Air Force SBIR

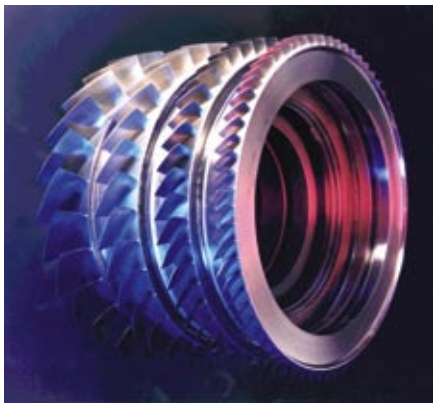
Transition Impact

Increasing the Durability of Titanium Fan Blades Saves Millions

- **SBIR technology increases strength and durability of engine fan blades**
- **B1B program has already avoided over $59 million in fan blade replacement costs**
- **Savings in other areas over the life of the B-1 are projected to total over $100 million**
- **Engineers predict similar savings for the F-110 engine**
- **Pervasive transition of this technology though several SPOs make potential savings easily approach $1 billion**

Air Force Requirements

Beginning in 1991, the B-1's F-101 engine began experiencing failures of titanium turbine blades. The failures were found to be caused by FOD from ice and other hard objects ingested into the engine. In some cases, pieces of fan blades that broke loose did irreparable damage to the rest of the engine resulting in millions of dollars in costs. Laser shock peening, a laser-based hardening method, was evaluated using the SBIR program as a potential solution to increasing the durability of titanium fan blades while decreasing the sensitivity to FOD.



SBIR Technology

The laser shock peening technology was first demonstrated under an AFRL/PR SBIR Phase II effort. Subsequently the technology was developed by AFRL/ML using multiple SBIR efforts, a enhancement program, and finally, a follow-on Manufacturing Technology effort to develop a production-ready process. The technology uses a strong laser pulse to impart high compressive residual stresses into the leading-edge surface of metal blades. The laser pulse ignites a blast or shock wave from the specially-coated surface of the blade. The expansion of the blast wave then creates a traveling stress wave into the blade, thereby compressing the material surface. This method significantly improves the high-cycle fatigue properties of the blade and greatly increases resistance to blade failure caused by FOD.

Air Force Transition Payoff

Application of this technology has already avoided over $59 million in fan blade replacement costs, significantly reduced secondary damage engine repair costs, and avoided cost from airfoil failures. It is estimated that 42 catastrophic failures over the remaining life of the B-lB/F101 program may result in another $40 million cost savings. These savings plus money saved by avoiding the redesign of the F119 engine will conservatively total more than $100M. Directorate engineers project a similar impact on the F110 engine. Potential savings could easily approach $1 billion when calculating this impact over all of the engines in the Air Force fleet.

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Rapid Laser Shock Peening Development

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