Office of the Chief Health and Medical Officer (OCHMO)
Human Spaceflight Standards Newsletter
March 2021

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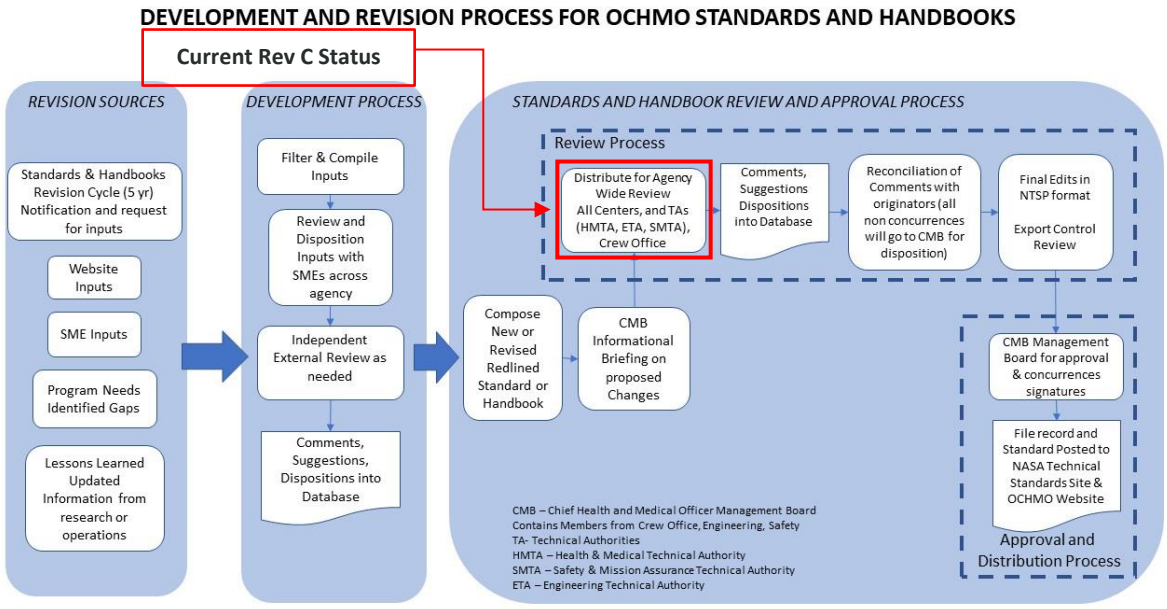
What is NASA-STD-3001?

NASA-STD-3001, NASA Spaceflight Human-System Standard Volumes 1 and 2, establishes Agency Standards 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 Standards are determined based on each program's mission profile and procurement strategy.

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

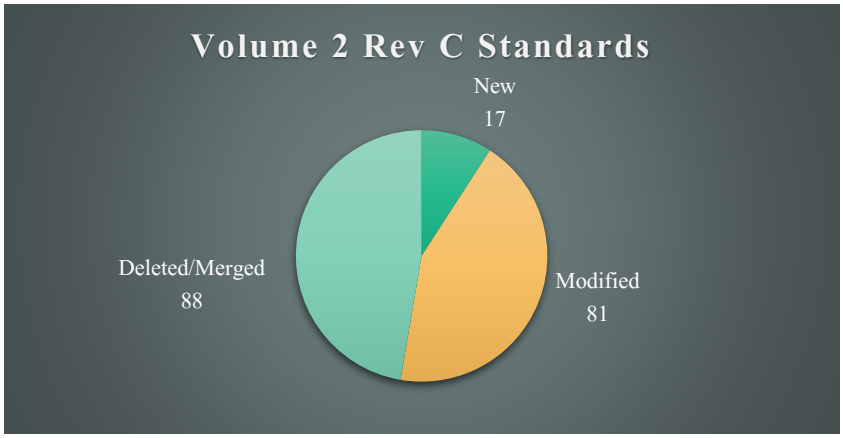
A Review of the Development and Revision Process for OCHMO Standards and Handbooks

When updating a Standards document, we follow a three-step process (see the graphic below for a summary). By following this process, we ensure that all comments are addressed in new document revisions and that changes are carefully tracked between document versions to better communicate relevant and important updates to each program.



NASA-Standard-3001, Volume 2, Revision C – Ready for Liftoff!

The much anticipated 'Rev C' of the NASA-STD-3001 Vol 2 is entering the last phases of the revision process described above. The redlined version is ready to be distributed to reviewers, bringing us closer to the final approval and publication of the revised Volume 2. Here are some important changes you will see in Rev C:



In addition, there were 2 new tables added, 4 tables modified, and 4 tables deleted.

- Water quantity – All of the water quantity and temperature Standards were consolidated into a Standard with an accompanying table for ease of use and reference.
- Body Waste Management – A table was created to capture the Standards that reflects specific information on Body Waste Quantities, including new data and requirements for Menses.

What is a Standard?

The majority of NASA-STD-3001 Vols. 1 & 2 are performance Standards, meaning they state Standards in terms of desired results without stating a method for achieving it. All Standards 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 Standards.

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

Through partnerships with the programs (e.g. xEMU, Gateway, HLS, etc.), the Human Research Program, and SMEs (internal and external to NASA), the Standards are constantly evolving and being reworked in an effort to minimize human health and performance risks. The Standards Team works with all NASA Spaceflight Programs in order to help tailor the Standards for their specific missions.

Links

The NASA-STD-3001 SharePoint (including where to submit recommendations for changes to the Standards, links to Standards documents, and SME lists) can be found at the following link: https://sashare.sp.jsc.nasa.gov/Teams/NASA-STD-3001/SitePages/Home.aspx

NASA-STD-3001 Vols. 1 & 2 can be found at the following link: https://www.nasa.gov/offices/ochmo/human_spaceflight/index.html

NASA-Standard-3001, Volume 2, Revision C (continued)

New Standards

- Section 3.2 Iterative Developmental Testing – Continued collaboration between the Standards Team and Human Factors SMEs recognized the need for a new Standard that requires programs or projects to perform iterative human-in-the-loop testing throughout the design and development cycle. This type of testing is an important method for identifying issues early when changes are affordable and feasible.
- Section 4.1 Physical Data Sets – To improve understanding of numerous physical data set Standards that must be considered together when designing a vehicle, Section 4.1 Physical Data Sets was consolidated into one revised Standard requiring programs to utilize datasets provided by NASA. This minimizes the number of verifications while still providing the required information.
- Section 6.5 Vehicle Acceleration Monitoring and Analysis – A new Standard was created to address the need for consistent monitoring of vehicle and crew acceleration parameters and specific kinematic responses during all dynamic phases of flight (e.g. ascent, abort, entry, descent and landing) to correlate with any injuries incurred by the crew.
- Section 8.4 No Drag-Throughs – A new Standard was created to address a recognized need for hatchways to be clear and uninhibited in the event of an emergency where a hatch needs to be closed quickly.
- Section 9.3 Temperature Exposures – A new Standard was created to define limitations of the temperature of any surface to which the bare skin of the crew is exposed to prevent skin injuries.

NASA-Standard-3001 Volume 1 & 2 Merger

The Standards Team is in the beginning stages of collaborating with SMEs to merge content between the Vol 1 Crew Health and Vol 2 Human Factors, Habitability, and Environmental Health. The merged documents will become NASA-STD-3002 and will enhance the usability of both volumes by linking health Standards with vehicle/hardware Standards (desired health outcomes with vehicle/design requirements). An important part of Volume 1 is policy and operational requirements that will be captured in a chapter of the 3002 and/or in policy documents and handbooks/technical briefs. The Standards Team is reviewing all the content between the two documents and drafting a proposed new format for the content merging and formatting. These proposed updates will enter a review and approval process estimated to last approximately 6 months.

Have a suggestion for updates to current 3001 Standards or a new Standard to be added to future document revisions? You can submit a comment using the NASA 3001 Suggested Document Changes form in SharePoint or email Tara Williams (tara.c.williams@nasa.gov).

Visit the OCHMO Standards Website

Contact Us

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

They can be contacted via e-mail:
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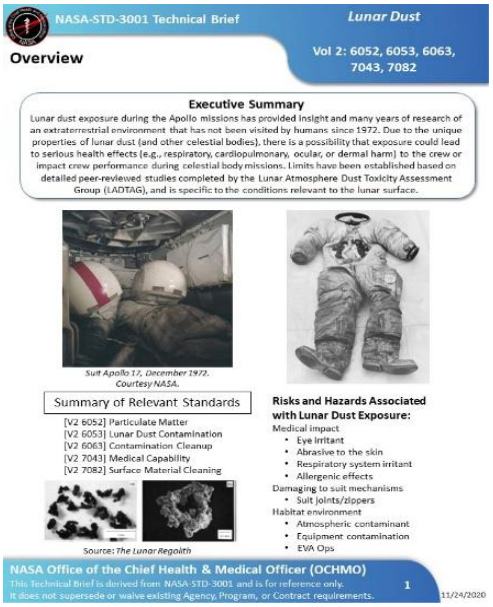
Standards Technical Briefs

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 13 technical briefs added to the website:

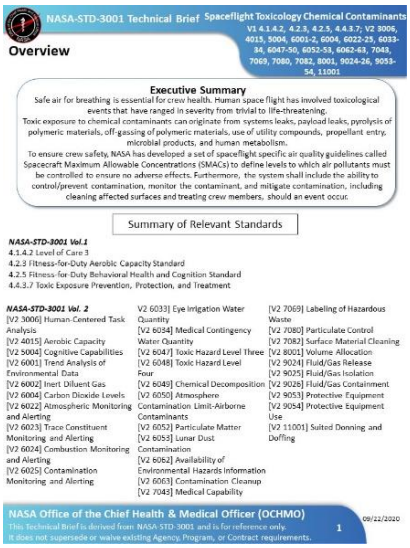
- Spaceflight Toxicology
- Sleep Accommodations
- Lunar Dust
- Cognitive Workload
- Behavioral Health Mishaps
- Usability, Workload, Error
- Cabin Architecture
- Entry Landing Mishaps
- Decompression & LEA Suit Mishaps
- Water
- Apollo Lunar Lander
- Medical Care
- Pharmaceuticals & Medications



In addition, there are several technical briefs in work that will appear on the website soon, including:

- Carbon Dioxide (CO_2)
- Human-in-the-Loop (HITL)
- Task Analysis
- Environmental Control and Life Support System (ECLSS)
- Suits
- Hatches

Is there a topic you'd like to see in a future Standards Technical Brief? Please submit your suggestions via email to Tara Williams (tara.c.williams@nasa.gov) or Sarah Childress (sarah.d.childress@nasa.gov).



Hazards of Spaceflight

There are many hazards associated with spaceflight, and the 3001 Standards Team seeks to address as many risks associated with these hazards as possible to protect crewmember health. The following are 5 largely contributing hazards of human spaceflight.

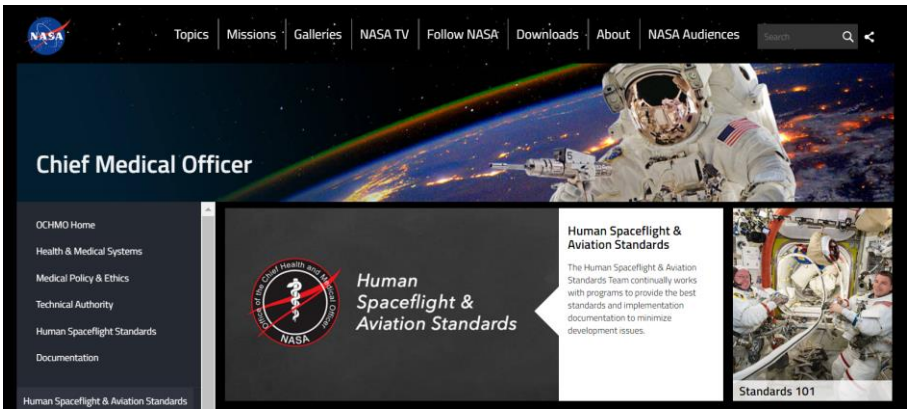
Human Integration Design Handbook (HIDH) Update

COMING SOON!

The HIDH is a companion document to NASA-STD-3001 Volume 2. It is a compendium of human space flight history, lessons learned, and design information for a wide variety of disciplines and provides background information on the rationale for human-system design Standards. The original HIDH was published in January 2010 with a Revision released in June 2014. The Standards Team is in the process of overhauling the HIDH in conjunction with preparations for the 3002 Merger. Current activities include brainstorming chapter organization and subsections, strategies to link the HIDH and 3002 Merger to be the most compatible and usable, and identifying points-of-contact when content editing is underway.

If you have a question about the forthcoming HIDH update, please contact Kristin Coffey (kristin.m.coffey@nasa.gov) or Sarah Childress (sarah.d.childress@nasa.gov). If you have a suggestion for changes to be included in the revised HIDH, you can submit them using the NASA 3001 Document Standard Changes form in SharePoint, and selecting HIDH as the Document.

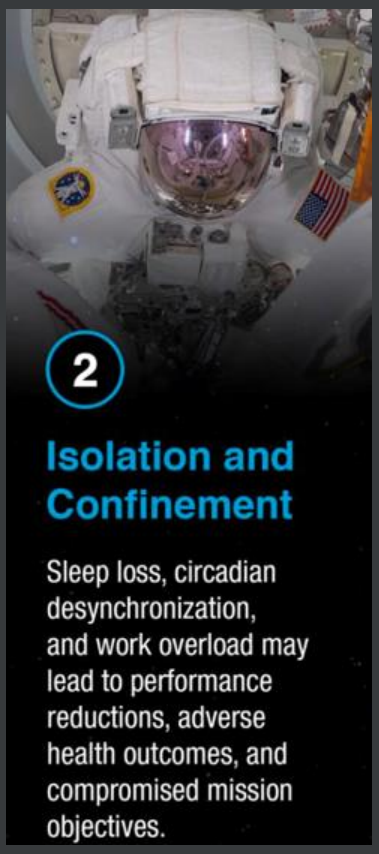
New Additions to the OCHMO/Standards Website

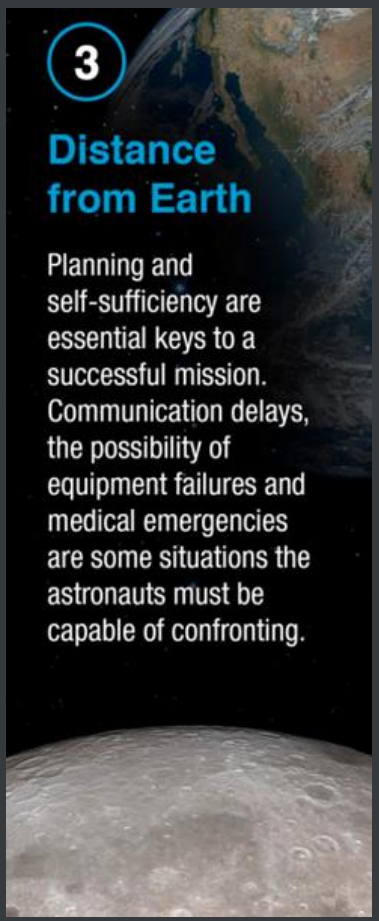


The Human Spaceflight Standards webpage, housed on the NASA OCHMO website, has a fresh and improved look with new content added.

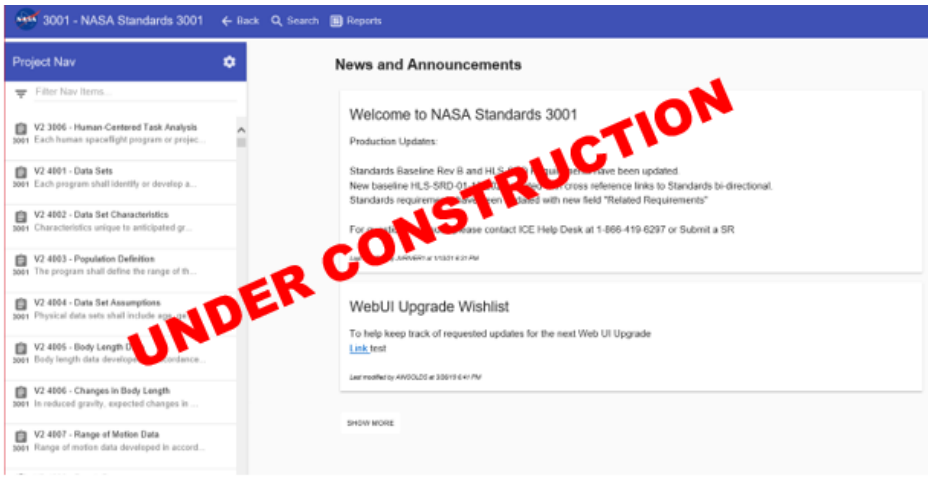
- Standards 101 – Provides an overview of Human Spaceflight Standards, including links to the current approved versions of NASA-STD-3001 Volumes 1 & 2.
- Decompression Sickness (DCS) Prebreathe Reference Library – Literature that provides background and reference data related to Standards for decompression sickness, prebreathe protocols, probability models, EVA operations, treatment, suit pressures, and vehicle atmospheres.
- Standards Hierarchy Pyramid – Explains the cross-relationship of Standards and how they impact specific missions/programs, particularly during the formulation stage of a new program.
- Newsletters – Links to PDF copies of current and past Human Spaceflight Newsletters.
- Technical Briefs – Technical Briefs are available for Standards that offer technical data, background, and application notes for vehicle developers and medical professionals. On the new website, the tech briefs have been divided into four categories: Human Physiology Behavioral Health, Medical Care, Mishaps, and Vehicle Systems. A list of newly added and forthcoming technical briefs is provided in the Standards Technical Briefs section of this newsletter.
- Aviation Medical Certification Standards – Provides a link to the current approved NASA Aviation Medical Certification Standards. This document provides the Standards and administrative procedures for the aviation medical certification of NASA aviation flight personnel.

Visit the OCHMO Standards Website





3001 Cradle WebUI Database



Our team is currently utilizing Cradle to build a database of the 3001 Standards, which will be published to a web-accessible interface shared with programs to help with future requirement development. To that end, we are also including both past and present program requirements in the database to show how they relate to, and are derived from, the 3001 Standards. Users will be able to cross-reference, compare, or even sort 3001 Standards and requirements by the associated human systems risk.

☆ In order to gain access, users will need to submit a NAMS request. Additional instructions will be released soon.

Radiation Exposure Updates

The National Academies of SCIENCES ENGINEERING MEDICINE

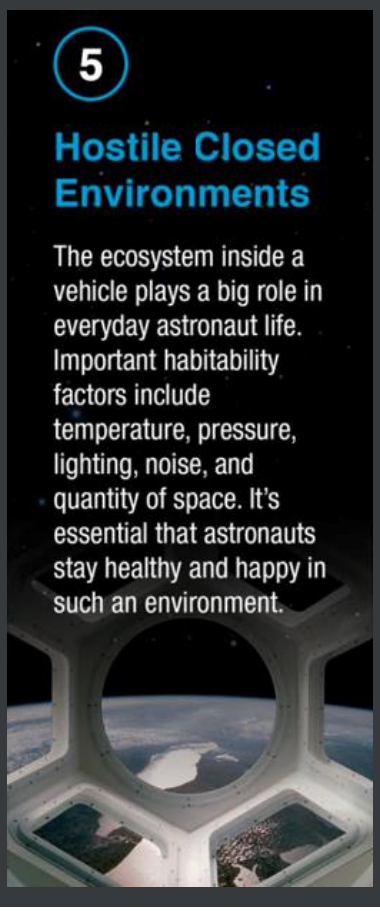
The National Academies of Science, Engineering, and Medicine has formed a committee of experts to review the current NASA guidelines for 'Space Permissible Exposure Limit for Space Flight Radiation Exposure Standard'. NASA will provide the Committee with potential changes to the NASA radiation risk management Standard, with respect to the uncertainty of cancer risk related to adverse health outcomes and performance decrements from exposure to radiation in space (primarily long-term effects).

The committee is charged to:

- Review and assess the NASA proposed updates to the Career Space Permissible Exposure Limit Standard for cancer mortality.
- Provide a written report with recommendations on the:
  - Best process and strategies for NASA to consider in modifying the NASA Career Space Permissible Exposure Limit Standard for cancer mortality.
  - Proposed options that NASA is considering for modifying the NASA Career Space Permissible Exposure Limit Standard for cancer mortality.

A virtual public session, hosted by the NAS committee, took place on January 25-26, 2021. During this session, several NASA subject matter experts gave brief presentations and facilitated discussions about upcoming changes to the NASA radiation exposure guidelines.

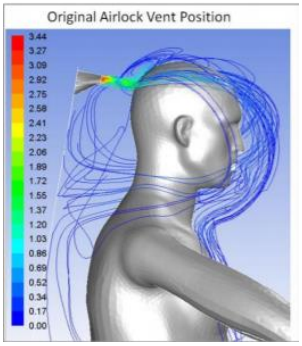
More information about the committee, project, and a recording of the recent webinars can be found on the National Academies Website.



Current Collaborative HRP Research Studies to Inform Standards

CO_2 Washout

The Standards Team is closely working with the Human Research Program (HRP) in starting-up CO_2 washout studies to provide new data and insight to human risk associated with inspired CO_2 during suited operations. This data will be used to update relevant existing Standards and create new Standards in the near future.



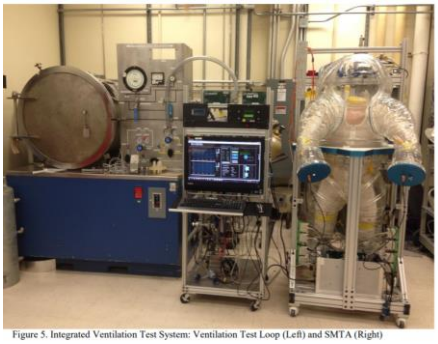


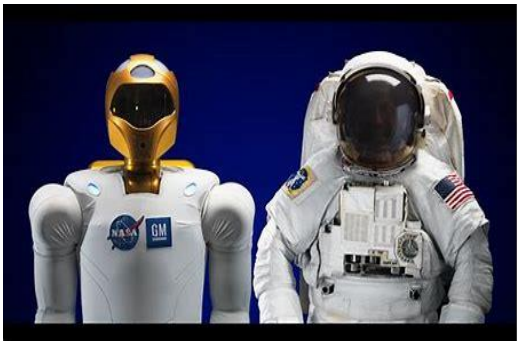
Figure 5. Integrated Ventilation Test System: Ventilation Test Loop (Left) and SMTA (Right)

Acceleration & Vibration Guidelines for Lunar Terrain Vehicles (LTV)

Ongoing work is being conducted with the HRP to update Standards and guidelines for design to minimize injury to the crew related to acceleration and vibration for crew operations in Lunar and Mars Design Reference Missions (DRMs). The goal is to establish high level guidance for the Standards that exist on the guidelines on verification Standards for assessing acceleration/vibration.

Automation/Autonomy Guidelines and Standards for Space Vehicles

OCHMO is looking to establish high level guidance for the automation Standards that exist, and determining if there are guidelines on verification Standards for assessing human-automation design and integration, including autonomy design if available. Example of a potential Standard/guideline includes one that addresses different levels of automation based on crew status (neuro-vestibular considerations) coupled with the crew's ability to perform "manual control" of the vehicle during gravitational transitions in a manner akin to limiting Shuttle crew head movement to minimize the neuro-vestibular effects while providing the information to the crew via head-up displays (G-transitions covered under the acceleration/vibration statement of work).



Human Spaceflight Standards Hierarchy Pyramid

Often it is necessary to assess the cross-relationship of Standards and their impact on a specific mission/program, especially during the formulation stage of a new program. To facilitate this assessment, a "Standards pyramid of hierarchy" was developed to aid in the determination of individual Standard's impact on missions. The purpose of this tool is to help look "across" all of the Standards and assess their impact on a mission's success related to loss of crew, loss of mission, and loss of individual mission objectives. The pyramid also categorizes Standards that increase the probability of achieving mission objectives. This hierarchy has been used in determining the applicability of Standards for programs during the formulation stage of development.