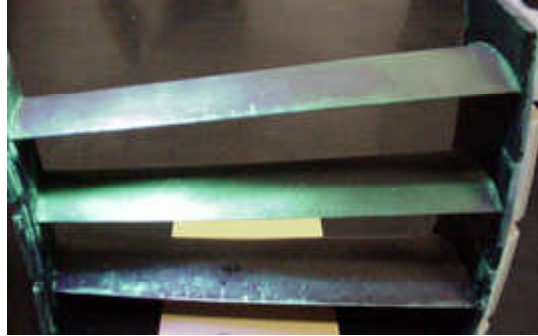
Erosion Coatings Developed to Increase the Life and Durability of Composites

Both the NASA Glenn Research Center and the Allison Advanced Development Company (AADC) have worked to develop and demonstrate erosion-resistant coatings that would increase the life and durability of composite materials used in commercial aircraft engines. These composite materials reduce component weight by 20 to 30 percent and result in less fuel burn and emissions and more fuel savings. Previously, however, their use was limited because of poor erosion resistance, which causes concerns about safety and leads to high maintenance costs. The coatings were tested by the University of Cincinnati, and the composites were manufactured by Texas Composites and coated by Engelhard and NASA Glenn.

Rolls-Royce Corporation uses composite materials, which are stronger and less dense than steel or titanium, to make bypass vanes for their AE3007 engines. These engines are widely used in regional jet aircraft (Embraer) and unmanned air vehicles such as the Northrop Grumman Global Hawk. Coatings developed by NASA/Rolls-Royce can reduce erosion from abrasive materials and from impurities in the air that pass over these vanes, allowing Rolls-Royce to take advantage of the benefits of composite materials over titanium without the added costs of increased maintenance and/or engine failure.

The Higher Operating Temperature Propulsion Components (HOTPC) Project developed cost-effective, durable coatings as part of NASA's goal to increase aviation system capacity growth. These erosion coatings will reduce the number of special inspections or instances of discontinued service due to erosion, allowing aircraft capacity to be maintained without inconveniencing the traveling public. A specific example of extending component life showed that these coatings increased the life of graphite fiber and polymer composite bypass vanes up to 8 times over that of the uncoated vanes. This increased durability allows components to operate to full design life without the fear of wear or failure.





Left: AE3007 engine test of bypass vanes with erosion-resistant coatings. Right: Minor cracking shown by fluorescent dye penetrant.

Recently, Rolls-Royce completed over 2000 hr of engine testing with the coated fan exit bypass vanes (see the photograph on the left). There was no loss of coating after nearly 5000 typical engine cycles. Midway through the engine tests, the coated vanes were removed from the engine during a scheduled maintenance and inspection period. The vanes were shipped back to Glenn, where they underwent further stress testing in the Structural Dynamics Lab, mimicking more extreme conditions than those typical of the AE3007 engine cycle. These vanes were then replaced in the AE3007 and subjected to another 1000 hr of engine tests. Once again, there was no loss of coating and only a minimal appearance of cracking (see the photograph on the right).

Find out more about this research:

Glenn's Polymers Branch:

<http://www.grc.nasa.gov/WWW/MDWeb/5150/Polymers.html>

Glenn's Structural Mechanics & Dynamics Branch:

<http://structures.grc.nasa.gov/5930/>

Glenn's Structural Dynamics Laboratory: <http://structures.grc.nasa.gov/5930/>

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