



Global Exploration Roadmap

International Standards to Promote Interoperability, Lessons Learned from CCP

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- Under the Commercial Orbital Transportation Services agreements, our commercial partners were required to meet ISS visiting vehicle interface and safety requirements and standards for all demonstration and flights to the ISS
 - This approach continues under the the ISS Commercial Resupply of Station (CRS) cargo transportation contracts
- With the Commercial Crew Program, NASA is working with industry partners to define and assess alternate standards that meet or exceed NASA identified standards.
 - As we proceed through partner transportation certification with our commercial partners, NASA will better understand the pool of standards and requirements that could be pertinent to future development efforts

Commercial Crew Program Background



- Program established in 2011, with the signing of the Formulation Authorization Document (FAD)
- Program goal is to facilitate U.S. commercial industry development of safe, reliable, and cost effective human space transportation to and from low Earth orbit and the International Space Station
- Commercial Crew Program will enable NASA to purchase commercial crew transportation services to meet its transportation needs to the nation's orbiting laboratory, the International Space Station, which is a stepping stone toward future exploration destinations.

NASA will not own or operate crew transportation systems, rather NASA will certify commercial transportation systems and purchase transportation services

Core Commercial Crew Certification Documentation



- **HQ**
 - Commercial Crew Transportation System Certification Requirements for NASA Low Earth Orbit Missions HEOMD-CSD-10001, Revision A
- **Commercial Crew Program**
 - Crew Transportation Technical Management Processes (CCT-PLN-1120)
 - International Space Station (ISS) Crew Transportation and Services Requirements Document (CCT-REQ-1130)
 - Crew Transportation Technical Standards and Design Evaluation Criteria (CCT-STD-1140)
 - Crew Transportation Operations Standards (CCT-STD-1150)
- **International Space Station Program**
 - ISS to Commercial Orbital Transportation Services Interface Requirements Document (SSP 50808)



- Consolidated set of technical requirements, standards, and processes that National Aeronautics and Space Administration (NASA) Program Managers shall implement for certification of CCTSs for low Earth orbit (LEO) transportation.
- Mandatory NASA standards are separated into 3 types:
 - **Type 1** documents are those that contain requirements the CCTS Program must meet as written - **Mandatory**
 - **Type 2** documents are those that contain requirements the CCTS Program can either choose to adopt, or propose an alternate – **Meets or Exceeds**
 - **Type 3** documents are those that contain requirements where the CCTS Program does not need to either formally adopt the document or recommend an alternate – **Reference**

Standards by Type & Technical Authority

HEOMD-CSD-10001, Revision A

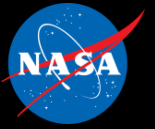


NASA Technical Authority	Type 1	Type 2	Type 3
Health & Medical	0	3	1
Engineering	0	35	7
Safety & Mission Assurance	0	36	10

- No mandatory standards for commercial crew certification effort
- NASA is focusing on the “what” not the “how” related to standards implementation
- Referenced specific applicable paragraphs, where appropriate

Program Types of Standards

CCT-REQ-1130, Rev C



- Provides requirements for development (design, manufacturing, testing, qualification, production and operation) of commercial services to deliver NASA crew and limited cargo to and from the ISS.
- Includes 3 types of standards
 - **Meet** standards must be followed completely with no deviation of alternative proposal
 - **Meet the intent of** standards can be met explicitly by following the standard or by proposing alternate standards that meet or are consistent with the requirement levied in the NASA standard (45 of 64 documents allow alternative documents)
 - **Reference** standard may be utilized and will have no verification language attached

ISS to Commercial Orbital Transportation Services Interface Requirements Document (SSP 50808)



- Provides interface and performance requirements between the International Space Station (ISS) and Commercial Orbital Transportation Services (COTS)
- Defines performance and design requirements for the COTS ground systems supporting COTS vehicle flights to ISS
- Defines design requirements on the COTS vehicle to ensure safe integration with the ISS
- Provides information and requirements needed for COTS integration with the ISS vehicle, cargo, and crew

Applicability for Global Exploration Roadmap Standards development



- The approach currently being implemented for the Commercial Crew Program could provide a blueprint for establishing applicable top level standards as NASA, International Partners and commercial entities continue to mature exploration capabilities
- Focus on the “What” and not the “How” related to requirements and standards implementation.
 - Allows for continued parallel development of exploration architectural elements
 - Enables organizational design freedom



Standards Topics



Health and Medical

- Human Factors design , habitability, and environmental health

Engineering

- Configuration management, electrical bonding, spacecraft charging, GSE design, mechanisms design, glass and windows, fracture control, materials & processes, IT security, program management, SE&I, software, factors of safety, loads and dynamics, pyrotechnic, TPS, batteries, threaded fasteners, EMI/EMC, quality, solar cells & panels, printed circuit boards, lightning

Safety and Mission Assurance

- Pressure vessel, parts policy, mishap/close calls/investigation/reporting, PRA,S&MA audits, range safety, orbital debris, GIDEP, quality assurance. Explosives propellants & pyrotechnics, conformal coating, wiring, fiber optic, software assurance, COPV, EEE parts, soldering,



Health and Medical

- Human integration design

Engineering

- DDT&E considerations, design & procedural standards, facility/systems/equipment general design, environmental testing, PCB, lightning,

Safety & Mission Assurance

- Safety and mission success, pressure vessels, metrology & calibration, parts, mishap and close calls, PRA, Safety reviews/audits/assessments, range safety, orbital debris, GIDEP, explosives/propellants/pyrotechnics, conformal coating, crimping, fiber optics, software assurance, COPV, EEE parts, IEEE software assurance, counterfeit EEE parts, general safety,