Human Spaceflight Standards Overview

Office of the Chief Health and Medical Officer
Standards Team

Sarah Childress

https://www.nasa.gov/offices/ochmo/human_spaceflight/index.html

OCHMO Standards Team

Dave Francisco
Technical Fellow

Yamil Garcia
HHPC Task Order Manager

- **Kim Lowe** — Human System Standard Integrator & Team Co-Lead
- **Sarah Childress** — Human System Standard Integrator & Team Co-Lead
- **Kristin Coffey** — Human System Standard Integrator
- **Imene Mechkene** — Human System Standard Integrator
- **Harrison Otto** — Human System Standard Integrator
- **Doug Ebert** — Human System Standard Integrator
- **Erin Connell** — Human System Standard Integrator
- **Emma Hwang** — Human System Tool Developer
- **Medical Doctor**

Standards team members are responsible for sections within 3001 which spans to the technical briefs and HIDH

Standards team members are also assigned to programs to support CHPOs

Rotations
The Standards team pulls in experts for rotations (some part time to full time) 3 months to a year for special projects to support updates and/or technical material generation

The Standards team has medical doctors that rotate to support the team

Human Spaceflight Standards NASA-STD-3001, Volumes 1 and 2: Human health, medical care, safety and performance

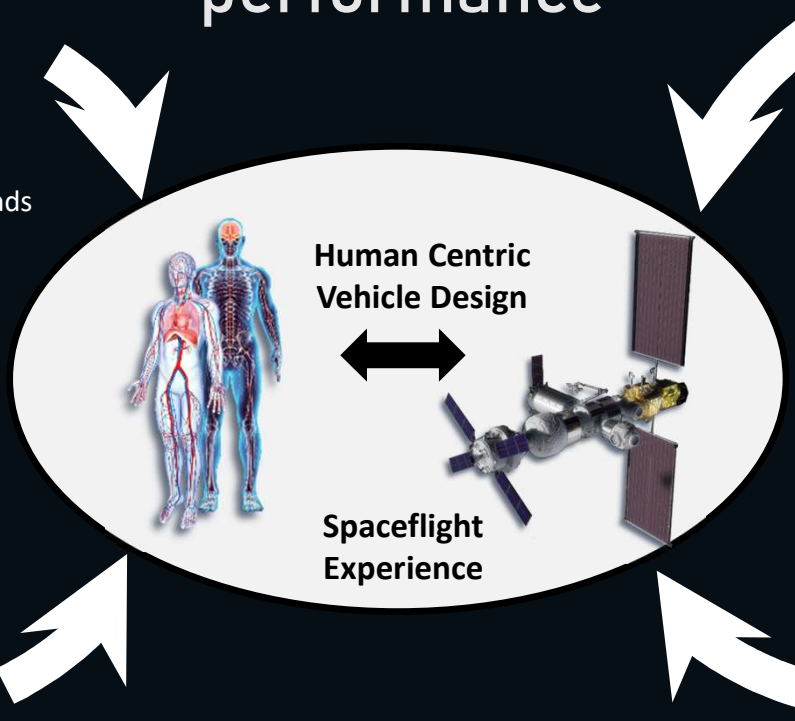
Human Requirements that drive vehicle systems

Affect on Spaceflight Experience

Air – O_2 Concentration, Pressure, CO_2
Water Quality and Quantity
Food, Nutritional Content,
Food Acceptability and Safety
Maximum Allowable Concentrations of Compounds
Microbial Control
Net Habitable Volume/Layout
Sleep Stations
Acoustics
Lighting – Circadian
Radiation Shielding

Medical Care In Mission

Expected Events
Protecting Health Outcomes – bone, muscle
Exercise
Diagnostic Capabilities
Treatment – Pharmaceutical, medical supplies
Medical Operations – Ground Support



Human Performance

Displays and Controls
Alarms and Warnings
Emergency Response
Personal Protection
Equipment
Automation
Task Analysis
Maintainability
Usability of Vehicle Systems
Minimizing design induced error
Cognitive workload

Psychological Support/Experience

Private Quarters, sleep quality
Lighting
Earth Private Communications
Windows
Exercise
Food Quality
Activities – earth observation, research, science, etc.

NASA-STD-3001 Requirement Types and Structure

- **Volume 1: Crew Health**
  - Sets requirements for medical care, including fitness for duty, spaceflight permissible exposure limits, permissible outcome limits, medical diagnosis, intervention, treatment and care, and countermeasures

Volume 2: Human Factors, Habitability & Environmental Health

- Sets standards for spacecraft (including vehicles, habitats, and suits), internal environments, ground processing, facilities, payloads, and related equipment, hardware, and software systems with which the crew interfaces during space operations

Standards Development for NASA-STD-3001

- What risk(s) are being addressed/mitigated?
- Research data (Human Research Program (HRP), literature, collaboration studies, analogs, etc.)
- Terrestrial data/standards (OSHA, FDA, IEEE, ISO, ASTM, etc.)
- Industry research and insight: how can we improve our Standards and documentation to provide companies with the knowledge needed to build human-rated spaceflight vehicles and environments?
- Rationale may contain possible implementation guidance on how a medical professional, engineer, or designer would utilize the Standards
  - Guidance on when to use the standard, what calculations are required and any caveats
  - What considerations are required to successfully implement the Standards?

Outcomes of HRP Research and Creation of 3001 Standards

Evidence Report:
Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Desynchronization, and Work Overload
Human Research Program
Behavioral Health and Performance Element

Evidence Report:
Risk of Adverse Health & Performance Effects of Celestial Dust Exposure
Human Research Program
Space Human Factors and Habitability (SHFH) Element

NASA-STD-3001

Volume 1, Rev B
[V1 3003] In-Mission Preventive Health Care
[V1 4014] Completion of Critical Tasks
[V1 6001] Circadian Shifting Operations and Fatigue Management

Volume 2, Rev C
[V2 5007] Cognitive Workload
[V2 6079] Crew Sleep Continuous Noise Limits
[V2 6082] Annoyance Noise Limits for Crew Sleep
[V2 6091] Vibration Exposure Limits during Sleep
[V2 8055] Physiological Effects of Light (Circadian Entrainment)
[V2 7070] Sleep Accommodation
[V2 7073] Partial-g Sleeping

Volume 2, Rev C
[V2 6153] Celestial Dust Monitoring and Alerting
[V2 6053] Lunar Dust Contamination

Outcomes of HRP Research and Creation of 3001 Technical Requirements

Evidence Report:
Risk of Bone Fracture due to Spaceflight-induced Changes to Bone
Human Research Program
Exploration Medical Capabilities Element

Evidence Report:
Risk of Hypobaric Hypoxia from the Exploration Atmosphere
Human Research Program

Human Health Countermeasures Element

NASA-STD-3001

Volume 1, Rev B
[V1 3002] Pre-Mission Preventive Health Care
[V1 3003] In-Mission Preventive Health Care
[V1 4026] Pre-Mission Bone Mineral Density
[V1 4027] Pre-Mission Bone Countermeasures
[V1 4014] Completion of Critical Tasks

Volume 1, Rev B
[V1 5009] Physiological Exposure Mission Training

[V1 6001] Circadian Shifting Operations and Fatigue Management

Volume 2, Rev C
[V2 7038] Physiological Countermeasures Capability
[V2 7100] Food Nutrient Composition

Volume 2, Rev C
[V2 6002] Inert Diluent Gas
[V2 6003] O2 Partial Pressure Range for Crew Exposure
[V2 6006] Total Pressure Tolerance Range for Indefinite Crew Exposure
[V2 11100] Pressure Suits for Protection from Cabin Depressurization

Outcomes of HRP Research and Creation of 3001 Technical Requirements

Evidence Report:
Risk of Decompression Sickness (DCS)
Human Research Program
Human Health Countermeasures Element

NASA-STD-3001

Volume 1, Rev B
[V1 3003] In-Mission Preventive Health Care
[V1 3004] In-Mission Medical Care

Volume 2, Rev C
[V2 6002] Inert Diluent Gas
[V2 6003] O2 Partial Pressure Range for Crew Exposure
[V2 6006] Total Pressure Tolerance Range for Indefinite Crew Exposure
[V2 6007] Rate of Pressure Change
[V2 6008] Decompression Sickness (DCS) Risk Identification
[V2 6009] Decompression Sickness Treatment Capability
[V2 11100] Pressure Suits for Protection from Cabin Depressurization
[V2 11032] LEA Suited Decompression Sickness Prevention Capability

Evidence Report:
Risk of Reduced Physical Performance Capabilities Due To Reduced Aerobic Capacity
Human Research Program
Human Health Countermeasures Element

Volume 1, Rev B
[V1 3003] In-Mission Preventive Health Care
[V1 4001] Microgravity EVA Aerobic Capacity Standard
[V1 4002] Celestial Surface EVA Aerobic Capacity
[V1 4003] In-Mission Aerobic Capacity

Volume 2, Rev C
[V2 4015] Aerobic Capacity

Human Spaceflight Standards Tools Overview

Standard – collection of agency level technical requirements that are supported by evidence

Technical Requirements - written in terms of desired results without stating a method for achieving it. All standards contain a **"shall"** statement. Written so that they can be verified by test, demonstration and/or analysis. Utilized directly to generate program requirements.

Rationales - provide a brief justification for the standard and are intended to provide additional information for implementation of that standard.

Technical Briefs – concise documents integrating content from multiple technical requirements to provide a quick, informative resource to reference when working with NASA-STD-3001. They are available for numerous standards and offer a summary of the technical data from research, operations, academia and industry as well as background and application notes for vehicle developers and the aerospace medical community.

Human Integration Design Handbook - a companion document to NASA-STD-3001 Volume 2. HIDH is a compendium of human space flight history, lessons learned, and design information for a wide variety of disciplines and provides extensive background information on the rationale for human-system design standards.

SPARC

SPARC

9

NASA Internal Website

SPARC

Systems Platform for Aggregating and Relating

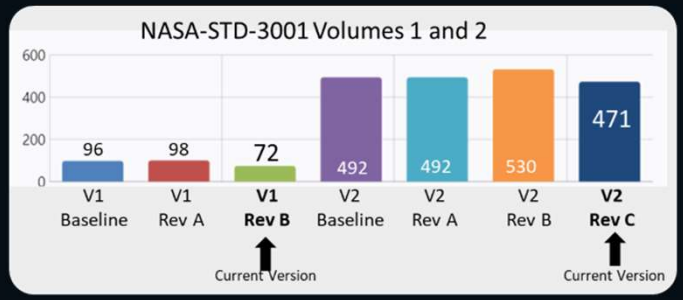
SPARC (nasa.gov) – available to NASA NDC users

Database that enables:

- Searching across all standards
- Searching across all program requirements
- Selection of applicable standards for a specific program
- Linkage to Technical Briefs

Collaboration with HRP, HSRB, SCLT and OCHMO

2,402	543
Program Requirements	NASA Technical Standards



Human Integration Design Handbook (HIDH) and Processes (HIDP)

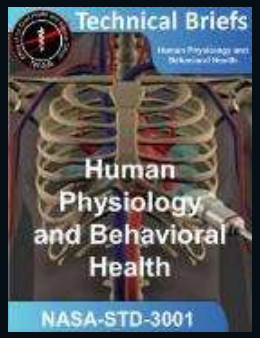
HIDH

- A guidance document that provides human health, performance, and/or engineering guidance information that may help the Government or its contractors in the design, construction, selection, management, support, or operation of systems, products, processes, or services.
  Major content areas includes:
  - Lessons learned
  - Application guidance for Standards
  - Data collection processes and reference materials

HIDP

- A how-to document to provide human-systems integration design processes, including methodologies and best practices that NASA has used to meet human systems and human rating requirements for developing crewed spacecraft. HIDP content is framed around human-centered design methodologies and processes in support of human-system integration requirements and human rating.
- Although NASA handbooks may contain "shall" statements, they are not intended to be program requirements documents

Technical Briefs

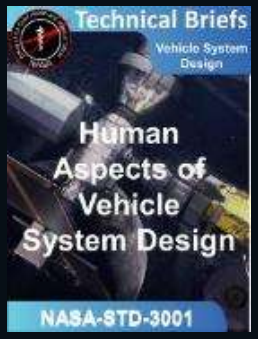


- Sensorimotor
- Orthostatic Intolerance
- Behavioral Health & Performance
- Decompression Sickness (DCS)
- Waste Management
- Water
- Bone Loss
- Food and Nutrition

- Entry Landing Mishaps
- Decompression & LEA Suit Mishaps
- EVA Mishaps
- Behavioral Health Mishaps

- Spaceflight Toxicology
- Medical Care
- Pharmaceuticals & Medications
- Health Stabilization Program
- Longitudinal Health Surveillance

Link:
https://www.nasa.gov/offices/ochmo/human_spaceflight/technical-briefs



- Touch Temperature
- Environmental Control & Life Support System (ECLSS)
- Fire Protection
- Human-in-the-Loop (HITL)
- Cabin Architecture
- Radiation Protection
- Apollo Lunar Lander
- Electrical Shock
- Lighting Design
- Artemis Lighting
- Carbon Dioxide (CO_2)
- Vehicle Hatches
- Sleep Accommodations
- Acoustics
- Acceleration
- Lunar Dust
- Cognitive Workload
- Usability, Workload, Error
- Automated and Robotic Systems
- Extraterrestrial Surface Transport Vehicles (Rovers)

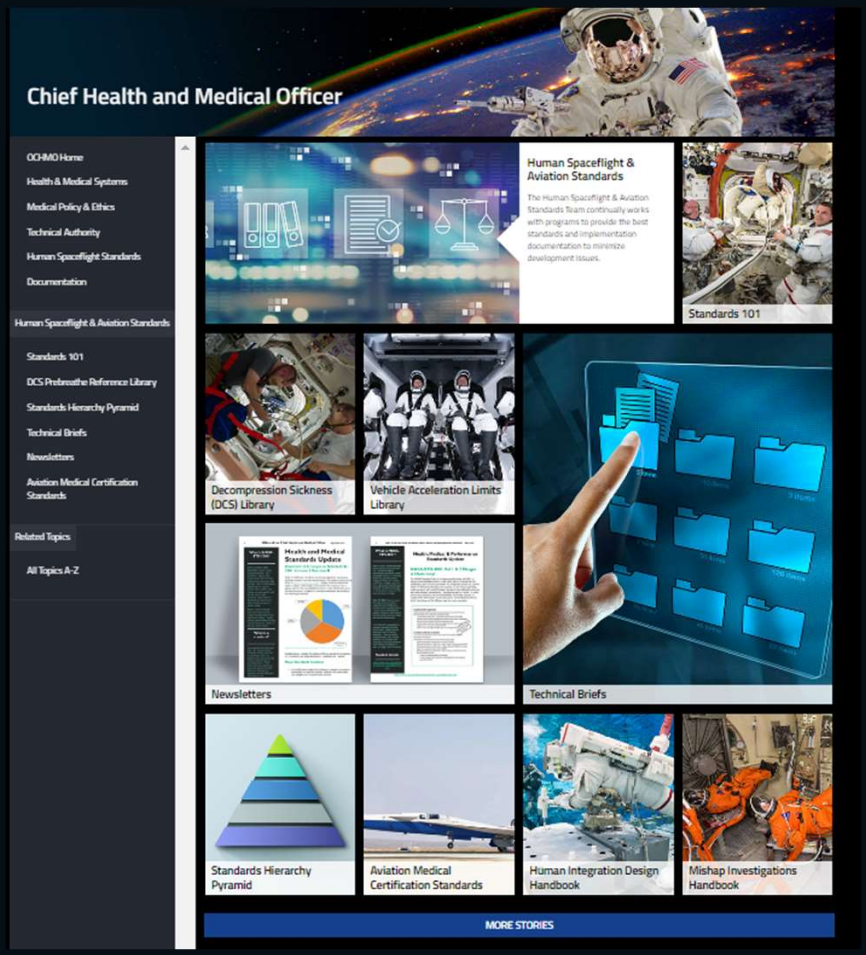
Public Website – Accessible by vendors

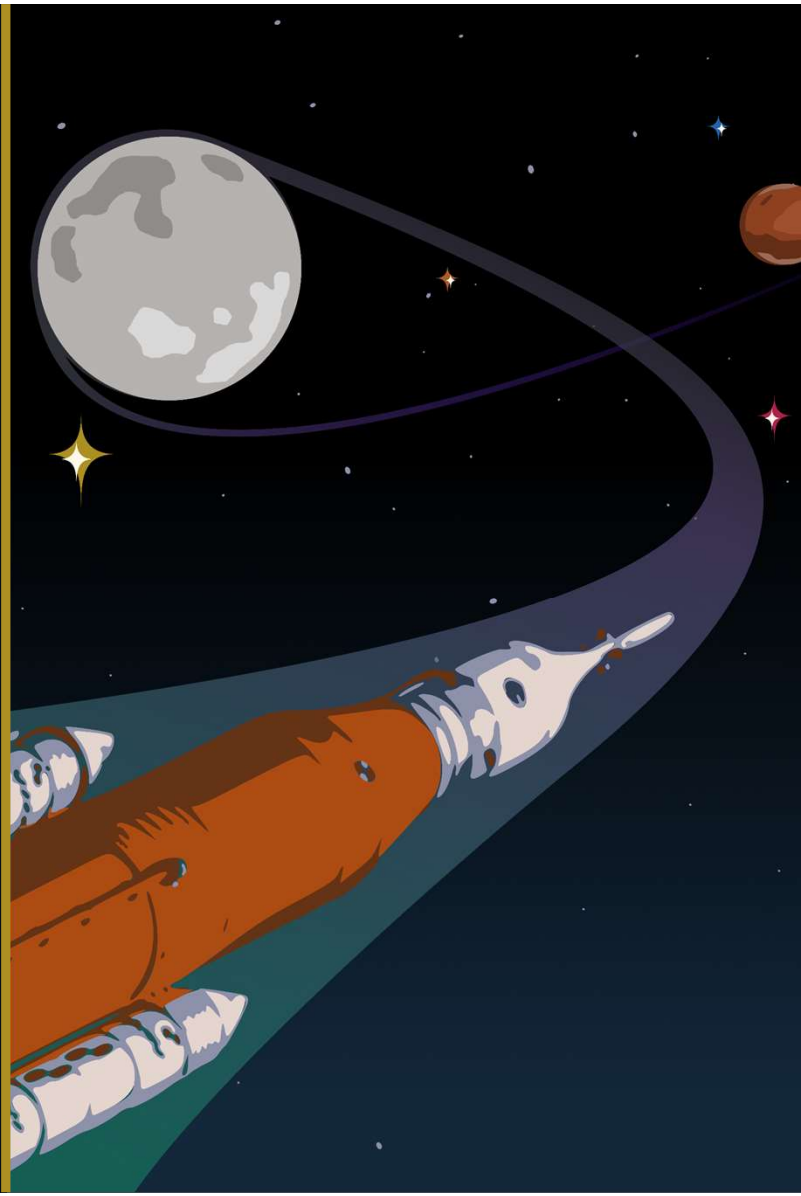
Resources Include:

- Access to standards & handbooks
- Reference Libraries
- Standards Hierarchy
- Technical Briefs
- Newsletters

Resources to understand and implement Human Spaceflight Standards are provided on a public facing website
Search NASA & OCHMO Link Below

https://www.nasa.gov/offices/ochmo/human_spaceflight/index.html





January 2023 Newsletter

The OCHMO Human Spaceflight Standards Newsletter provides information on changes to NASA-STD-3001 technical requirements, status updates on other ongoing Standards projects, and solicits feedback from the NASA community on future needs.

The newsletters are posted at least twice a year, with more frequency when important changes and announcements arise.

Current and past OCHMO Human Spaceflight Standards Newsletters are also publicly available on our website at:
https://www.nasa.gov/offices/ochmo/human_spaceflight/newsletters

https://www.nasa.gov/sites/default/files/atoms/files/newsletter_january_2023.pdf

Questions?