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| **Fiscal Year:** | FY 2018 | **Task Last Updated:** | FY 10/17/2018 |
| **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:** | 03/31/2021 |
| **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:** | 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:** | | | |

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| **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.<br>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.<br><br>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.<br><br>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 Tsukuba, Japan in January, 2018. At that meeting, the science teams presented their status to the group. In addition, plans for a parabolic aircraft campaign were discussed.<br>A series of NASA Glenn Zero Gravity Research Facility (ZGRF) tests were continued this year to determine the approximate high velocity blowoff limits for thin cotton fabrics for both opposed and some concurrent flow conditions. For concurrent flow, flame spread was obtained over the accessible range of flow at 12% oxygen at one atmosphere pressure. These results were shared with the Flammability Limits At Reduced-g Experiment (FLARE) Co-Investigator while planning his aircraft campaigns.<br><br>Concurrent blowoff parabolic aircraft testing was conducted in Japan in the G-II aircraft in August and September, 2018. A number of blowoff conditions were obtained as well as flame spread. The data was shared, and analysis is underway of the flame spread and blowoff onset. Concurrent blowoff of thin cotton sheet occurs frequently on only on one side of the sample at near-limit conditions. Often, during a single test, the flame will blow off one side only to re-form, wrapping around the base from the flame on the other side. This is possible because the cotton fabric burns away at the base. Definitive blowoff occurs when both sides of the flame blow off. This one-sided blowoff behavior creates a larger band of uncertainty along the blowoff boundary.<br><br>A successful Technical Interchange Meeting (TIM) was held at NASA White Sands Test Facility (WSTF) Aug. 22-23, 2018. The FLARE project status and the ISO standardization plan were discussed. Extensive data was shared on JAXA parabolic aircraft testing and 1g blowoff testing of practical materials (Nomex HT90-40, Polycarbonate, Kevlar, Kapton, Conex, Technora, Kydex). NASA has proposed an improved upward flame spread Test 1 of NASA STD 6001B which evaluates the upward limiting oxygen index and maximum oxygen concentration (ULOI/MOC) of a material in 1g. JAXA is pursuing a downward burning limiting oxygen index (LOI) method as a potential alternative index for flammability. For either of these methods, there is a discrepancy in the actual flammability limit in microgravity since material flammability can be higher in microgravity. |
| **Bibliography Type:** | Description: (Last Updated: 04/17/2024) |
| **Abstracts for Journals and Proceedings** | Olson SL. "Normal gravity test method to estimate microgravity material flammability limits in exploration atmospheres: upward blowoff of axisymmetric samples." FLARE Workshop, JAXA, Tsukuba, Japan, January 22-24 2018. FLARE Workshop, JAXA, Tsukuba, Japan, January 22-24 2018. , Jan-2018 |