



# OCHMO Human Spaceflight Standards Newsletter October 2023

## What is NASA-STD-3001?

NASA-STD-3001, NASA Spaceflight Human-System Standard Volumes 1 and 2, establishes Agency technical requirements that enable human spaceflight missions by minimizing health risks, providing vehicle design parameters, and enabling the performance of flight and ground crew. Applicability and tailoring of these technical requirements are determined based on each program's mission profile and procurement strategy.

NASA-STD-3001 Volume 1 covers the technical requirements needed to support astronaut health and Volume 2 covers system design that will maintain astronaut safety and promote performance.

Through partnerships with the programs (e.g., Orion, Gateway, HLS, EHP, etc.), international and commercial partners, the Human Research Program, and SMEs (internal and external to NASA), the technical requirements are constantly evolving and being reworked to minimize human health and performance risks. The Standards Team works with all NASA Spaceflight Programs to help tailor the technical requirements for their specific missions.

## Table of Contents

### Page 2

- Updates to NASA Space Flight Human-System Standard: Volume 1 – Crew Health (Revision C)

### Page 3

- Updates to NASA Space Flight Human-System Standard: Volume 2 – Crew Health (Revision D)

### Page 4

- OCHMO Technical Briefs

### Page 5

- Independent Assessment and Collaborative Projects
- Commercial Partners Food and Exercise Technical Integration Meeting

### Page 6

- Crew Mortality Summit
- Updates to the OCHMO Standards Team

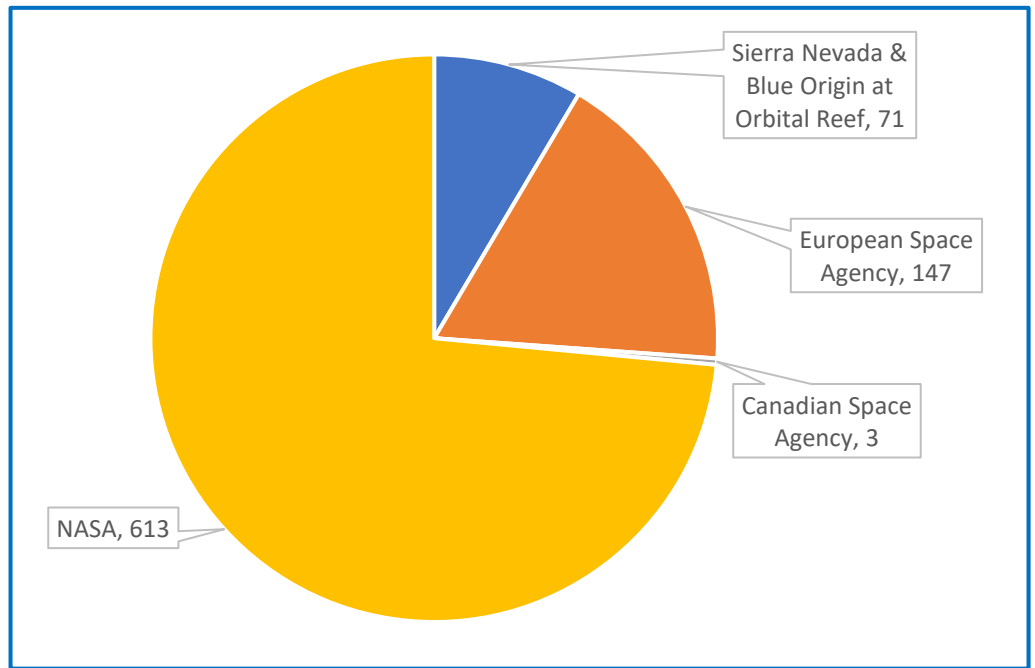


### What is a Standard?

The majority of NASA-STD-3001 Vols. 1 & 2 are performance technical requirements, meaning they state technical requirements in terms of desired results without stating a method for achieving it. All technical requirements contain a "shall" statement and can be followed by a short, italicized rationale statement. Rationales are intended to provide additional information for the implementation of the technical requirements.

NASA-STD-3001 Standards are overarching and apply to all of NASA's Spaceflight Programs. These technical requirements are essential pieces used to create program requirements that lead to successful designs and implementations.

NASA-STD-3001 Volumes 1 and 2 were updated and released for review to the agency, commercial providers, and international partners in March 2023. We received a total of 834 comments, distributed as depicted in the graph below:



### NASA Space Flight Human-System Standard: Volume 1 – Crew Health (Revision C) [Link to Approved Document](#)

NASA Standard 3001 Volume 1 Revision C has received agencywide approval and is now available for public viewing on the OCHMO standards website! NASA-STD-3001 Volume 1, Crew Health, sets standards for fitness for duty, space permissible radiation exposure limits and permissible outcome limits, health and medical care, medical diagnosis, intervention, treatment and care, and countermeasures.

The revision of Volume 1 consisted of the following:

- 353 total comments dispositioned
  - 150 comments accepted
  - 92 comments accepted with modifications
  - 18 comments deferred to next revision
  - 83 not accepted
  - 10 noted

**Volume 1 Rev C comments by organization:**  
 277 from NASA (various centers)  
 73 from ESA  
 3 from CSA

### Major changes to NASA-STD-3001 Volume 1, Rev C included:

- 8 new Crew Mortality technical requirements
  - Including requirements on establishing a Pre-Mission Crew Mortality Plan, In-Mission Forensic Sample Collection, and handling of crew remains. A summary of these technical requirements is available in [OCHMO-TB-012 Mortality Related to Human Spaceflight](#).
- 1 new Galactic Cosmic Radiation (GCR) technical requirement
  - Providing guidance on protection from GCR exposure in habitable space systems in free space or on planetary surfaces.



**NASA Space Flight Human-System Standard: Volume 2 – Crew Health (Revision D)**  
[Link to Approved Document](#)

**Links**

Have suggested changes to the NASA-STD-3001 documents? Use this link to submit your comments to the team:

[Suggest Changes to the NASA-STD-3001 Documents](#)

View the new Human System Risks [website](#) for information on the risks of human spaceflight and NASA’s strategy to understand, manage, and mitigate these risks to protect astronaut health and mission success.



For internal NASA employees: Access the [SPARC database](#) by signing in with your NASA NDC credentials to review the linkages and traces between NASA-STD-3001 and program requirements.

NASA Standard 3001 Volume 2 Revision D has received agencywide approval and is now available for public viewing on the OCHMO standards website! NASA-STD-3001 Volume 2, Human Factors, Habitability, and Environmental Health, sets standards for the design, selection, and application of hardware, software, processes, procedures, practices, and methods for human-rated systems. It focuses on human-system integration and how the crew interacts with designed systems and the environment to maintain health, safety, and overall mission performance.

The revision of Volume 2 consisted of the following:

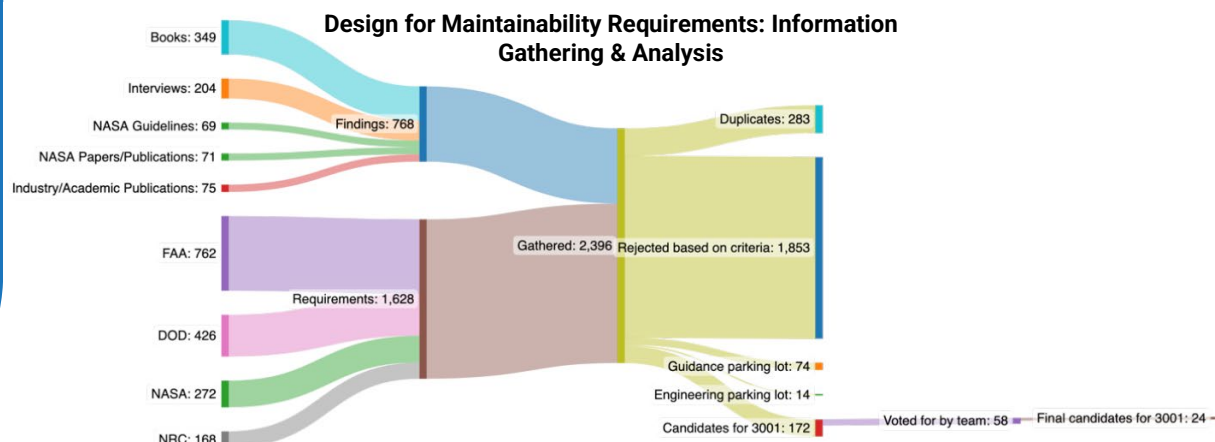
- 481 total comments dispositioned
  - 155 comments accepted
  - 72 comments accepted with modifications
  - 71 comments deferred to next revision
  - 120 not accepted
  - 58 noted

**Volume 2 Rev D comments by organization:**  
336 from NASA (various centers)  
74 from ESA  
71 from commercial providers

**Major changes to NASA-STD-3001 Volume 2, Rev D included:**

- A reduction in total number of technical requirements from 498 (Rev C) to 464 (Rev D)
- Major overhaul of Human Error and Performance chapters (5 & 10), which was highlighted in previous newsletters, including 88 comments to the updates:
  - 32 new technical requirements
  - 13 deleted technical requirements
  - 58 merged into new or existing technical requirements
- New section of maintainability requirements:

The OCHMO Standards Team, in collaboration with the NASA Engineering and Safety Center (NESC) and Office of Safety and Mission Assurance (OSMA), conducted a review and update of relevant human-systems requirements on the design of space systems to support the crew’s capability to conduct maintenance safely, effectively, and efficiently. The team reviewed past and current maintainability-related standards within NASA, other government agencies (DoD, FAA, NUREG), and industry (IEEE, SAE) to identify potential gaps in current NASA standards, and consulted a wide range of sources and interviewed 50 Subject Matter Experts to understand NASA’s maintenance practices and challenges, maintenance related incidents on prior NASA missions, latest trends in designing for maintainability and conducting maintenance, and performing maintenance in extreme environments by a small team. The process yielded a final set of 22 technical requirements that were added to NASA-STD-3001 Vol 2 Rev D.





Successful Crew-7 Launch & Crew-6 Landing

Congratulations to NASA's Commercial Crew Program for the successful launch of Crew-7, the seventh commercial crew of astronauts to launch from Kennedy Space Center to the International Space Station. Crew-7 lifted-off from pad 39A at KSC on 08/26/2023 and docked to the ISS on 08/27/2023.

The program also safely brought home Crew-6, which splashed down in the Atlantic Ocean on 09/04/2023. Crew-6 was NASA's sixth commercial crew of astronauts and launched from KSC on 03/02/2023, completing a 186-day mission on the ISS.



Visit the Commercial Crew Program website to read more about CCP's latest news and updates.

Visit OCHMO Standards

OCHMO Technical Briefs

Technical Briefs have been developed for certain topics to offer technical data, background, and application notes to aid with the development of hardware, systems, and vehicles, as well as human needs/limitations. These tech briefs integrate content from multiple Standards and provide a quick, informative resource to reference when working with NASA-STD-3001.

The Standards Team is currently updating all versions of the existing technical briefs to be consistent with the new NASA-STD-3001 Volume 1 Rev C and Volume 2 Rev D documents. In addition, since the last newsletter release there have been 6 technical briefs added to the website:

- Automated & Robotic Systems
Crew Selection & Recertification
Extraterrestrial Surface Transport Vehicles (Rovers)
Habitable Atmosphere
Mission Duration
Mortality Related to Human Spaceflight

Grid of technical brief thumbnails including: Crew Selection and Recertification (OCHMO-TB-034), Habitable Atmosphere (OCHMO-TB-003), Mortality Related to Human Spaceflight (OCHMO-TB-012), and Executive Summaries for various standards.

In April 2023, the OCHMO Standards Team published an article in npj Microgravity titled 'NASA Space Flight Human-System Standard: enabling human spaceflight missions by supporting astronaut health, safety, and performance'. The purpose of this paper is to describe NASA's approach to establishing and maintaining a set of Agency-level Space Flight Human System Standards managed by the Office of the Chief Health and Medical Officer (OCHMO) at NASA that enables space flight missions by minimizing health risks to astronauts, providing vehicle design parameters, and supporting the performance of both flight and ground crews.

npj microgravity COMMENT OPEN
NASA Space Flight Human-System Standard: enabling human spaceflight missions by supporting astronaut health, safety, and performance
Sarah D. Chidress, Tara C. Williams, and David R. Francisco

INTRODUCTION
There are five primary hazards of space flight... 1. Radiation Exposure... 2. Hostile/Unfriendly Environment... 3. Isolation... 4. Distance from Earth...



### Independent Assessments and Projects

#### Review of the proposed hydrogen sulfide (H<sub>2</sub>S) SMAC level

NASA's OCHMO initiated a review of a proposed Spacecraft Maximum Allowable Concentration (SMAC) for H<sub>2</sub>S by assembling a panel of 3 subject matters experts external to NASA. The panel met with the Standards Team virtually 3 times in February and March 2023, and panel members submitted individual opinion statements in April 2023. Their feedback and comments have been provided to the JSC Toxicology group for consideration in finalizing the proposed H<sub>2</sub>S SMAC level.

#### Exploration Atmosphere Research Strategies

NASA's OCHMO initiated a review of the current "Validation of Exploration Atmosphere Prebreathe Protocol" and additional materials summarizing the history and technical background of Exploration Atmosphere at NASA by assembling a panel of 3 subject matter experts external to NASA. The panel met with the Standards Team virtually in May and June 2023, and panel members submitted individual opinion statements in August 2023. A summary of their statements and the outcomes of the meetings are currently being compiled and will be shared with the NASA Exploration Atmosphere working group to consider for future research and implementation.



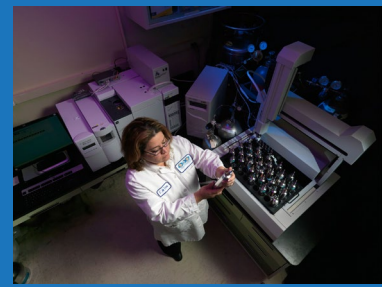
#### Suited CO<sub>2</sub> Washout

NASA has been ramping up its efforts to work with commercial providers to design safe and effective spacesuits for future exploration missions. One major area of concern is controlling suited CO<sub>2</sub> levels. NASA's OCHMO is tasked with ensuring that spacesuit CO<sub>2</sub> levels meet the NASA-STD-3001 requirements. Current research methods have presented with issues on unrepeatability and data integrity, thus OCHMO is looking for effective testing that measures inspired CO<sub>2</sub> levels inside a spacesuit helmet, including CO<sub>2</sub> produced by the human and the amount washed out by air flow. The goal is to provide these testing methods to NASA's commercial providers developing future exploration spacesuits that are repeatable, minimize variability, and easily implemented to expedite the process in creating the next generation of spacesuits for Artemis.

#### Food Safety Regulations

As NASA moves forward to the Moon and eventually exploring Mars, the need to develop food systems that are safe and last for longer-duration spaceflight has been recognized. NASA has requested the Potomac Institute to assess the Food & Drug Administration (FDA) to help determine guidelines for safety and production of food for spaceflight. This assessment includes:

- FDA (and related federal agencies) process for food safety on airlines (CFR1240 and 1250) and terrestrial food production (U.S. FDA)
- Compare what is needed for the FDA to regulate space food production and delivery, including production, packaging, shipment, storage, preparation, and consumption in the space environment
- Assess any legal jurisdiction hurdles for the FDA to regulate space food safety and identify any agreements that should be considered between NASA and the FDA (or related federal agencies) to enable effective space food safety regulation
- Outline a process/strategy for educating the public/terrestrial food production vendors on space food production



Read more about NASA's Exposure Guidelines (SMACs & SWEGs) [HERE](#)



Read more about NASA's Exploration Atmosphere Chamber Testing studies [HERE](#)



Visit the [NASA Suit Up website](#) to stay up to date on the future of spacesuits



Read more about the Potomac Institute on their [website](#).



### Contact Us

The OCHMO Standards Team, led by NASA Technical Standards Manager Dave Francisco, has experience working with the NASA-STD-3001 documents as well as the program requirements that flow from them. They are willing to meet for consultations to clear any confusion regarding technical standards, provide clarification for the intent of specific standards, or further describe the formation of standards from risks.

POC – Dave Francisco:  
[david.r.francisco@nasa.gov](mailto:david.r.francisco@nasa.gov)

Sarah Childress:  
[sarah.d.childress@nasa.gov](mailto:sarah.d.childress@nasa.gov)

Kristin Coffey:  
[kristin.m.coffey@nasa.gov](mailto:kristin.m.coffey@nasa.gov)

Doug Ebert:  
[douglas.j.ebert@nasa.gov](mailto:douglas.j.ebert@nasa.gov)

Emma Hwang:  
[emma.y.hwang@nasa.gov](mailto:emma.y.hwang@nasa.gov)

Kim Lowe:  
[kimberly-michelle.p.lowe@nasa.gov](mailto:kimberly-michelle.p.lowe@nasa.gov)

Imene Mechkene:  
[imene.m.mechkene@nasa.gov](mailto:imene.m.mechkene@nasa.gov)

Chance Melton:  
[chance.j.melton@nasa.gov](mailto:chance.j.melton@nasa.gov)

### Commercial Partners Food and Exercise Technical Integration Meeting Summer 2023

NASA's OCHMO Standards Team attended a Food and Exercise TIM hosted by the Commercial LEO Development Program (CLDP) with the goal to discuss the importance of the food system in spaceflight, challenges and opportunities in designing a spaceflight food system, nutritional requirements for astronauts; as well as the importance of exercise countermeasures to mitigate spaceflight associated physiological decrements, and the challenges of designing an effective and vehicle-friendly exercise system.



### Crew Mortality Summit

NASA recognizes the need for further discussions and policy development in the event tragic events were to happen while in space. Team members representing various specialities, including astronauts, flight crew physicians, planetary protection, coronial and forensic pathology, space taphonomy, anthropology, forensic entomology, as well as team members from OCHMO, including NASA's Chief Health and Medical Officer, JD Polk. The team was tasked with facilitating difficult conversations to identify actions needed for the agency to consider as it relates to protection of the crew, medico-legal aspects, planetary protection, forensics, and the handling of crew remains. The group had robust discussions about the items or processes to help facilitate or guide agencies and countries in the event a crewmember should perish during a visit to space or while on a mission. As a result, it was recognized that there are challenges and a need for future development of policy and procedures as humans have more presence in space exploration, not only through NASA, but as commercial space endeavors continue to grow.

### Updates to the OCHMO Standards Team

#### Summer Intern – Chance Melton

Chance is a senior at Texas A&M University pursuing a degree in neuroscience. He conducts PTSD research on rat models at A&M and took a summer internship with the Standards Team to supplement his research skills and knowledge. This summer, Chance divided his time between Medical Operations and the Standards Team, allowing him to gain experience in two different areas at NASA. As part of the Standards Team, he created the newly published Crew Selection and Recertification technical brief, drafted a trace from the Medical Evaluation Documents (MEDB) to NASA Standard 3001 and worked on a future plan for crew survivability. Going forward, Chance will continue working with the Standards Team on a part-time basis while finishing his degree at A&M and hopes to matriculate into medical school in the Fall of 2024.



#### Farewell to Standards Integrator Harrison Otto!

This August, the Standards Team said goodbye to our valuable team member, Harrison Otto. But fortunately, he will remain close as he pursues an exciting new path working on automated and robotic systems here at NASA's Johnson Space Center. We wish Harrison all the best in his new ventures!