

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1999
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials
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COST (\$ In Thousands)	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	65,628	73,855	63,334	69,521	68,517	70,467	71,964	73,511	Continuing	Continuing
4347 Materials for Structures, Propulsion, and Subsystems	39,766	43,862	37,946	40,752	39,659	40,587	41,785	42,989	Continuing	Continuing
4348 Materials for Electronics, Optics, and Survivability	13,140	15,231	8,575	9,050	8,526	8,811	8,696	8,590	Continuing	Continuing
4349 Materials Technology for Sustainment	12,722	14,762	16,813	19,719	20,332	21,069	21,483	21,932	Continuing	Continuing
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0	0

(U) A. Mission Description: This Applied Research program is the primary source of advanced materials and processes to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems. Structural, propulsion, and sub-systems materials and processes are developed for aircraft, missile, space, satellite, and launch systems applications. Electronic and optical, advanced electromagnetic, and laser protection materials and processes are developed for application in Air Force aircraft, missile, space, and personnel protection systems. Advanced nondestructive materials evaluation methods, materials design data, pollution prevention materials, materials failure analysis, and materials repair methods are developed to improve the sustainment of Air Force systems for the current and future warfighters. Note: In FY 1999, Congress added \$2.0 million for inorganic/organic optical limiters, \$1.2 million for friction stir welding, \$1.5 million for environmentally safe aircraft coatings, and \$8.0 million for advanced materials research which explains the perceived decrease in FY 2000.

(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.

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

	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost Cont</u>
(U) Previous President's Budget/FY 1999 PB	69,339	62,578	63,927	70,330	
(U) Appropriated Value	73,224	75,278			
(U) Adjustments to Appropriated Value					
a. Congressional/General Reductions	-2,915	-1,423			
b. SBIR	-1,036				
c. Omnibus/Other Above Threshold Reprogrammings	-2,504				
d. Below Threshold Reprogrammings	-1,141				
(U) Adjustments to Budget Year Since FY 1999 PB			-593	-809	
(U) Current Budget Submit/FY 2000 PB	65,628	73,855	63,334	69,521	Cont

(U) Significant Program Changes: Not Applicable.

FY1999: \$1,288 identified as a source for SBIR.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602102F Materials				PROJECT 4347		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4347 Materials for Structures, Propulsion, and Subsystems	39,766	43,862	37,946	40,752	39,659	40,587	41,785	42,989	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> Develops materials technologies for aircraft, spacecraft, and missiles with improved affordability, maintainability, and enhanced performance of current and future Air Force systems. Advanced thermal protection and carbon-carbon (C-C) composites materials are developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet the requirements of aircraft, spacecraft, missiles, and ballistic reentry systems. A family of affordable lightweight materials are developed, including metals, metallic and nonmetallic composites, and ceramics which can provide upgraded capability for existing aircraft, spacecraft, missile, and propulsion systems to meet the requirements for new systems beyond the year 2000. Included are turbine engine materials with operating capabilities from 1700°F to 2800°F that will enable engine designs to double the thrust to weight of 1986 engine performance capabilities. Spacecraft material technologies are developed that are lightweight, dimensionally stable, noncontaminating, and resistant to the space environment. Alternative or replacement materials are developed to maintain the performance of aging operational reentry systems. Fluids, lubricants, seals, coatings, and other nonstructural material technologies are developed for the subsystems on aircraft, spacecraft, and missile systems as well as their propulsion systems.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> – (U) \$7,552 Developed C-C and thermal protection material (TPM) technologies to improve performance, affordability, and operational capability of strategic and tactical systems. – (U) \$5,703 Developed nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance, reduced toxicity, and reduced life cycle costs. – (U) \$10,831 Developed advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures. – (U) \$7,891 Developed and transitioned affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems. – (U) \$7,789 Developed ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures. – (U) \$39,766 Total 										
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4347
<p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$8,332 Develop carbon-carbon (C-C) and thermal protection material (TPM) technologies to improve performance, affordability, and operational capability of strategic and tactical systems. - (U) \$7,187 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs. - (U) \$9,556 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures. - (U) \$9,654 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems. - (U) \$8,368 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures. - (U) \$765 Identified as a source for SBIR. - (U) \$43,862 Total <p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,046 Develop C-C and advanced thermal management materials to improve performance, affordability, and operational capability of aircraft and future space vehicles. - (U) \$5,948 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs. - (U) \$11,897 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures. - (U) \$9,518 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems. - (U) \$7,537 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures. - (U) \$37,946 Total 		
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	0602102F Materials	4347
<p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none">- (U) \$3,364 Develop carbon-carbon (C-C) and advanced thermal management materials to improve performance, affordability, and operational capability of aircraft and future space vehicles.- (U) \$6,373 Develop nonstructural materials (such as fluids, lubricants, seals, greases, and coatings) for improved system performance and reduced life cycle costs.- (U) \$12,746 Develop advanced nonmetallic composite structural materials that are affordable for aircraft applications including lightweight airframes, control surfaces, smart skins, and engine compressor frames and ducts, and for spacecraft applications including lightweight trusses, struts, solar arrays, antenna supports, and space vehicle bus structures.- (U) \$10,197 Develop and transition affordable lightweight metals and metal matrix composites, higher-temperature intermetallic alloys, and materials processing technology to enable enhanced performance, lower acquisition costs, and improved reliability of Air Force weapon systems.- (U) \$8,072 Develop ceramic matrix composites to develop an understanding of material response to service life environments and to characterize materials to enable revolutionary performance improvements in advanced propulsion systems and high temperature airframe structures.- (U) \$40,752 Total <p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (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) DOD Metal Matrix Composite Steering Group.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602102F Materials				PROJECT 4348		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4348 Materials for Electronics, Optics, and Survivability	13,140	15,231	8,575	9,050	8,526	8,811	8,696	8,590	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> Develops materials technologies for space sensor systems, radars, and subsystems for aircraft, missile, and space applications. This project also develops new materials for protection of aircrews, sensors, aircraft, and space systems from laser threats. Radar modules, microwave devices, infrared (IR) detectors, and infrared countermeasures are used in target detection, electronic warfare, active aircraft protection, and communications. The performance of these systems is constrained by the quality and physical characteristics of these materials. Materials are developed in this project that enable radars and sensors with higher operating speeds, greater tunability, higher output power, improved thermal management, (including higher operating temperatures), greater sensitivity, and extended dynamic range. The improved materials also increase production quality, increase yields, and reduce costs for radar and sensor systems. Protection from lasers is dependent upon the power level and wavelength or color emanating from the laser device and the susceptibility of the material or system being lased. Additionally, protection schemes are dependent on other characteristics of the laser such as variability of the wavelength and mode of operation (continuous wave or pulsed). Materials are optimized to counter the most prominent threat wavelengths and new materials are developed to respond to emerging threat wavelengths and ultimately to reject laser energy independent of threat wavelengths.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,714 Developed new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems. - (U) \$5,820 Developed materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles. - (U) \$1,606 Developed materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats. - (U) \$13,140 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$7,512 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems. - (U) \$5,624 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles. - (U) \$1,830 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats. - (U) \$265 Identified as a source for SBIR. - (U) \$15,231 Total 										
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4348
<p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,773 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems. - (U) \$4,111 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking infrared (IR) missiles. - (U) \$691 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats. - (U) \$8,575 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$3,982 Develop new materials and processes to provide improved performance, affordability, and operational capability for Air Force radar and space sensor systems - (U) \$4,343 Develop materials to enhance the safety and survivability of aircrews against laser threats and heat seeking IR missiles. - (U) \$725 Develop materials to enhance the survivability and mission effectiveness of air and space sensor systems against laser threats. - (U) \$9,050 Total <p>(U) <u>B. Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) <u>C. Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none"> - (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) Tri-Service Laser Hardening Materials and Structures Group. - (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) <u>D. Acquisition Strategy:</u> Not Applicable.</p> <p>(U) <u>E. Schedule Profile:</u> Not Applicable.</p>		
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)								DATE February 1999		
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602102F Materials				PROJECT 4349		
<i>COST (\$ In Thousands)</i>	FY 1998 Actual	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
4349 Materials Technology for Sustainment	12,722	14,762	16,813	19,719	20,332	21,069	21,483	21,932	Continuing	Continuing
<p>(U) A. <u>Mission Description:</u> Develops materials to provide operational support to Air Force mission areas by providing technologies to inspect the quality of delivered systems, transitioning more reliable and maintainable materials, establishing capability to detect and characterize performance threatening defects, eliminating the dependency on hazardous and toxic materials in repair and maintenance, and providing quick reaction support to the operational commands and repair centers. Non-destructive inspection/evaluation (NDI/E) methods are essential to ensure optimum quality in the design and production of aircraft, spacecraft, propulsion, and missile systems. NDI/E methods are essential to monitor and detect the onset of any service-initiated damage and/or deterioration. This project develops techniques that increase the capability and reliability of currently used methods to detect and characterize performance threatening defects in metallic and nonmetallic composite structures.</p> <p>(U) <u>FY 1998 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$4,509 Developed NDI/E technologies 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. - (U) \$6,520 Developed support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures. - (U) \$1,693 Developed alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems. - (U) \$12,722 Total <p>(U) <u>FY 1999 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,122 Develop NDI/E technologies 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. - (U) \$7,392 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures. - (U) \$1,990 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems. - (U) \$258 Identified as a source for SBIR. - (U) \$14,762 Total 										
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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 1999
BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT 4349
<p>(U) <u>FY 2000 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$5,377 Develop non-destructive inspection/evaluation (NDI/E) technologies 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. - (U) \$7,568 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures. - (U) \$3,868 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems. - (U) \$16,813 Total <p>(U) <u>FY 2001 (\$ in Thousands):</u></p> <ul style="list-style-type: none"> - (U) \$6,310 Develop NDI/E technologies 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. - (U) \$8,873 Develop support capabilities, information, and processes to resolve problems in the use of materials, in conducting failure analysis of components, in materials repair of aircraft structures, and in reducing corrosion in aircraft structures. - (U) \$4,536 Develop alternative materials, processes, and environmentally friendly technologies which will eliminate dependency on hazardous and toxic substances in the acquisition, maintenance, and repair of aerospace systems. - (U) \$19,719 Total 		
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602102F Materials	February 1999
<p>(U) B. <u>Project Change Summary - Description of Significant Changes:</u> Not Applicable.</p> <p>(U) C. <u>Other Program Funding Summary:</u></p> <p>(U) <u>Related Activities:</u></p> <ul style="list-style-type: none">- (U) PE 0603112F, Advanced Materials for Weapons Systems.- (U) PE 0603211F, Aerospace Structures.- (U) Office of Science and Technology Committee Materials Working Group on Non-Destructive Materials.- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. <p>(U) D. <u>Acquisition Strategy:</u> Not Applicable.</p> <p>(U) E. <u>Schedule Profile:</u> Not Applicable.</p>		
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