RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

	COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	75,541	96,422	77,164	78,037	78,253	79,204	80,098	82,377	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	50,451	63,539	46,749	46,106	46,628	47,269	48,595	49,978	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	4,655	12,408	9,051	9,444	9,157	8,802	7,734	7,955	Continuing	TBD
4349	Materials Technology for Sustainment	20,435	20,475	19,945	20,238	20,326	20,716	21,283	21,888	Continuing	TBD
4915	Deployed Air Base Technology	0	0	1,419	2,249	2,142	2,417	2,486	2,556	0	0
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

Note: In FY 2002, the deployed air base technology efforts in PE 0602201F, Aerospace Flight Dynamics, Project 4397, Air Base Technology, are transferred into this PE in Project 4915, Deployed Air Base Technology. FY 2003 - FY 2007 budget numbers do not reflect the DoD strategy review results.

(U) A. Mission Description

The Materials program develops advanced materials and processing technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. The program has four projects: (1) develops structural, propulsion, and sub-systems materials and processes technologies; (2) develops electronic, optical, and survivability materials and processes technologies; (3) develops sustainment materials and processes technologies; and (4) develops air base operations technologies including power generation, deployable shelters, and fire fighting. Note: In FY 2001, Congress added $4.5 million for special aerospace materials and manufacturing processes, $3.0 million for advanced physical vapor transport growth process for silicon carbide components, $2.2 million for aircraft structural integrity, $4.0 million for carbon foam development for aircraft and spacecraft, $2.0 million for ceramic matrix composites, $3.2 million for laser processing tools, $1.3 million for resin systems for engine applications, $1.0 million for thermal protection systems for hypervelocity vehicles, $1.0 million for weathering and corrosion on aircraft surfaces and parts, $0.5 million for infrared (IR) detectors, radio frequency (RF), and power electronics, and $1.8 million for thermal management for space structures. This explains the perceived overall decrease in the Materials program in FY 2002.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials

(U) B. Budget Activity Justification

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

(U) C. Program Change Summary ($ in Thousands)

		FY 2000	FY 2001	FY 2002	Total Cost
(U)	Previous President's Budget (FY 2001 PBR)	78,103	72,815	70,719	
(U)	Appropriated Value	78,811	97,315		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-45			
	b. Small Business Innovative Research	-1,735			
	c. Omnibus or Other Above Threshold Reprogram				
	d. Below Threshold Reprogram	-871			
	e. Rescissions	-619	-893		
(U)	Adjustments to Budget Years Since FY 2001 PBR			6,445	
(U)	Current Budget Submit/FY 2002 PBR	75,541	96,422	77,164	TBD

(U) Significant Program Changes:

In FY 2002, the increase in this program is due to realignment of efforts to align with Air Force Research Laboratory organizational structure.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4347

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4347	Materials for Structures, Propulsion, and Subsystems	50,451	63,539	46,749	46,106	46,628	47,269	48,595	49,978	Continuing	TBD

(U) A. Mission Description

Develops materials and processing technology base for aircraft, spacecraft, and missiles to improve affordability, maintainability, and performance of current and future Air Force systems. Advanced thermal protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet aircraft, spacecraft, and missile requirements. A family of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide upgraded capability for existing aircraft, spacecraft, missile, and propulsion systems to meet the future system requirements. Develop high temperature turbine engine materials that will enable engine designs to double the turbine engine thrust to weight ratio. Spacecraft material technologies are being developed that are lightweight, thermally conductive, dimensionally stable, noncontaminating, and resistant to the space environment. Alternative or replacement materials are developed to maintain the performance of aging operational systems. Friction and wear resistant materials, paints, coatings, and other nonstructural material technologies are being developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems. Concurrent development of advanced processing methods to enable 'adaptive' processing of aerospace materials. Note: In FY 2001, Congress added $4.5 million for special aerospace materials and manufacturing processes, $2.2 million for aircraft structural integrity, $4.0 million for carbon foam development for aircraft and spacecraft, $2.0 million for ceramic matrix composites, $3.2 million for laser processing tools, $1.3 million for resin systems for engine applications, $1.0 million for thermal protection systems for hypervelocity vehicles, and $1.8 million for thermal management for space structures which explains the perceived decrease in FY 2002.

(U) FY 2000 ($ in Thousands)

(U) $9,029 Developed enabling polymeric and carbon-carbon materials technologies for diverse, high-payoff Air Force system needs including structural and thermal applications. Evaluated carbon matrix composites degradation mechanisms to enhance life prediction of advanced aircraft environmental control systems and hot, exhaust-washed structures and engine components. Identifed suitable polymers and conductive elastomers as base materials for low-observable gap sealants, thin wires, and electrostatic discharge coatings. Identified and evaluated toughened and nanostructured polymers for thin films to enable inflatable membrane structures such as deployable mirrors for surveillance and space counterforce applications.

(U) $7,260 Developed nonstructural materials technology base for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Evaluated advanced lubricants for high-speed bearing and rotating components in spacecraft and developed optically tailorable thermal control coatings with controlled emissivity for spacecraft thermal control.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
PROJECT 4347	

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

Demonstrated the feasibility of electrically conductive elastomers for use in low-observable gap treatments and established baseline analytical capability to predict the optical properties of specialty coatings. Evaluated permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life.

(U) $8,946 Developed advanced, affordable nonmetallic composite structural materials and process technologies for Air Force systems applications including lightweight structures (airframes, control surfaces, trusses, struts, engine components, substructures), space vehicle tanks, and space vehicle bus structures. Developed processing and/or mechanics models which predict component dimensions and decrease the amount of shimming, rework, and fit up of large integrated structures for future Air Force air platforms. Developed non-autoclave processes for large structural, cryogenics tanks, and substructures for future Air Force space platforms. Identified materials and processes for low-cost, multifunction composites to enable small, highly tailorable space platforms. Identified and developed novel product forms (foams, nanomaterials) for lightweight, tough, and affordable structural materials.

(U) $20,487 Developed and transitioned affordable lightweight metallic materials, behavior and life prediction technology, higher temperature intermetallic alloys, and metals processing technology to enable enhanced performance, lower acquisition cost, increased durability, and improved reliability for Air Force weapon systems. Optimized wrought gamma titanium aluminides with a 200°F higher temperature capability for advanced gas turbine engine critical components and characterized advanced intermetallic alloys with the potential of achieving a 300°F temperature increase over current turbine blade materials. Developed life prediction and design methods to better predict the impact of high cycle fatigue (HCF) on critical engine components and identified critical components and inspection requirements for turbine engine rotor life extension, retirement for cause criteria, and enable repair processes. Developed and optimized process technologies, such as spray forming, permanent mold casting, and advanced metalworking processes to enable the production of affordable and high quality aluminum, titanium, nickel, and beryllium alloys. Developed process technology for lower tier materials suppliers to improve quality and affordability of components for weapon systems. Developed metallic materials, such as discontinuously reinforced aluminum, nanocrystalline aluminum, and high temperature metallic sheets for lighter weight and higher strength components for space systems and thermal protection for space vehicles.

(U) $4,729 Developed ceramics and ceramic matrix composites technology base for revolutionary performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures, and determined the durability of ceramics under service life conditions to guide further materials development and to assess useable life. Conducted rocket engine rig tests of vanes, thrusters, and nozzle ramp subelements, developed integrally woven ceramic composite structures for actively cooled space vehicle applications, and developed thermal protection materials for emerging reusable space vehicles. Identified optimum constituents for 2400°F capable ceramic matrix composite for turbine engine combustors and airfoils, performed subscale dynamometer testing of multiple ceramic composites for next generation aircraft brake friction materials, and initiated extended durability testing of ceramic composites for exhaust components. Developed repair techniques for radar

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT: 4347

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

absorbing material (RAM) coatings and engine tested a repaired ceramic matrix composite exhaust nozzle seal. Developed advanced constituents such as oxidation resistant interface coatings for longest life, highest performance ceramic composites.

(U) $50,451 Total

(U) FY 2001 ($ in Thousands)

(U) $5,014 Develop enabling polymeric materials technologies for diverse, high-payoff Air Force system needs including structural applications. Evaluate suitable polymers and conductive elastomers as base materials for low-observable gap sealants, thin wires, and electrostatic discharge coatings. Evaluate toughened and nanostructured polymers for thin films to enable inflatable membrane structures such as deployable mirrors for surveillance and space counterforce applications. Develop new methods for rapid fabrication of nanometer to micron three-dimensional structures and rapid composite repair.

(U) $10,244 Develop and transition nonstructural materials technology base for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Develop advanced lubricant materials for high-speed bearing and rotating components (gyroscopes) in spacecraft and fabricate optically tailorable thermal control coatings with controlled emissivity for spacecraft thermal control. Validate feasibility of electrically conductive elastomers for use in low-observable gap treatments and develop analytical techniques to predict the optical properties of specialty coatings. Develop permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life for aircraft platforms.

(U) $18,884 Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures (airframes, control surfaces, trusses, struts, engine components, substructures), space vehicles tanks, space vehicle bus structures, radiators, and other structures requiring thermal and/or structural management for environmental control. Validate processing and/or mechanics models which predict component dimensions and decrease the amount of shimming, rework, and fit up for large integrated structures for future Air Force air platforms. Develop composite material degradation mechanisms to improve life prediction for aircraft environmental control systems and hot, exhaust-washed structures and engine components. Validate non-autoclave processes for large structural, cryogenics tanks, and substructures for future Air Force space platforms and develop materials and process for low-cost, multifunction composites enabling small, highly tailorable space platforms. Evaluate novel product forms (foams, nanomaterials) for lightweight, tough, and affordable structural materials.

(U) $23,450 Develop and transition affordable lightweight metallic materials, behavior and life prediction technology, higher temperature intermetallic alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability, and improve reliability of Air Force weapon systems. Transition wrought gamma titanium aluminides with a 200°F higher temperature capability for demonstration in advanced gas

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

turbine engine critical components. Develop specific molybdenum-based and niobium-based intermetallic alloys with the potential of achieving a 300°F temperature capability increase over turbine blade materials. Develop life prediction and design methods to better predict the impact of high cycle fatigue damage on critical engine components. Develop life prediction methodologies and inspection technologies to extend turbine engine rotor life, establish retirement for cause criteria, and enable repair processes for critical components. Optimize and transition process technologies, such as permanent mold casting, laser forming, and roll forming to enable the production of affordable and high quality metallic components. Optimize metallic materials, such as discontinuously reinforced aluminum, nanocrystalline aluminum, and high temperature metallic sheets to produce lightweight, high strength components for space systems and thermal protection for space vehicles.

(U) $5,947 Develop ceramics and ceramic matrix composites technologies for enhanced performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Determine the durability of ceramics under service life conditions to guide further materials development and to assess useable life. Test integrally woven ceramic composite structures for actively cooled space vehicle applications, develop thermal protection materials with improved durability for emerging reusable space vehicles, and evaluate ceramic composites for space mirror applications. Validate 2400°F material capability for turbine engine combustors and airfoils through extensive coupon and subelement testing, optimize ceramic composites for aircraft brake friction materials, and test durability of reduced cost ceramic composite for exhaust components. Validate repair techniques for radar absorbing material (RAM) coatings and quantifying the shelf life of the repair constituents. Validate advanced constituent, oxidation resistant, interface coatings through fiber and composite testing.

(U) $63,539 Total

(U) FY 2002 ($ in Thousands)

(U) $8,126 Develop enabling polymeric materials for diverse aerospace structural applications including spacecraft mirror applications, enhanced aircraft canopies, micromechanical devices, and advanced wiring concepts. Evaluate toughened and nanostructured polymers as temperature resistant in Air Force aircraft and space applications. Demonstrate and verify new methods for rapid fabrication of micron three-dimensional structures for Air Force micromechanical devices. Demonstrate use of hybrid thin wires for aircraft and spacecraft applications. Investigate feasibility of flexible, higher efficiency polymeric fibers for photvoltaic advanced solar cells. Optimize light-absorbing polymeric materials for incorporation into paint formulations for corrosion characterization applications.

(U) $10,728 Develop affordable, advanced organic matrix composite structural materials and technologies for Air Force systems applications including lightweight structures requiring thermal and/or structural management for environmental control. Scale-up and publish demonstrated processing and/or mechanics models which predict component dimensions improving low-observable and affordability for large integrated structures for future Air Force air platforms. Investigate specific composite material degradation mechanisms to improve life prediction for aircraft

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
02 - Applied Research	0602102F Materials	4347

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

environmental control systems and hot, exhaust-washed structures and engine components. Evaluate next generation high temperature organic matrix composites for air and space platforms. Evaluate non-autoclave materials and processes for composite cryogenic tank structures for future space platforms. Process and fabricate novel product foams such as nanomaterials, nanotubes, and carbon foams for lightweight, tough, and affordable structural materials.

(U) $7,975 Develop and transition nonstructural materials for fluids, lubricants, aircraft topcoat, and corrosion resistant coatings and specialty treatments to improve system performance and reduce life cycle costs. Test optically tailorable thermal control coatings with controlled heat dissipation for spacecraft thermal control. Evaluate effects of the space environment on polymer and thermal control coatings. Explore electrically conductive elastomers for use in low-observable gap treatments. Establish baseline analytical techniques to predict the optical properties of specialty coatings. Process permanent corrosion resistant primer resins and environmentally safe corrosion protection with a 30-year life for aircraft surfaces. Identify nanostructured multifunctional coatings to control friction and wear in extreme operating environments. Evaluate surface treatments for friction, stiction, and wear control in micro-scale devices and micromechanical applications.

(U) $15,778 Develop and transition affordable lightweight metallic materials, behavior and life prediction technologies, higher temperature intermetallic alloys, and metals processing technology to enhance performance, lower acquisition cost, increase durability, and improve reliability for weapon systems. Demonstrate life prediction methodology and surface treatments needed to prevent High-Cycle Fatigue damage in integrally bladed rotors. Characterize high temperature metallic alloys with the potential of achieving a 300°F temperature capability increase over current turbine blade materials. Refine damage-tolerant life prediction methodologies for high temperature resistant titanium alloy for their use in fracture-critical turbine engine applications. Develop advanced affordable process technologies to enable more affordable production of complex structural metal components for air and space vehicles. Develop processing methods for the metallic materials for lightweight, high-strength components in future space vehicles.

(U) $4,142 Develop ceramics and ceramic matrix composite technologies for enhanced performance and supportability improvements in advanced propulsion systems and high temperature aerospace structures. Evaluate ceramic composites for exhaust and hot section components under real and simulated service life conditions, with a focus toward life prediction and durability assessment. Develop highly durable thermal protection materials for aerospace vehicles with aircraft-like operability. Develop ceramic composites for lightweight space mirror applications. Identify best performing aircraft brake material and perform full-scale dynamometer tests. Optimize radar absorbing material coating repair for superalloy and/or titanium alloy substrates. Evaluate advanced oxidation-resistant interface coatings in severe applications. Initiate development of more durable ceramic composites based on these new coatings.

(U) $46,749 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
PROJECT: 4347	

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0603112F, Advanced Materials for Weapon Systems
(U) PE 0603211F, Aerospace Systems
(U) PE 0603202F, Aeropropulsion Subsystem Integration.
(U) PE 0603216F, Aeropropulsion and Power Technology
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4348

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4348	Materials for Electronics, Optics, and Survivability	4,655	12,408	9,051	9,444	9,157	8,802	7,734	7,955	Continuing	TBD

(U) A. Mission Description

Develops materials technologies for surveillance and terrestrial situational awareness systems and subsystems for aircraft, missile, and space applications. Develops materials for protection of aircrews, sensors, aircraft, and space systems from laser and high power microwave directed energy threats. Develops sensor modules, microwave devices, infrared detectors, and infrared countermeasures (IRCM) devices are used in target detection, weapons targeting, electronic warfare, and active aircraft protection. Electronic and optical materials are being developed to enable surveillance and terrestrial situational awareness with higher operating speeds, greater tunability, higher output power, improved thermal management (including higher operating temperatures), greater sensitivity, and extended dynamic range. Materials are being developed to counter the most prominent threat laser wavelengths and new materials are being developed to respond to emerging threat wavelengths and ultimately to reject the directed energy independent of agile threat wavelengths, without impairing mission effectiveness. Note: In FY 2001, Congress added $3.0 million for advanced physical vapor transport growth process for silicon carbide components and $0.5 million for infrared (IR) detectors, radio frequency (RF), and power electronics which explains the perceived decrease in FY 2002.

(U) FY 2000 ($ in Thousands)

(U)	$98	Developed and transitioned materials technology base to enhance the safety and survivability of aircrews against heat seeking IR missile threats. Determined viability of new ferroelectric nonlinear-optical materials that can be periodically poled for far-infrared laser generation with high energy to replace state-of-the-art lithium niobate for infrared IRCM devices.
(U)	$3,696	Developed and transitioned materials technology base to enhance the safety and survivability of aircrews against laser threats. Developed second generation, nonlinear absorbers as infrared materials. Validated stepped limiter device. Demonstrated damage tolerant, biological limiter host materials for protection of personnel eyes, viewing systems, and night vision goggles.
(U)	$861	Developed and transitioned enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensor systems against laser threats. Identified liquid crystal materials for autonomous tunable filters to block unknown wavelengths in evaluating switchable (hologram) narrow notch filters to provide day and night sensor agile jamming protection and in demonstrating switchable filters.
(U)	$4,655	Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
PROJECT: 4348	

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$5,558	Develop materials and process technologies for power control and microwave devices to provide improved performance, affordability, and operational capability of surveillance and situational awareness systems. Develop materials and materials processes to provide increased reliability and temperature capability while reducing power consumption, weight, cost, cooling, complexity, and size. Develop bulk and epitaxial materials with improved performance at and above the X-band wavelength region to enable improved power control devices. Evaluate sensor materials for defect density, doping, and stoichiometry through advanced process control techniques.
(U)	$3,268	Develop enabling infrared (IR) detector materials and process technologies to enable improved performance, affordability, and operational capability of surveillance and situational awareness systems. Evaluate alternative materials to fabricate IR detector focal plane arrays at very long wavelengths. Demonstrate multi-layered and hyperspectral/multi-spectral IR detector materials that respond to combinations of wavelengths within spectral bands and between spectral bands. Develop new processing techniques to improve yield in small lot manufacturing.
(U)	$2,870	Develop materials technology to enhance the safety and survivability of aircrews against heat seeking IR missile and laser threats. Develop new nonlinear-optical materials to replace state-of-the-art lithium niobate for infrared countermeasure devices. Demonstrate second generation, nonlinear absorbers as IR materials; design a gradient limiter device, transition damage tolerant, biological limiter host materials for protection of personnel eyes, viewing systems, and night vision goggles; and establish a hardened night vision goggle testbed.
(U)	$712	Develop enabling materials technologies to enhance the survivability and mission effectiveness of Air Force sensor systems against laser threats. Evaluate liquid crystal materials for autonomous tunable filters to block unknown wavelengths. Evaluate switchable (hologram) narrow notch filters to provide day and night sensor agile jamming protection. Demonstrate dual wavelength, high optical density switchable filter stacks for laser eye protection.
(U)	$12,408	Total

(U) FY 2002 ($ in Thousands)

(U)	$2,264	Develop and demonstrate materials and process technologies for power generation, power control, and for microwave components to provide improved performance, affordability, and operational capability for surveillance, targeting/tracking, situational awareness, and lethal and non-lethal weapon systems. Develop and demonstrate materials and materials processing technologies to enable increased power generation and power control components reliability and temperature capability while reducing power consumption, weight, cost, cooling, complexity, and size. Develop and demonstrate materials and materials processes to provide presently unattainable performance for power control systems, advanced radar, and electronic counter measures systems. Develop materials and materials process technologies for ultra-lightweight, ultra-high power aircraft electrical generators enabling airborne lethal and non-lethal directed energy weapons in fighter-sized aircraft.
(U)	$2,408	Develop and demonstrate IR detector materials and materials processing technologies to enable improved performance, affordability, and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT: 4348

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

operational capability of surveillance, tracking, targeting, and situational awareness systems. Develop alternative infrared (IR) detector materials for space applications capable of detecting very long wavelengths. Develop the process control required for growth of complex IR detector materials that are responsive to multiple wavelengths within and between spectral bands. Validate new processing techniques to improve IR detector materials yield and affordability in small lots.

(U) $3,714 Develop and demonstrate materials technology to enhance the safety and survivability of aircrews and related assets against heat seeking missiles and laser threats. Demonstrate improved growth and processing techniques for large nonlinear crystals for generating higher power far-IR laser radiation for advanced infrared countermeasures. Develop and validate materials processing techniques and materials that will enable high performance optical control of phased array radar and satellite to satellite data links. Identify and characterize organic materials with large nonlinear absorption properties for the protection of personnel eyes, viewing systems, and night vision goggles.

(U) $665 Develop enabling materials technologies to enhance the survivability and mission effectiveness of aerospace sensors, viewing systems, and night vision goggles against laser threats. Develop liquid crystal materials for autonomous tunable filters to block agile laser wavelengths. Evaluate high optical density, multiple wavelength switchable filter stacks on curved substrates for agile laser wavelength eye protection.

(U) $9,051 Total

(U) B. Project Change Summary

Not Applicable

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0603112F, Advanced Materials for Weapon Systems
(U) PE 0602202F, Human Effectiveness Applied Research
(U) PE 0602204F, Aerospace Sensors.
(U) PE 0603231F, Crew Systems and Personnel Protection Technology.
(U) PE 0603211F, Aerospace Structures.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
PROJECT: 4348	

(U) E. Schedule Profile Continued

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4349

COST ($ in Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4349	Materials Technology for Sustainment	20,435	20,475	19,945	20,238	20,326	20,716	21,283	21,888	Continuing	TBD

(U) A. Mission Description

Develops and transitions materials and materials processing technologies to support operational Air Force mission areas by providing the ability to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing capability to detect and characterize performance threatening defects, characterizing materials processes and properties necessary for materials transition, and providing quick reaction support and failure analysis to the operational commands and repair centers. Develops repair techniques and nondestructive inspection/evaluation (NDI/E) methods that are needed for metallic and non-metallic structures, coatings, corrosion control processes, and to support integration of composite structures for space and aircraft systems. Various NDI/E methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, propulsion, and missile systems. These NDI/E methods are also essential to monitor and detect the onset of any service-initiated damage and/or deterioration due to aging of operational systems. Note: In FY 2001, Congress added $1.0 million for weathering and corrosion on aircraft surfaces and parts.

(U) FY 2000 ($ in Thousands)

(U) $7,055 Developed and transitioned NDI/E technology base to evaluate and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems. Demonstrated enhanced laser generated ultrasound capabilities to detect the onset of hidden corrosion between metallic structural elements for aging aircraft structures. Established design and laboratory scale baseline feasibility capability to evaluate remote inspection capabilities for crack detection within complex structures. Identified methods to nondestructively measure near surface (100 micron) residual stress depth gradients which will allow depots to safely extend the service life of turbine engine rotors.

(U) $2,454 Developed alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of low-observable aerospace systems. Identified NDI/E point inspection device requirements to verify repair quality. Established the baseline criteria for an integrated low-observable repair kit. Fabricated high temperature and/or ultraviolet (UV) gap sealants and conductive elastomers. Evaluated ultrasonically applied and/or removed thermoplastic Radar Absorbing Material (RAM) repairs, high temperature RAM coating repairs, and Radar Absorbing Structures (RAS) field level repairs.

(U) $10,926 Developed and transitioned support capabilities, information, and processes to resolve problems in the use of materials, to perform electronic and structural failure analysis of components, in the repair of aircraft structures, and to reduce aircraft corrosion. Provided failure analysis and materials investigations for field, acquisition, and depot organizations. Developed alternative wiring and connector technologies and investigate new techniques for analyzing structural failures of replacement materials for aging Air Force systems. Measured and characterized high cycle

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY 02 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4349

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

fatigue (HCF) foreign object damage (FOD) propagation values for turbine engine blade materials and transitioned to industry military handbook 5 (MIL-HDBK 5), the primary source of static design allowables for metallic materials and structural elements (fasteners). Developed standard test procedures to assess application of low-observable gap-filler materials and evaluate on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Tested capabilities for evaluation of corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems and develop technical understanding of corrosion to model and reduce corrosion in aircraft structures.

(U) $20,435 Total

(U) FY 2001 ($ in Thousands)

(U) $4,401 Develop and transition non-destructive inspection/evaluation (NDI/E) technology to identify and characterize damage in complex, low-observable materials and structures, and to inspect and maintain integrity of aging aerospace structures and propulsion systems. Transition enhanced laser-generated ultrasound capabilities to detect the onset of hidden corrosion between metallic structural elements. Initiate development of an NDI/E response computer simulation model for integrated product design. Develop and design laboratory scale capability to evaluate remote inspection capabilities for crack detection within complex structures. Evaluate methods to nondestructively measure near surface (100 micron) residual stress depth gradients to allow depots to safely extend the service life of turbine engine rotors.

(U) $2,979 Develop and transition enabling technologies to reduce the Air Force maintenance burden due to low-observable requirements. Establish baseline capability for NDI/E point inspection devices to verify repair quality. Assemble an integrated low-observable repair kit. Demonstrate high temperature and/or ultraviolet gap sealants and conductive elastomers. Develop ultrasonically applied and/or removed thermoplastic radar absorbing material (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.

(U) $4,727 Develop and transition support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Perform failure analysis and materials investigations for field, acquisition, and depot organizations. Transition electrostatic discharge protection materials technologies for space and low-observable applications. Evaluate testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.

(U) $8,368 Develop and transition support capabilities, information, and processes to resolve problems in the use of materials, in the repair of aircraft structures, and to reduce aircraft corrosion. Establish residual stresses baseline criteria of HCF and FOD in turbine engine blade materials. Evaluate advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high energy chemical oxygen-iodine laser devices. Develop improved gap-filler materials for low-observable platforms and test on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Develop capabilities to evaluate corrosion and erosion resistance of new and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials	PROJECT: 4349

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

emerging materials used in operationally fielded Air Force systems. Validate technical understanding of corrosion.

(U) $20,475 Total

(U) FY 2002 ($ in Thousands)

(U) $4,473 Develop non-destructive inspection/evaluation (NDI/E) technology to identify and characterize damage in complex, low-observable materials and structures. Develop inspection technology for aging aerospace structures and propulsion systems. Identify methods to rapidly detect and characterize multi-site damage and cracks in large area, aging structures. Identify computer simulations and models of NDI/E technique response which will enable the development of improved inspections in a virtual environment to permit the depots to rapidly assess the potential of new corrosion and crack detection NDI/E methods. Develop transition methods to measure residual stress to allow depots to safely extend the service life of turbine engine rotors. Identify and develop methods to detect and characterize the severity of fretting fatigue in engine components. Identify NDI/E methods to characterize the low-observable properties of paints and coatings during and after application.

(U) $3,128 Develop enabling technologies to reduce the Air Force maintenance burden due to low-observable requirements. Develop capability for NDI/E point inspection devices and verify repair quality. Evaluate an integrated low-observable repair kit. Validate high temperature and/or ultraviolet gap sealants and conductive elastomers. Demonstrate ultrasonically applied and/or removed thermoplastic radar absorbing material (RAM) repairs, high temperature RAM coating repairs, and radar absorbing structure field level repairs.

(U) $4,803 Develop and transition support capabilities, information, and processes to resolve problems in the use of materials and provide electronic and structural failure analysis of components. Perform failure analysis and materials investigations for field, acquisition, and depot organizations. Continue certification and transition of emerging electrostatic discharge protection materials technologies and techniques for space and low-observable applications. Continue experimental evaluation of testing techniques needed for analyzing structural failures of replacement materials for aging Air Force systems.

(U) $7,541 Develop support capabilities, information, and processes to resolve problems in the use of materials, in the repair of aircraft structures and to reduce aircraft corrosion. Validate residual stresses baseline criteria of high cycle fatigue foreign object damage in turbine engine blade materials. Demonstrate advanced composite materials compatibility with laser effluents as an alternative to metallic materials for high energy chemical oxygen-iodine laser devices. Evaluate improved gap-filler materials for low-observable platforms and test on-aircraft processed adhesive and patch repair of high-temperature composite aircraft structures. Demonstrate capabilities to evaluate corrosion and erosion resistance of new and emerging materials used in operationally fielded Air Force systems. Establish baseline for improved corrosion management procedures.

(U) $19,945 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE June 2001
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602102F Materials
PROJECT: 4349	

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapons Systems.

(U) PE 0603211F, Aerospace Structures

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: June 2001

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602102F Materials

PROJECT: 4915

COST ($ in Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
4915 Deployed Air Base Technology	0	0	1,419	2,249	2,142	2,417	2,486	2,556	0	0

Note: In FY 2002, the deployed air base technology efforts in PE 0602201F, Aerospace Flight Dynamics, Project 4397, Air Base Technology, are transferred into this PE in Project 4915, Deployed Air Base Technology.

(U) A. Mission Description

Supports the air expeditionary forces (AEF) through development of new technologies for deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs. Develops efficient and cost-effective technologies to provide force protection and survivability, including fire fighting, to AEF deployed warfighters. Develops affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapon systems sustainment, and ensure deployability.

(U) FY 2000 ($ in Thousands)

(U) $0 This effort was performed in PE 0602201F, Aerospace Flight Dynamics, Project 4397, Air Base Technology, ($1.441 million).

(U) $0 Total

(U) FY 2001 ($ in Thousands)

(U) $0 This effort was performed in PE 0602201F, Aerospace Flight Dynamics, Project 4397, Air Base Technology, ($4.157 million).

(U) $0 Total

(U) FY 2002 ($ in Thousands)

(U) $892 Develop new deployable airbase systems to reduce airlift, setup times, manpower requirements, and sustainment costs in support of AEF technologies. Develop lightweight, flexible solar cell technologies that improve operating efficiency and reduce sustainment costs of airmobile systems. Develop lightweight, rapidly assembled matting systems to enable rapid expansion of aircraft parking at deployment locations. Develop effective advanced fire fighting agents and equipment to protect deployed warfighters.

(U) $110 Develop affordable, deployable technologies that ensure military readiness, maintain aerospace missions, support weapons systems sustainment, and ensure deployablity. Develop safe, cost-effective disposal of problem AEF wastes for low-observable (LO) material waste treatment.

(U) $417 Develop efficient and cost-effective technologies to provide force protection and survivability to AEF deployed warfighters and materials. Develop atmospheric threat prediction models and deployable sensors systems to protect AEF forces from toxic industrial materials.

(U) $1,419 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
02 - Applied Research	0602102F Materials	4915

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0603112F, Advanced Materials for Weapon Systems

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.