Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force											Date: February 2018	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*							
COST ($ in Millions)	**Prior Years**	**FY 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
Total Program Element	-	54.095	37.856	34.426	0.000	34.426	36.584	37.567	39.021	39.813	Continuing	Continuing
632100: *Laser Hardened Materials*	-	17.230	14.948	14.786	0.000	14.786	15.806	16.124	16.450	16.784	Continuing	Continuing
633153: *Non-Destructive Inspection Development*	-	5.900	6.331	6.375	0.000	6.375	6.500	6.632	6.765	6.904	Continuing	Continuing
633946: *Materials Transition*	-	30.965	16.577	13.265	0.000	13.265	14.278	14.811	15.806	16.125	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates advanced materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in threat environments. Advanced materials technologies are also developed and demonstrated to enhance protection for Air Force sensors and systems to ensure safety, survivability, and operability in threat environments.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602202F, 0602203F, 0602204F, 0602601F, 0602602F, 0602605F, 0602788F, 1206601F, and 0602298F.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary ($ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	35.137	37.856	35.139	0.000	35.139
Current President's Budget	54.095	37.856	34.426	0.000	34.426
Total Adjustments	18.958	0.000	-0.713	0.000	-0.713
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	18.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	2.300	0.000			
• SBIR/STTR Transfer	-1.342	0.000			
• Other Adjustments	0.000	0.000	-0.713	0.000	-0.713

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Air Force	Date: February 2018
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2017	FY 2018
Project: 633946: *Materials Transition*		
Congressional Add: *Program increase - Protective Equipment*	0.974	-
Congressional Add: *Program increase - Metals Affordability Research*	16.558	-
Congressional Add Subtotals for Project: 633946	17.532	-
Congressional Add Totals for all Projects	17.532	-

Change Summary Explanation

Increase in FY 2017 due to reprogramming for Hypersonics Science and Technology activities.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 632100 / *Laser Hardened Materials*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
632100: *Laser Hardened Materials*	-	17.230	14.948	14.786	0.000	14.786	15.806	16.124	16.450	16.784	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in threat environments. Advanced materials technologies are also developed and demonstrated to enhance protection for Air Force sensors and systems to ensure safety, survivability, and operability in threat environments.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Aerospace Systems Protection	9.030	7.026	7.015

Description: Develop and demonstrate materials technologies that enhance hardening for sensors, avionics, and components to increase survivability and mission effectiveness of aerospace systems.

FY 2018 Plans:

Validate and continue to develop protection materials for visual/Near-Infrared (NIR)Space Intelligence, Surveillance Reconnaissance (ISR) sensors. Assess the demonstrated results and pursue the use of protection technologies for future sensor designs and strategies to mitigate directed energy damage for visual/NIR, Short Wave Infrared (SWIR), and Mid Wave Infrared (MWIR) detectors. Apply gained technologies and integrate the developments into survivable electro-optic sensors that provide full spectrum protection for missile warning. Analyze the performance impact of damage-limiting semiconductor materials designed to harden electro-optic imaging sensors. Initiate transition of developed laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Advance the employment and integration of evolved computational materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings development for use in sensor hardening. Technology stimulation and maturation to develop defensive capability for air systems airframe and anti-access munitions hardening assessments and solutions.

FY 2019 Plans:

Continue to validate and continue to develop protection materials for visual/NIR ISR sensors. Assess the demonstrated results and pursue the use of protection technologies for future sensor designs and strategies to mitigate directed energy damage for visual/NIR, SWIR, and MWIR detectors. Apply gained technologies and integrate the developments into survivable electro-optic sensors that provide full spectrum protection for missile warning. Continue analyzing the performance impact of damage-limiting semiconductor materials designed to harden electro-optic imaging sensors. Continue transition of developed laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Continue to advance the employment and integration of evolved computational materials science to model materials characteristics to increase accuracy and shorten design cycle

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 632100 / *Laser Hardened Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
time of coatings development for use in sensor hardening. Continue technology stimulation and maturation to develop defensive capability for air systems airframe and anti-access munitions hardening assessments and solutions. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.011 million. Justification for this decrease is described in the plans above.			
Title: Aircrew Protection ***Description:*** Develop and demonstrate materials technologies that enhance protection for Air Force aircrews to ensure safety and to enable aircrews to perform required missions in a threat environment. ***FY 2018 Plans:*** Develop, validate, and demonstrate laser protection materials and technologies for personnel protection. Validate and develop helmet-mounted sensor hardening materials focusing on next-generation nighttime sensors. Advance development of visor based aircrew protection materials with agile protection. Evaluate advances in characterization and demonstration of eye protection technologies using computational materials science tools. Validate, mature, and test improvements to functionality and performance of personnel protection technologies in expected operational conditions. ***FY 2019 Plans:*** Continue to develop, validate, and demonstrate laser protection materials and technologies for personnel protection. Continue to validate and develop helmet-mounted sensor hardening materials focusing on next-generation nighttime sensors. Continue to advance development of visor based aircrew protection materials with agile protection. Continue to evaluate advances in characterization and demonstration of eye protection technologies using computational materials science tools. Continue to validate, mature, and test improvements to functionality and performance of personnel protection technologies in expected operational conditions. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.151 million. Justification for this decrease is described in the plans above.	8.200	7.922	7.771
Accomplishments/Planned Programs Subtotals	17.230	14.948	14.786

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 632100 / *Laser Hardened Materials*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 633153 / *Non-Destructive Inspection Development*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
633153: *Non-Destructive Inspection Development*	-	5.900	6.331	6.375	0.000	6.375	6.500	6.632	6.765	6.904	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced nondestructive inspection and evaluation (NDI/E) technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. NDI/E capabilities greatly influence and/or limit many design, manufacturing, and maintenance practices. This project provides technology to satisfy Air Force requirements to extend the lifetime of current systems through increased reliability and cost-effectiveness at field and depot maintenance levels. Equally important is assuring manufacturing quality, integrity, and safety requirements.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Advanced Engine Inspection Technologies	1.563	1.558	1.581
Description: Develop and demonstrate advanced technologies to improve capabilities to inspect for cracks and other damage to extend the total safe life of turbine engines. ***FY 2018 Plans:*** Validate repeatability of NDI/E (nondestructive inspection/evaluation) approaches to assess materials and damage state of critical turbine engine components for the purpose of extending the useful life without increasing risk of in-flight failure of fracture critical to gas turbine engine components. Assess model prediction, accuracy, and effectiveness of digital nondestructive inspection technologies and demonstrate tool automation for high confidence repeatable results. ***FY 2019 Plans:*** Continue to develop nondestructive inspection/evaluation approaches to assess materials and damage state of critical turbine engine components for the purpose of extending the useful life without increasing risk of in-flight failure of fracture critical to gas turbine engine components. Continue to assess model prediction, accuracy, and effectiveness of digital nondestructive inspection technologies and demonstrate tool automation for high confidence repeatable results. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.023 million. Justification for the increase is described in the plans above.			
Title: Special Material Inspection Technologies (formerly known as "Low-Observable Inspection Technologies")	1.186	1.182	1.199
Description: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability. ***FY 2018 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633153 / *Non-Destructive Inspection Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Transition improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of special materials that enables/ensures more affordable signature assessment. Develop tools to improve characterization of specialty multilayer coatings. Continue to develop hand-held and robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. ***FY 2019 Plans:*** Continue to transition improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of special materials that enables/ensures more affordable coatings assessment. Continue to validate tools to improve characterization of specialty multilayer coatings. Continue to develop robotic technologies for visual inspections that will realize human-assisted inspection capabilities and begin to provide capabilities for automated multi-spectral characterization. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.017 million. Justification for the increase is described in the plans above.			
Title: Advanced System Monitoring Technologies	3.151	3.591	3.595
Description: Develop and demonstrate advanced systems status monitoring technologies to provide on-board and embedded sensing to gain continuous awareness of the state of key subsystems. ***FY 2018 Plans:*** Validate analytical methods to assess the location of damage in multi-layered structure base on nondestructive inspection data and results. Transition robotic nondestructive inspection methods to minimize disassembly and reduced maintenance burden to perform inspections of aircraft structures. Develop novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. Continue enhanced methods for collecting and analyzing digital Non-Destructive Inspection/Evaluation (NDI/E) data necessary for improved damage detection and characterization. Integrate computational materials science tools with life prediction methods to enable risk-based life management. Comprehensive development of physical and digital nondestructive evaluation tools to support and provide concept approach of Damage State Awareness of materials. ***FY 2019 Plans:*** Continue demonstrating analytical methods to assess the location of damage in multi-layered structure base on nondestructive inspection data and results. Continue to transition robotic nondestructive inspection methods to minimize disassembly and reduced maintenance burden to perform inspections of aircraft structures. Continue development of novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. Continue enhanced methods for collecting and analyzing digital Non-Destructive Inspection/Evaluation (NDI/E) data necessary for improved damage detection			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633153 / *Non-Destructive Inspection Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
and characterization. Continue the integration of computational materials science tools with life prediction methods to enable risk-based life management. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 increased compared to FY 2018 by $0.004 million. Justification for the increase is described in the plans above.			
Accomplishments/Planned Programs Subtotals	5.900	6.331	6.375

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force			Date: February 2018
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 633946 / *Materials Transition*	

COST ($ in Millions)	Prior Years	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
633946: *Materials Transition*	-	30.965	16.577	13.265	0.000	13.265	14.278	14.811	15.806	16.125	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced materials and processing technologies for fielded and planned Air Force weapon, airframe, and propulsion applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. This design and scale-up data improves the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Air Vehicle Materials Technologies	11.436	14.090	11.228
Description: Develop and demonstrate materials and processes technologies for air vehicle and subsystems to enhance lift, propulsion, Low-Observable (LO) performance, power generation management, and affordability of air vehicles. ***FY 2018 Plans:*** Transition magnetoresistive sensing and materials and processes to increase special materials affordability. Develop of advanced directed energy protection technologies. Develop of technologies for electromagnetic hardening acquisition and field support. Develop of technologies for organic engine lifing analysis for enhanced engine component risk management capability. ***FY 2019 Plans:*** Transition magnetoresistive sensing and materials and processes to increase special materials affordability. Continue development of advanced directed energy protection technologies. Continue development of technologies for electromagnetic hardening acquisition and field support. Continue development of technologies for organic engine lifing analysis for enhanced engine component risk management capability. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $2.862 million. Justification for the decrease is decreased emphasis in air vehicles materials technologies.			
Title: High Temperature Material Technologies	1.997	2.487	2.037
Description: Develop and demonstrate affordable, novel high temperature materials/structures and thermal management concepts to enable future defense capabilities for prompt global strike concepts. ***FY 2018 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633946 / *Materials Transition*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Validate repeatability of multimaterial structures to optimally address operational temperature zones for hot structure and expendable thermal protection systems made out of advanced ceramics, ceramic matrix composites, hybrids, advanced and affordable metals, and intermetallics. Demonstrate and model 2700-degree Fahrenheit ceramic matrix composites for turbine hot section components. Develop high performance and affordable metals for next-generation turbine engine disks and low cost propulsion, aerostructure and munitions components. ***FY 2019 Plans:*** Continue work on multimaterial structures that optimally address operational temperature zones for hot structure and expendable thermal protection systems made out of advanced ceramics, ceramic matrix composites, hybrids, advanced and affordable metals, and intermetallics. Transition 2700-degree Fahrenheit ceramic matrix composites for turbine hot section components to industry. Continue to develop high performance and affordable metals for next-generation turbine disk and low cost propulsion, aerostructure and munitions components. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2019 decreased compared to FY 2018 by $0.450 million. Justification for the decrease is described in the plans above.			
Accomplishments/Planned Programs Subtotals	13.433	16.577	13.265

	FY 2017	FY 2018
Congressional Add: Program increase - Protective Equipment ***FY 2017 Accomplishments:*** Conducted congressionally directed effort.	0.974	-
Congressional Add: Program increase - Metals Affordability Research ***FY 2017 Accomplishments:*** Conducted congressionally directed effort.	16.558	-
Congressional Adds Subtotals	17.532	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Air Force		Date: February 2018
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633946 / *Materials Transition*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air Force resources are applied and how those resources are contributing to Air Force performance goals and most importantly, how they contribute to our mission.