Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Air Force											Date: May 2017	
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 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	38.238	35.137	37.856	0.000	37.856	35.139	36.861	37.849	39.306	Continuing	Continuing
632100: *Laser Hardened Materials*	-	8.655	15.472	14.948	0.000	14.948	15.139	15.926	16.245	16.570	Continuing	Continuing
633153: *Non-Destructive Inspection Development*	-	4.906	6.350	6.331	0.000	6.331	6.423	6.550	6.681	6.815	Continuing	Continuing
633946: *Materials Transition*	-	24.677	13.315	16.577	0.000	16.577	13.577	14.385	14.923	15.921	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates materials technology for transition into Air Force systems. The program has three projects which develop: hardened materials technologies for the protection of aircrews and sensors; non-destructive inspection and evaluation technologies; and materials transition technologies on structural and non-structural materials for aerospace applications. Efforts in the program have been coordinated through the Department of Defense Science and Technology Executive Committee process to harmonize efforts and eliminate duplication.

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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	46.665	35.137	36.664	0.000	36.664
Current President's Budget	38.238	35.137	37.856	0.000	37.856
Total Adjustments	-8.427	0.000	1.192	0.000	1.192
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-7.510	0.000			
• SBIR/STTR Transfer	-0.917	0.000			
• Other Adjustments	0.000	0.000	1.192	0.000	1.192

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: 633946: *Materials Transition*		
Congressional Add: *Metals Affordability Research*	9.000	-

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Air Force	Date: May 2017
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 2016	FY 2017
Congressional Add Subtotals for Project: 633946	9.000	-
Congressional Add Totals for all Projects	9.000	-

Change Summary Explanation

Decrease in FY 2016 reflects reprogramming for Air Dominance activities and to support Research and Development Projects, 10 U.S.C. Section 2358.

Increase FY 2018 due higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
632100: *Laser Hardened Materials*	-	8.655	15.472	14.948	0.000	14.948	15.139	15.926	16.245	16.570	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 2016	FY 2017	FY 2018
Title: Aerospace Systems Protection	4.068	7.306	7.026

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

FY 2016 Accomplishments:

Developed survivable electro-optic sensors that provide full spectrum protection for missile warning. Continued development of protection materials for visual/near infrared (NIR) Intelligence Surveillance Reconnaissance (ISR) sensors. Demonstrated use of protection technologies for future ISR sensor designs and strategies to mitigate directed energy damage for visual/NIR, short-wave infrared (SWIR), and mid-wave infrared (MWIR) detectors. Continued evaluating the performance impact of damage-limiting semiconductor materials designed to harden electro-optic imaging sensors. Developed laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Continued to employ computational materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings for use in sensor hardening. Initiated air systems airframe and anti-access munitions hardening assessment.

FY 2017 Plans:

Continue to analyze and develop protection materials for visual/near infrared ISR sensors. Continue to demonstrate use of protection technologies for future sensor designs and strategies to mitigate directed energy damage for visual/NIR, SWIR, and MWIR detectors. Continue to develop 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 to develop laser countermeasures for survivability of dynamic electro-optic/infrared imagers. Continue to employ computational materials science to model materials characteristics to increase accuracy and shorten design cycle time of coatings for use in sensor hardening. Develop air systems airframe and anti-access munitions hardening assessments and solutions.

FY 2018 Plans:

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
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. 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. Continue technology stimulation and maturation to develop defensive capability for air systems airframe and anti-access munitions hardening assessments and solutions.			
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 2016 Accomplishments:*** Developed and demonstrated laser protection materials and technologies for personnel protection. Validated and continued development of helmet mounted sensor hardening materials. Continued to advance development of visor based aircrew protection materials. Characterized and demonstrated eye protection technologies using computational materials science tools. Improved functionality and performance of personnel protection technologies in expected operational conditions. ***FY 2017 Plans:*** Continue to develop 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 characterize and demonstrate eye protection technologies using computational materials science tools. Demonstrate and continue to improve functionality and performance of personnel protection technologies in expected operational conditions. ***FY 2018 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. 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.	4.587	8.166	7.922
Accomplishments/Planned Programs Subtotals	8.655	15.472	14.948

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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*

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: FY 2018 Air Force			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
633153: *Non-Destructive Inspection Development*	-	4.906	6.350	6.331	0.000	6.331	6.423	6.550	6.681	6.815	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 2016	FY 2017	FY 2018
Title: Advanced Engine Inspection Technologies	1.207	1.964	1.558
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 2016 Accomplishments:*** Demonstrated a robotic snake-arm system, designed to reach difficult-to-access areas, performed accurate inspections without major disassembly of aircraft structure while proving quick logistics deployment and ease of operator interaction. Demonstrated nondestructive 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. ***FY 2017 Plans:*** Continue to demonstrate nondestructive evaluation approaches to assess material 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. Validate robotic nondestructive inspection methods to minimize disassembly and reduced maintenance burden to perform inspections of aircraft structures. Continue to develop novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. ***FY 2018 Plans:*** Validate repeatability of NDI/E 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.			
Title: Special Material Inspection Technologies (formerly known as "Low-Observable Inspection Technologies")	0.916	1.585	1.182

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
Description: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability. ***FY 2016 Accomplishments:*** Demonstrated a hand-held aircraft exhaust surface coating damage registration sensor with automatic database information transfer which reduces inspection time and increases accuracy compared to current manual system. Initiated new and continued development of improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of LO materials that enables/ensures more affordable signature assessment. ***FY 2017 Plans:*** Continue to improve 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. Initiate development of 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 2018 Plans:*** 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. Continue to 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.			
Title: Advanced System Monitoring Technologies ***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 2016 Accomplishments:*** Transitioned improved field and depot-level NDI/E technologies and methodologies for assessing the structural integrity of airframes. Continued development of analytical methods to assess the location of damage in multi-layered structures using nondestructive inspection data and results. Developed robotic nondestructive inspection methods to minimize disassembly and reduced maintenance burden to perform inspections of aircraft structures. Initiated development of novel approaches to collect, analyze, transport, archive, and use digital nondestructive inspection data and information. Continued enhanced methods for	2.783	2.801	3.591

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
collecting and analyzing digital NDI/E data necessary for improved damage detection and characterization. Demonstrated the integration of computational materials science tools with life prediction methods to enable risk-based life management. ***FY 2017 Plans:*** Continue development of analytical methods to assess the location of damage in multi-layered structure base on nondestructive inspection data and results. Validate 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 NDI/E data necessary for improved damage detection and characterization. Continue the integration of computational materials science tools with life prediction methods to enable risk-based life management. ***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. 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 NDI/E data necessary for improved damage detection and characterization. Continue the integration of computational materials science tools with life prediction methods to enable risk-based life management. Continue comprehensive development of physical and digital nondestructive evaluation tools to support and provide concept approach of Damage State Awareness of materials.			
Accomplishments/Planned Programs Subtotals	4.906	6.350	6.331

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force			Date: May 2017
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 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
633946: *Materials Transition*	-	24.677	13.315	16.577	0.000	16.577	13.577	14.385	14.923	15.921	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 2016	FY 2017	FY 2018
Title: Air Vehicle Materials Technologies	13.388	10.672	14.090
Description: Develop and demonstrate materials and processes technologies for air vehicle and subsystems to enhance lift, propulsion, LO performance, power generation management, and affordability of air vehicles. ***FY 2016 Accomplishments:*** Demonstrated processing methods and lifing tools for ceramic matrix composites and graded microstructure turbine engine disk concepts. Continued developing the repeatability and modernizing of magnetoresistive sensing technologies. Integrated damage with risk-based life management strategies for turbine engines. Developed materials and processes to increase LO, special materials and metals affordability. ***FY 2017 Plans:*** Demonstrate in field the repeatability of magnetoresistive sensing. Transition materials and processes to increase LO materials affordability. Initiate development of methods to perform damage characterization of turbine engines. Continue to develop affordable metals and computational technologies for advanced aero structure and engine components. ***FY 2018 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.			
Title: High Temperature Material Technologies	2.289	2.643	2.487
Description: Develop and demonstrate affordable, novel high temperature materials/structures and thermal management concepts to enable future defense capabilities for prompt global strike concepts.			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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 2016	FY 2017	FY 2018
FY 2016 Accomplishments: High temperature alloy compositions were selected for the bore, rim, and disk assembly portions of the advanced high pressure turbine disk for the next-generation turbine engine. Demonstrated the 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 metals, and intermetallics. Validated enviro-mechanical damage models of 2700-degree Fahrenheit ceramic matrix composites used in turbine hot section components and finalized vane geometry for rig test to further validate damage models in realistic environment. Advanced development of high temperature materials for next-generation turbine engine disks. ***FY 2017 Plans:*** Continue to 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. Continue to demonstrate and model 2700-degree Fahrenheit ceramic matrix composites for turbine hot section components. Continue to develop high temperature materials for next-generation turbine engine disks. ***FY 2018 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 temperature materials for next-generation turbine engine disks.			
Accomplishments/Planned Programs Subtotals	15.677	13.315	16.577

	FY 2016	FY 2017
Congressional Add: Metals Affordability Research ***FY 2016 Accomplishments:*** Conducted congressionally directed effort in low-cost special aerospace metals.	9.000	-
Congressional Adds Subtotals	9.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Air Force		Date: May 2017
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

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