



OCHMO Human Spaceflight Standards Newsletter September 2024

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 health, 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 subject matter experts (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.

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NASA Medical Selection, Recertification, and Mission Medical Evaluation Standards OCHMO-STD-100.1, Revision A

OCHMO-STD-100.1 is published by NASA to provide uniform medical requirements for processes, procedures, practices, and methods that have been endorsed as standard for NASA programs and projects, including requirements for selection and annual recertification of NASA astronauts.

The intent of Revision A is to provide an Agency level document for medical selection and mission medical evaluations for spaceflight crews and streamline accessibility of spaceflight medical requirement information.

The document was modified to add:

Mission Medical Evaluations (MED B) – Agency Level vs. Program

Private Astronaut Selection Medical Standards

NASA Suborbital Research Specialist Medical Standards

New clinical content additions include:

- Factor V Leiden and anti-phospholipid antibodies to astronaut candidate screening
- Lab requirements: potassium (K), ionized calcium (Ca), urinalysis components, human chorionic gonadotrophin (HCG)
- Updated colonoscopy at or over age 45 years: within the last 5 years; and at or over 40 years with history positive for colon cancer
- Updated osteoporosis T-score cutoff from <2.5 to ≤ 2.5 .
- MRI of shoulder added to Special Assessments for Annual Recertification
- Space Motion Sickness (SMS) medication requirement
- Updated medical screening requirements for private astronauts on spaceflight missions <30 days

Modifications to the ISSP MED Bs include:

- Removed the agency specific, MRID, and MO reference columns in the Medical Evaluation requirements table, and added an annual reference column
- Removed the radiation requirement (MED B 3.1) from NASA requirement
- Removed agency specific (i.e., ESA, CSA, JAXA, Roscosmos) requirements and matrices
- Removed Single Flow to Launch content
- Removed requirements for biodosimetry, calf volume measurement, and arm ergometry (Orlan)

The updated OCHMO-STD-100.1A document is available at:
<https://www.nasa.gov/ochmo/aerospace-medical-certification-standard/>

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.



Links

Have suggested changes to the NASA-STD-3001 documents? For internal NASA employees, use this link to submit your comments to the team: [Suggest Changes to the NASA-STD-3001 Documents](#)

Or you can send an email to the team [here](#)



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.

OCHMO Technical Briefs

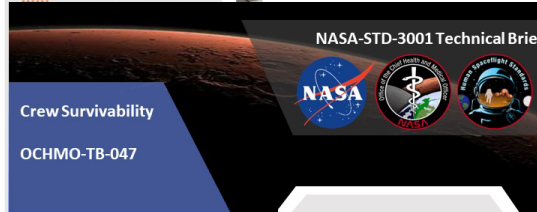
[Technical Briefs](#) have been developed for certain topics to offer technical data, background, and application notes to aid with the development of hardware, systems, and vehicles, as well as human needs/limitations. These tech briefs integrate content from multiple Standards and provide a quick,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

Since the last newsletter release, there have been 6 technical briefs added to the website:

- Design for Maintainability
- Exercise Overview
- Microbiology in Space Overview
- Crew Survivability
- Non-Ionizing Radiation
- Spaceflight Associated Neuro-Ocular Syndrome



Executive Summary
The human cardiovascular and skeletal muscle systems have evolved to meet the challenges of upright posture in the Earth's gravitational environment. During spaceflight, astronauts experience altered gravity environments that lead to physiological decrements in aerobic capacity, muscle strength, bone strength, vision changes, and altered vascular motility, which can lead to a decrease in crew performance. Exercise is prescribed to astronauts as a countermeasure to altered gravity and is vital to maintaining optimal crew health and performance. It addresses these decrements and is also used as a countermeasure for orthostatic intolerance and immune and sensorimotor functioning. The extent of physiological deconditioning varies per individual and is dependent on a multitude of factors such as starting fitness level, age, mission duration, and gravity level. Without intervention, acute deconditioning begins immediately upon exposure to an altered gravity environment and is measurable within a few days. As mission duration increases, the decrements will continue to increase without intervention. NASA has generated standards/thresholds to protect health outcomes and enable performance for mission tasks.



Executive Summary
As future spaceflight missions become increasingly complex, longer in duration, and a further distance from Earth, readily available rescue and evacuation options must be evaluated to protect crewmembers during off-nominal survival scenarios. This technical brief explores options to support rescue scenarios by reducing the human usage of consumables (i.e., oxygen, food, water, power) to extend the mission to enable rescue. By considering these potential survival scenarios during the planning and design phase, providers can make informed decisions on vehicle capabilities, mission supplies, crew make-up and rescue options.



Artemis I SLS waiting on the launchpad

NOTE: The parameters discussed in this illustration purposes only. The details must consider exact circumstances.



Executive Summary
Spaceflight Associated Neuro-ocular Syndrome (SANS) refers to a constellation of ocular findings including optic disc edema, posterior globe flattening, choriorretinal folds, and hyperopic shifts in refractive error observed in astronauts during and following long-duration spaceflight. SANS etiology is not certain, but altered gravity and fluid shifts resulting in venous congestion and intracranial pressure elevations are the most likely causes. The concerns associated with signs and symptoms of SANS are decrements in vision that can affect in-flight crew capability and task performance as well as long-term eye health risks that could result from eye and brain structural changes that develop during spaceflight. In this technical brief we discuss the pathophysiology, and countermeasures being used and studied in order mitigate these risks.



NASA astronaut Tim Kopra conducts a self-exam as part of the Ocular Health investigation on the ISS.

- Relevant Technical Requirements**
- NASA-STD-3001 Volume 1, Rev C
 - [V1 3001] Selection and Recertification
 - [V1 3002] Pre-Mission Preventive Health Care
 - [V1 3003] In-Mission Preventive Health Care
 - [V1 3004] In-Mission Medical Care
 - [V1 3016] Post-Mission Health Care
 - [V1 3018] Post-Mission Long-Term Monitoring
 - [V1 4020] In-Mission Nutrient Intake
 - [V1 5001] Medical Training
 - [V1 5002] Crewmember Training
 - [V1 5003] Crew Medical Officer Medical Training
 - [V1 6008] Crew Health Operations Concept Document
 - [V1 6009] Medical and Crew Health Technical Requirements Document
 - NASA-STD-3001 Volume 2, Rev D
 - [V2 6001] Trend Analysis of Environmental and Suit Data
 - [V2 6004] Nominal Vehicle/Habitat Carbon Dioxide
 - [V2 6022] Atmospheric Monitoring and Alerting Parameters
 - [V2 6107] Nominal Vehicle/Habitat Atmospheric Ventilation
 - [V2 7100] Food Nutrient Composition
 - [V2 7043] Medical Capability
 - [V2 7045] Medical Equipment Usability



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

Laura Bostick:
laura.l.bostick@nasa.gov

Carisa Champion
carisa.r.champion@nasa.gov

Sarah Childress:
sarah.d.childress@nasa.gov

Kristin Coffey:
kristin.m.coffey@nasa.gov

Doug Ebert:
douglas.j.ebert@nasa.gov

Amanda Hogan
amanda.l.hogan@nasa.gov

Emma Hwang:
emma.y.hwang@nasa.gov

Joanne Kaouk:
joanne.l.kaouk@nasa.gov

Kim Lowe:
kimberly-
michelle.p.lowe@nasa.gov

Independent Assessments

Communication Delay

NASA OCHMO initiated an initial testing for communication delays during a hardware maintenance task utilizing a 5 second delay. The testing was completed and results were summarized in a report which was shared with NASA programs. Additional follow-on studies were initiated by the NASA Human Research Program (HRP) following the release of the study outcomes.

Patent Foramen Ovale (PFO) and Decompression Sickness (DCS)

NASA OCHMO initiated a working group to review the status and progress of research and clinical activities intended to mitigate the risk of DCS issues related to PFO during spaceflight and associated ground testing and human subject studies. The working group was assembled from internal NASA subject matter experts, the NASA OCHMO Standards Team, NASA stakeholders, and external subjects matter experts including cardiologists, hypobaric medicine, spaceflight medicine, and military occupational health expert.

The working group met in June 2024, and a summary report was released in August 2024.



Suited Carbon Dioxide (CO₂) Test Methods

NASA OCHMO is supporting ongoing testing to determine safe levels of inspired CO₂ within spacesuit helmets. Phase I and Phase II testing of suited CO₂ washout has been completed, and various stakeholders have been meeting on a regular basis to discuss the results of the testing and create plans for Phase III. NASA OCHMO is utilizing the participating external experts to review the analysis of the data collected thus far in an effort to produce testing methods that are repeatable, minimize variability, and easily implemented for NASA's commercial providers developing future spacesuits.

Acceleration and Dynamic Loads

NASA OCHMO is supporting a reassessment of existing technical requirements for landing loads, due to a concern that landing on the lunar surface will need further risk reduction to prevent minor injuries that may occur during a lunar surface landing that could impair crew ability to perform EVA mission tasks on the surface.

Venous Thromboembolism (VTE) in Spaceflight

VTE refers to a spectrum of blood clotting disorders which includes deep vein thrombosis (DVT) and pulmonary embolism. Recently, an asymptomatic, obstructive, left internal jugular vein DVT was identified in a long-duration astronaut during a research ultrasound examination aboard the International Space Station. NASA OCHMO is in the process of establishing a working group comprised of internal and external experts to assess the existing screening, in-flight treatments, and countermeasures for VTE during spaceflight.

Advanced Displays and Controls

NASA OCHMO is currently reviewing questions from partners regarding the implementation of graphical user interface (GUI) standards in relation to advanced displays and controls, including projection displays, XR/VR/AR, etc., and working with internal and external experts to determine if new or updated NASA-STD-3001 technical requirements are needed.