Fiscal Year:	FY 2016	**Task Last Updated:**	FY 07/21/2016
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		
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PI Organization Type:	NASA CENTER	**Phone:**	216-433-2859
Organization Name:	NASA Glenn Research Center		
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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:**	06/30/2019
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:**	1
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA GRC
Contact Monitor:	Urban, David	**Contact Phone:**	216-433-2835
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Flight Program:	ISS		
Flight Assignment:			
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 JAXA, NASA, ESA (European Space Agency), and universities in Japan, USA, and France. Dr. Olson is a U.S. Co-Investigator for the Japan Aerospace Exploration Agency (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 method 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:	An international workshop was held at Hokkaido University in Sapporo, Japan in January, 2016. At that meeting, the science requirements were reviewed and finalized. The science teams presented their status to the group. In addition, plans for a parabolic aircraft campaign were discussed. A series of NASA Glenn Zero Gravity Research Facility (ZGRF) tests were performed this year with the updated Microgravity Wind Tunnel, which includes a new longer test section and two high resolution GIGE cameras. The tests were performed to determine the approximate high velocity blowoff limits for thin cotton fabrics. The materials were ignited in normal gravity and then the experiment was dropped. The ambient gas oxidizer concentration was switched to the test atmosphere to determine if the flame could survive in the reduced oxygen concentration during the 5.18 second drop. For opposed flow flame spread, the low gravity blowoff limits were determined at three oxygen concentrations. These were compared to normal gravity data. The 1g data indicates the limiting (zero flow) oxygen concentration is ~15.9% O2, significantly higher than the observed ZGRF limits at ~13% O2. This demonstrates how the 1g test is not a conservative test to evaluate microgravity flammability. However, it may be possible to account for the buoyant flow and correct the data to predict a conservative microgravity limit. Some concurrent ZGRF tests have also been conducted, and the blowoff limits are even lower than opposed limits, but further drop and 1g testing is required to determine if a similar shift in the limits is feasible for concurrent flow. Because concurrent flames grow rapidly, it is difficult to get a 1g flame blowoff before the flame exceeds the apparatus size.
Bibliography Type:	Description: (Last Updated: 05/01/2023)
Abstracts for Journals and Proceedings	Olson SL. "Concurrent Flow Blowoff Boundary Extrapolation to Zero Stretch: A Proposed New Materials Flammability Test Method." Presented at the FLARE International Workshop, Sapporo Japan, Jan. 20-22, 2016. FLARE International Workshop, Sapporo Japan, Jan. 20-22, 2016. , Jan-2016