

Fiscal Year:	FY 2021	Task Last Updated: FY 10/15/2021	
PI Name:	Olson, Sandra Ph.D.		
Project Title:	Fundamental Research on International Standard of Fire Safety in Space - Subteam 1: Study of Flammability of Fabric Materials		
Division Name:	Physical Sciences		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	COMBUSTION SCIENCE--Combustion science		
Joint Agency Name:		TechPort:	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	Sandra.Olson@nasa.gov	Fax:	FY 216 977-7065
PI Organization Type:	NASA CENTER	Phone:	216-433-2859
Organization Name:	NASA Glenn Research Center		
PI Address 1:	LTX, Combustion Physics and Reacting Systems Branch		
PI Address 2:	MS 77-5, 21000 Brookpark Rd.		
PI Web Page:			
City:	Cleveland	State:	OH
Zip Code:	44135	Congressional District:	9
Comments:			
Project Type:	FLIGHT,GROUND	Solicitation / Funding Source:	2012 Japanese Space Agency (JAXA) AO for Fundamental Research on an International Standard of Fire Safety in Space
Start Date:	07/01/2014	End Date:	03/31/2024
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA GRC
Contact Monitor:	Urban, David	Contact Phone:	216-433-2835
Contact Email:	david.l.urban@nasa.gov		
Flight Program:	ISS		
Flight Assignment:	NOTE: End date changed to 3/31/2024 per PI (Ed., 10/29/21) NOTE: End date changed to 7/31/2022 per PI (Ed., 10/5/20) NOTE: Changed end date to 3/31/2021 per PI (Ed., 6/3/19)		
Key Personnel Changes/Previous PI:	Dr. Sandra Olson is U.S. Co-Investigator on Japan Aerospace Exploration Agency (JAXA)-sponsored project, "Flammability Limits At Reduced-g Experiment (FLARE)." JAXA Principal Investigator (PI) is Prof. Osamu Fujita, Hokkaido University.		
COI Name (Institution):			
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The objective of the project is to develop a methodology to correlate material flammability limits in normal gravity and microgravity, which allows quantitative estimation of material flammability limit in microgravity based on the flammability data obtained on the ground. The project involves an international team including Japan Aerospace Exploration Agency (JAXA), NASA, ESA (European Space Agency), and universities in Japan, USA, and France. Dr. Olson is a U.S. Co-Investigator for the JAXA sponsored experiments to be conducted aboard the Japanese Experiment Module, Kibo. To establish global standards for fire safety in space, we seek to develop a fundamental understanding of how NASA's material flammability test, NASA-STD-6001.A Test 1, relates to the actual flammability of materials in micro and partial gravity. The investigation strategy is to perform extensive research via ground-based experiments, including 1g and parabolic flight tests, and via theoretical formulations. Flight experiments on orbit in International Space Station (ISS)/KIBO will be performed to verify the correlation. The flight experiments on orbit are expected in 2018 or later. By the end of the project, a new fire safety standard test method for screening spacecraft materials will be proposed that addresses the shortcomings of existing standard test methods such as NASA-STD-6001B.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Studying materials flammability in space allows us to accurately control the flow field and thus elucidate the importance of a critical Damkohler number (flow time /reaction time) on flame extinction. The anticipated improved methodology should reduce time and cost for the spacecraft material screening. Investigation and results have Earth benefits for terrestrial fire safety.
Task Progress:	International Standard ISO 4589-4 "Plastics – Determination of burning behavior by oxygen index – Part 4: High gas velocity test" was established on April 6, 2021 by the FLARE project. This standard was developed within the Technical Committee ISO TC 61(Plastics), Subcommittee SC 4 (Burning Behavior) based on FLARE 1G research results. International round-robin flammability tests were performed by NASA White Sands Test Facility (WSTF), JAXA, and Italy. The Solid Combustion Experiment Module (SCEM) was installed in the Multipurpose Small Payload Rack (MSPR) in Jan.-Feb. 2021. Hardware checkout occurred starting in February. In early April, the control computer froze, and subsequent troubleshooting determined that the solid-state hard drive (SSD) on the motherboard had failed. JAXA decided in September 2021 to re-stow the hardware after removing the failed motherboard for return to Earth for a forensic analysis. A replacement motherboard with both an SSD and a standard hard drive will be built and launched to the ISS in Feb. 2022. A second motherboard will be built based upon the forensic analysis conclusions and a new interface plate for easier access to the computer for debugging will be launched later, if warranted. A preliminary new schedule, which depends on coordination with other experiments scheduled to go in the MSPR, is that setup and checkout could start in June 2022, and experiments could start as early as July 2022. The operations may need to be split up to accommodate other experiments in the MSPR. The 2021 annual international Flammability Limits At Reduced-g Experiment (FLARE) workshop, originally planned to be held in Tsukuba, Japan, was held virtually again this year due to the coronavirus pandemic. Participants were asked to record their talks to be viewed in advance of the scheduled workshop so that discussion during the workshop could focus on international collaboration efforts and discussion of the talks. The next workshop is scheduled for Sept. 2022 in Tsukuba, Japan. Due to the pandemic and mandatory telework, no testing was possible at NASA Glenn Research Center this past year.
Bibliography Type:	Description: (Last Updated: 04/17/2024)
Abstracts for Journals and Proceedings	Olson SL. "Smolder wave characterization." Flammability Limits At Reduced-g Experiment (FLARE) Workshop, Virtual, September 8-10, 2021. Sponsored by Japan Aerospace Exploration Agency (JAXA). Abstracts. Flammability Limits At Reduced-g Experiment (FLARE) Workshop, Virtual, September 8-10, 2021. Sponsored by Japan Aerospace Exploration Agency (JAXA). , Sep-2021
Articles in Peer-reviewed Journals	Olson SL, Fujita O, Kikuchi M, Kashiwagi T. "Quantitative infrared image analysis of simultaneous upstream and downstream microgravity flame spread over thermally thin cellulose fuel in low speed forced flow." Combustion and Flame. 2021 May;227:402-20. https://doi.org/10.1016/j.combustflame.2021.01.011 , May-2021