Commercial Space Transportation Advisory Committee (COMSTAC)

Spring 2022 | Day 2 • PM

Questions can be sent in through the links on:

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COMMERCIAL SPACE TRANSPORTATION
faa.gov/space

Federal Aviation Administration

Commercial Space Transportation Advisory Committee (COMSTAC)

Safety Working Group

Tasker #1 Response and Discussion

Federal Aviation Administration

faa.gov/space

Safety Working Group Task #1

- The FAA would like the COMSTAC's:
  - Recommendation on the top 5 high priority areas for future regulation of Human Spaceflight, referencing the 2014 *Recommended Practices for Human Spaceflight Occupant Safety* as a starting point for areas to consider
  - Advice on expanding the Recommended Practices document scope to include:
    - Flights longer than 2 weeks
    - Flights beyond LEO
    - Rendezvous and docking
    - Radiation hazards
    - Planetary protection
    - Government astronauts
    - SFPs flying on-board autonomous vehicles
  - Advice on if there should be different Recommended Practices that may apply to suborbital versus orbital flights and if so, initial recommendations as to what those topics should include

5 Priorities for Future Human Spaceflight Regulation

COMSTAC

1. A permanent regulatory environment that specifies the scope of informed consent and to the maximum extent incorporates performance-based requirements
2. Consider the current and anticipated body of voluntary industry consensus standards to inform future regulations and serve as means of compliance. Specific examples include: medical qualifications for SFPs, safety and emergency training, restraints, and cabin environment
3. Utilize industry provided input including November 2021 Recommendations for Human Spaceflight (HSF) Regulation as well as seeking industry feedback on 2014 *Recommended Practices for Human Spaceflight Occupant Safety* as focus areas for regulatory updates
4. Addressing integration of occupant and public safety including priorities when conflicts arise
5. Building a regulatory framework that considers applicability to/dovetailing with future orbital transportation/orbiting platform requirements at the point regulatory authority (by whatever agency) is established for on-orbit activities. FAA should work with other government agencies and industry to establish a roadmap for future on-orbit regulatory authority

Recommended Practices Scope Expansion

COMSTAC

- The COMSTAC finds the proposed topics below to be of interest to industry and appropriate for the United States Government to address. However, they clearly lie outside the current regulatory authority of the DoT/FAA and therefore are not appropriate for COMSTAC to address at this time. If FAA wishes to pursue these, they should seek guidance from the White House and Congress
    - Flights longer than 2 weeks
    - Flights beyond LEO
    - Rendezvous and docking
    - Planetary protection
- The COMSTAC finds the topic of Government astronauts to be of interest to industry in terms of liability ***but*** recommends deferring development of recommended practices on this topic until after the upcoming Part 440 Space Rulemaking Committee

Recommended Practices Scope Expansion – Radiation Hazards

COMSTAC

- Though COMSTAC recommends against pursuing efforts exclusively related to on-orbit activities, guidance on this topic would be helpful for launch and reentry
- For instance, as solar flares can impact avionics and aerodynamic forces, strong solar activity should be considered even on short duration flights
- COMSTAC supports FAA efforts to examine public and occupational health limits on short-term and lifetime radiation exposure and consider guidance on space weather constraints and design mitigations to ensure human safety during launch and reentry

Recommended Practices Scope Expansion – SFPs Flying On-Board Autonomous Vehicles

- The COMSTAC supports FAA developing guidance on this topic, particularly since autonomous vehicles are already in commercial operation with more in development
- COMSTAC notes that autonomous human spaceflight systems are already in safe operation under FAA licenses which do not require onboard crew for the safety of SFPs or the uninvolved public
- Results of a comprehensive system safety analysis that incorporates the extent of vehicle autonomy as well as human factors can be utilized to consider additional mitigations
    - For example, if an SFP is required to interact with safety systems, a non-pilot crewmember or a specifically trained SFP may be prudent and could be supplied by the operator, a contractor, or a customer
- COMSTAC recognizes that guidance on this topic must consider variations in system architecture, operations concepts, mission lengths, and flight environments

Suborbital vs. Orbital in Recommended Practices

- The COMSTAC acknowledges both differences and commonality between suborbital and orbital vehicles and missions
- In cases where practices are largely applicable to both, common documents are advised
- Additional industry input and deliberation is needed in order to develop specific examples and rationale for common and separate practices

Commercial Space Transportation Advisory Committee (COMSTAC)

Innovation & Infrastructure Working Group

Tasker #4 Global Climate Change Impact Response and Discussion

Federal Aviation Administration

faa.gov/space

Global Climate Change Impacts

Task

COMSTAC advice is needed on what research is necessary to move the industry forward regarding global climate change.

Global Climate Change Impacts

Observations (Spaceports)

- As the Earth warms, sea-levels rise, droughts, wildfires, and severe weather increase, vital spaceport infrastructure must adapt to the impacts of a changing climate.
- Spaceports located on the coast have been particularly impacted by sea level rise requiring increasingly defensive investments.
- Frequency, intensity and duration of hurricanes, tropical storms & other intense storms, have also led to increased flooding and wind damage. Less visible but still concerning is the enhanced threat of drought and fire hazards at non-coastal sites.
- Spaceport launch and testing infrastructure damage is increasing but the cost of repair and/or replacement with more resilient facilities is only addressed on a case-by-case basis and funding is ad hoc and insufficient.
- Spaceport use is increasing and expected to grow exponentially.
- Concurrently, National security imperatives are also driving strategy to respond to these impacts.

Global Climate Change Impacts

Findings (Spaceports)

- Most critical is the need for long-term maintenance, monitoring, and replenishment strategies for Spaceports. Mitigation of ongoing risk, protecting capital investments, and ensuring safety, reliability, and sustainability given their increasingly essential role.

- Costs associated with climate change mitigation and building newer, more resilient Spaceport infrastructure is an imperative if our nation's access to space is to remain operational, competitive and secure.

- The US depended on seaports, airports and transit authorities earlier and now we are depending on spaceports for the future national security, economic growth and global leadership.

Global Climate Change Impacts

Recommendations (Spaceports)

- AST should request a report be compiled by an independent 3Rd party with DOD, NOAA, NASA and other agency participations to assess the actual and potential impacts caused by climate change to our Nation's spaceports. This report should also develop strategies for avoidance and mitigation. Who leads the effort? What are the metrics against which progress is judged? And propose potential sustained funding resources for this effort.

- This effort should be incorporated into the ongoing Inter-agency Task Force on the development of a National Spaceport Strategy.

Commercial Space Transportation Advisory Committee (COMSTAC)

Innovation & Infrastructure Working Group

Tasker #6 High-Speed Aerospace Transportation Response and Discussion

Federal Aviation Administration

High-Speed Aerospace Transportation

Task

- The U.S. is moving into a renewed era of high-speed aerospace transportation (HSAT), including flight research, development, testing, and operations. Many of these evolutions will be flown through space and will utilize FAA-licensed spaceports for departure and arrival procedures. These operations, like orbital launch and reentry operations, will also need to be seamlessly integrated into the National Airspace System (NAS) to ensure minimal impact on other, non-involved commercial flight operations in the NAS.

- The FAA requests COMSTAC examine HSAT and associated spaceport operations as well as their integration into the NAS and make recommendations regarding what regulatory considerations should be taken now and in the near future.

High-Speed Aerospace Transportation

COMSTAC

Discussion

- Operations considerations
- Airspace considerations
- Spaceport considerations
- Climate impact considerations

High-Speed Aerospace Transportation

Discussion

- The U.S. Government should establish a goal of leading the world in Point-to-Point transportation through space. Accomplishing this challenging goal will require a partnership between government, industry, and academia, and will involve not only advances in engineering and technology, but also work in policy, law, regulations, customs and security, flight and ground operations, market analysis, and economics.

  - National Spaceport Network Development Plan, Global Spaceport Alliance, June 2020

- The ability to conduct high- speed, long-distance transportation, specifically point-to-point transportation through space, will be a major game changer for both national security and economic competitiveness. This is an area that the United States needs to lead. Although the technical challenges are significant, work is also needed in policy, law, regulations, customs and security, flight and ground operations, market analysis, and economics, and these are all areas that should be part of near-term discussions between the FAA Office of Commercial Space Transportation and our international partners. We also recommend that a study be initiated now to identify pre-approved corridors or trajectories, such as between selected FAA-licensed spaceports, that could safely and efficiently support the initial flight tests or demonstrations of such vehicles, after they become available.

  - Statement by Dr. George C. Nield, Chairman, Global Spaceport Alliance, Fall 2020 COMSTAC Meeting

High-Speed Aerospace Transportation

Discussion

- Feedback and conversations from COMSTAC colleagues and the broader commercial space community
- Higher end of HSAT e.g. not supersonic, but rather space vehicles designed for long-range P2P where the line becomes blurred with orbital flight
- Technically could be called suborbital, but in long-range cases the energies and flight profiles nearly the same as as orbital systems
- Aspects of NAS integration, spaceports, and future regulatory process
- Goal is to make as flexible as possible and ensure development is not impeded

High-Speed Aerospace Transportation

Observations

- “Spectrum” of systems currently in development – some could fly within the decade
- **Broad categories**
  - Airbreathing endoatmospheric (e.g. jet, ramjet, scramjet)
  - Non-airbreathing endoatmospheric (e.g., rocket boost-glide)
  - Orbital and other exoatmospheric (e.g. Rocket Cargo concepts)
  - Others (e.g. trans-atmospheric, “scramjet skip”)
- **Many architectures**
  - HTOL
  - VTOL
  - Air-launch
  - Rail-launch
- High-performance/highly energetic systems (including rocket-based) with eventual jet-like reliability and aircraft-like operations
- Companies don’t want to address issues alone – need the support of FAA, both AST and non-AST

High-Speed Aerospace Transportation

Observations

- **Companies are seeking the most permissive flight environment possible**
  - Need to avoid being too rigid from the outset
  - Creation of an integrated environment where vehicles seamlessly operate
  - Desire is for more flexibility in Upper Class E and above the NAS

- **“Space Flight Rules” (SpFR) for exoatmospheric ops**
  - Need to blend into existing protocols and procedures
  - Separation rules, handing, arrival/departure procedures, etc. need to be addressed
  - Analogies and/or lessons learned from Autonomous Flight Rules (AFR) development?
  - Goal is to ”file and fly” similar to rules for supersonic aircraft under FAA JO 7110.65 9-12-15a

- Eventually want to get to certified space transiting systems that can operate from any airport (or heliport in case of VTOL vehicles)

High-Speed Aerospace Transportation

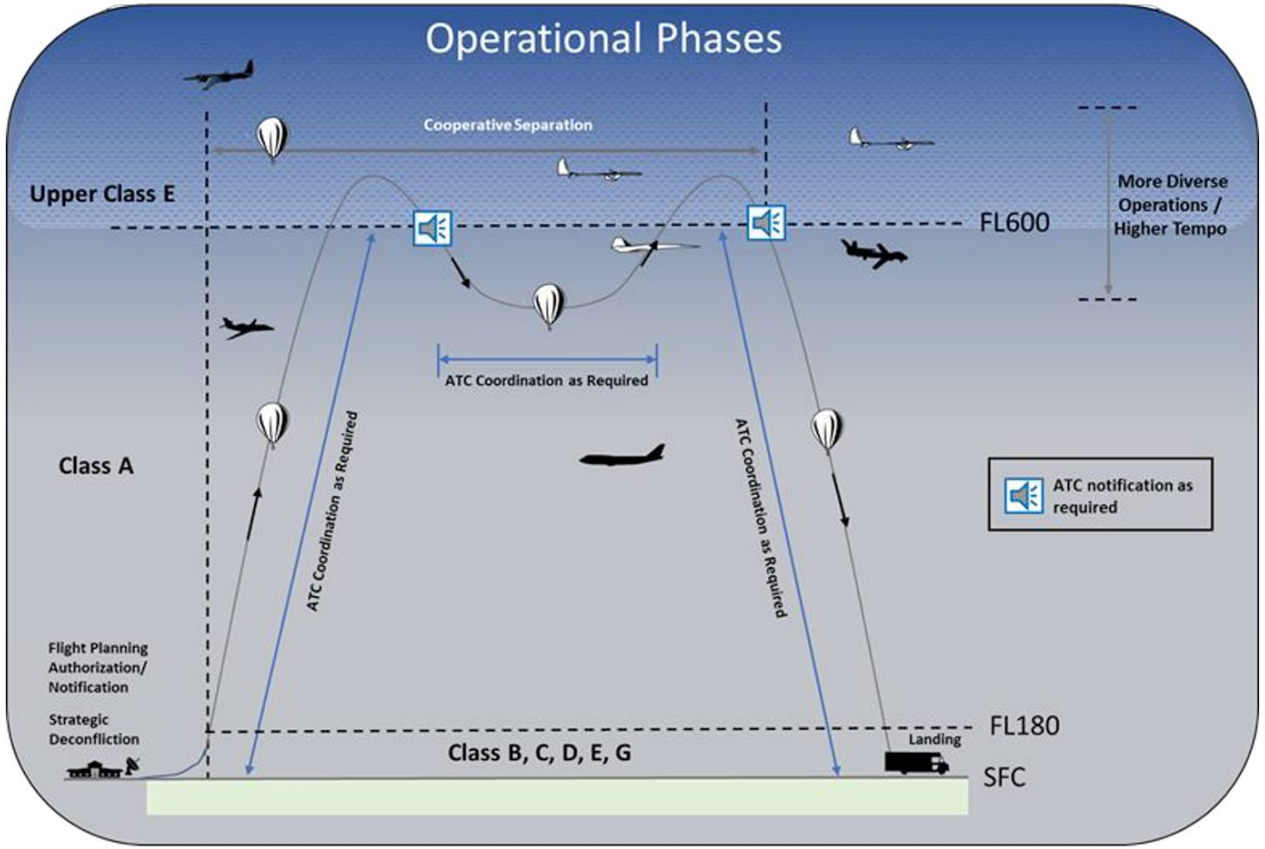
COMSTAC

Observations

- New procedures for high-altitude operations are being worked in the FAA/NASA NextGen Upper Class E Traffic Management (ETM) effort and proposed ETM ConOps

- Endoatmospheric systems operating in Upper Class E should:
  - Operate under a “cooperative separation” model as proposed in NextGen ETM ConOps

  - Use current flight planning, notification and authorization requirements for supersonic aircraft



High-Speed Aerospace Transportation

Observations

- **Spaceports**
  - Spaceports are preferred initially, but space transiting systems want to eventually operate out of any airport (or heliport for VTOL vehicles)
  - Non-space transiting systems would prefer to be regulated under Part 91 and could operate out of airports from the start
  - Airspace corridors for development, testing and initial operations are critical
- **Environmental Reviews**
  - Assessment of environmental impacts at spaceports through existing reviews could be utilized
  - Need global approaches for environmental reviews as different regions may have different restrictions

High-Speed Aerospace Transportation

Findings

- **A strategic effort is needed in the near-term to roadmap the smooth introduction of HSAT systems within the next decade**
  - Should be viewed as a systems engineering challenge
  - Interagency (and eventual international) participation
  - Identification of friction points and roadblocks -- avoidance of bureaucratic friction
  - Avoid focusing too much on specific architectures for now
  - Goal is to get to eventual regulatory responsibility
  - AST doesn't necessarily need to be in charge (Part 91 should govern HSAT systems that never enter space, for example), but shouldn't cede designated advocacy role for space transiting systems and should act as focal point/facilitator
  - Don't need to solve everything today but time horizon cannot be open-ended

High-Speed Aerospace Transportation

Findings

- **Designated overland flight corridors need to be established for the development, testing, and initial operations of HSAT systems**
  - Several efforts underway today (e.g., existing Kansas supersonic corridor, planned corridors in vicinity of Midland Air and Space Port)
  - Need to ensure approvals and establishment occur ASAP as systems come online
  - Consideration of relaxed overland flight restrictions to supersonic flight within corridors – leading to eventual widespread relaxation for operational systems after appropriate testing and demonstrations
    - “Overflight rules might have made sense when they were made, but not with today’s technology”

High-Speed Aerospace Transportation

Recommendations

- **Strategic Analysis**
  - AST should facilitate the initiation of an interagency effort to explore HSAT systems, their development, integration into the NAS, and eventual certification
  - This effort should be coordinated closely with the NextGen Upper Class E Traffic Management effort
  - A dedicated working group should be formed and a strategic roadmap completed no later than the end of FY 2023
- **High-speed aerospace corridors**
  - Working with the appropriate FAA and other state, local, and federal entities, AST should help facilitate and promote the development of designated corridors for the development, testing, and eventual operations of HSAT systems
  - As a follow-on to the 2020 Notice of Proposed Rulemaking, FAA should accelerate the issuance of new noise certification standards for supersonic overland flight

Commercial Space Transportation Advisory Committee (COMSTAC)

Break – 10 minutes

Questions can be sent in through the links on:
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Commercial Space Transportation Advisory Committee (COMSTAC)

Questions and Answers on Standards

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Answers from ASTM

- Please provide any recommendations, findings, and observation on the progress of the industry developing voluntary industry consensus standards on human spaceflight safety. Specifically…

Answers from ASTM

- **Are there any voluntary industry consensus standards on human spaceflight safety that <u>have been accepted</u> by the industry at-large?**
  - ASTM International Committee F47 on Commercial Spaceflight has been recognized by industry for their efforts in developing consensus standards. More than 100 industry professionals participate on the committee, including all major operators, industry association representatives, spaceport operators, industry consultants, and regulatory representatives.
  - The committee currently has six published standards that were approved by industry experts.
    - (published standards on next slide)

Answers from ASTM

1. F3344-19 Standard Guide for Storage, Use, and Handling of Liquid Rocket Propellants

2. F3377-20 Standard Terminology Relating to Commercial Spaceflight

3. F3479-20 Standard Specification for Failure Tolerance for Occupant Safety of Suborbital Vehicles

4. F3514-21 Standard Guidance for Space Data Exchange to Support Integration of Space Operations into Air Traffic Management

5. F3520-21 Standard Guide for Training and Qualification of Safety-Critical Space Operations Personnel

6. F3550-22 Standard Guide for Classifying Safety-Related Events

Answers from ASTM

- **How are they being implemented, and how much are they being used? If the use is minimal, what is preventing broader acceptance and implementation of consensus standards?**
  - ASTM International does not measure the use of their standards. However, based on the industry input and comments throughout the consensus process, it is believed that the industry approves of these as a means of compliance for future regulatory reference.

Answers from ASTM

- **What voluntary industry consensus standards are <u>currently being worked</u> on and what is their timeline towards acceptance? (see ASTM and ISO standards development spreadsheet)**
  - In addition to the six already approved and published standards, Committee F47 is in the process of developing nine additional standards.

WK61254 Standard Classification for Spacecraft Vehicle Types	WK76057 Standard Guide for Medical Qualifications for Suborbital Vehicle Spaceflight Participant
WK70011 Standard Practice for Crew Safety	WK76298 Standard Test Method for Verification of Software and Systems for Commercial Space Flight Vehicles
WK73835 Standard Guide for Spaceflight Participant Safety and Emergency Training	WK77620 Standard Practice for the Design of Suborbital Space Vehicles
WK74019 Standard Guide for Qualification for Safety-Critical Systems in Space Flight	Human Factors Standard (Task group formed week of 4/11/2022)
WKK74068 Standard Guide for Spaceport Standardization & Classification	

Answers from ASTM

- **Are there any areas that are currently <u>not</u> worked on but should be to have an initial set of accepted standards for a safety framework?**
  - Committee F47 has a road map to organize the highest priority safety standards along with other standards needs. Right now, all the identified high priority items are in development
  - The F47 road map is constantly evolving, and as new needs are identified they are categorized by priority level and assigned to a task group
  - The F47 committee members are closely monitoring the evolution of the industry and taking into consideration a regulatory safety framework as they prioritize standards needs

Answers from ASTM

- **When would such a complete set of accepted standards be ready for a safety framework?**
  - Industry consensus standards work is never complete. Our committees have been in place for nearly 125 years and are still actively working on revising standards to keep up with technology and new standards are often developed to align with innovations and new processes.
  - For Commercial Space, the committee is working diligently and many groups meet virtually weekly, bi-weekly etc to develop the content of the technical standards

Answers from ASTM

- **Are there any stakeholders that are <u>not</u> currently involved but should be? Are the right subject matter experts included in the development?**
  - ASTM International requires a balance of interest for committees to operate and conduct business. This means that the number of producers cannot outweigh the number of users, general interest and consumers combined.
  - F47 currently has 100 members on their roster, representing the broadest of industry stakeholders. The committee feels confident in their representation and is consistently reviewing each task group to make sure it is populated with the highest level of industry expertise as well as to ensure representation from the stakeholders most effected by its development
  - The F47 committee leadership and staff actively promote the standardization efforts underway, upcoming, and already published. They also conduct outreach to other industry associations and at industry events to create awareness and engagement at every level.

Questions on Standards

- Are there any changes to the recommended list from COMSTAC in 2014 to include standards on breathable atmosphere, crew-imparted loads, hazardous test notification, landing gear, occupant restraints and acceleration support, propellant handling, and risk communication?
  - As a framework, would those constitute a complete set for the safety framework?
  - What are the most important risk factors associated with human space flight?

Questions on Standards

- Please provide any recommendations and observation on the status of recent Industry Readiness Indicators including,
  - An assessment of current and near-term projection of spaceflights with participants for adventure, occupation, and/or transportation
  - What is the extent of international operations and competition?

Questions on Standards

- Please provide any recommendations and observation on industry's progress in developing safety framework indicators including
  - What is the extent of voluntary safety reporting inside companies? To what extend are lessons learned shared externally?
  - What are the barriers to sharing lessons-learned more broadly with the industry?
  - To what extent are voluntary safety consensus standards used and complied with?
  - To what extent is such compliance verified and what is the process of verification?

Questions on Standards

- Please provide any recommendation and observation on a roadmap and timeline towards a safety framework and the transition plan of such a framework including
  - What are the characteristics of an industry-acceptable safety framework and what would it look like especially after the learning period has ended? Describe specifics such as guidelines, requirements, audits, data sharing, safety culture
  - What are key indicators that would necessitate a transition to the next phase in a roadmap and timeline in a safety framework?
  - What is an acceptable form of regulatory framework that would provide adequate levels of assurance of safety of spaceflight participants and crew?
    - Should the levels of safety assurance for space flight participants and crew be the same or different?
    - How would you define those levels of assurance?

Commercial Space Transportation Advisory Committee (COMSTAC)

Public Comments

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New Business

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Commercial Space Transportation Advisory Committee (COMSTAC)

Closing Remarks

Chair Charity Weeden
Vice-Chair Karina Drees

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Commercial Space Transportation Advisory Committee (COMSTAC)

Closing Remarks and Adjournment

Next COMSTAC Meeting scheduled for October 2022

Federal Aviation Administration

ISAM Request

- **The ISAM Request for Comment has been released on the Federal Register: https://www.federalregister.gov/documents/2022/05/04/2022-09549/notice-of-request-for-comment**

Thank you