



Center of Excellence for  
Commercial Space Transportation

# **Flight Crew Medical Standards and Spaceflight Participant Medical Acceptance Guidelines for Commercial Space Flight**

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Although the FAA has sponsored this project, it neither endorsed nor rejects the finding of this research. The presentation of this information is in the interest of invoking technical community comment on the results and conclusions of the research.

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## Section I: Introduction

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**Project Description:** A degree of uncertainty remains in the commercial human space flight industry as to what medical standards are appropriate for flight crew members of commercial spaceflight vehicles. While the FAA currently requires a Second Class medical certificate, some aerospace medicine physicians and commercial operators consider a Second Class FAA medical examination inadequate, particularly for orbital flight. In addition, numerous recommendations and guidelines have been proposed for spaceflight participant (SFP) medical acceptance guidelines. Multiple organizations and interest groups have published medical recommendations for commercial spaceflight; however, there has not been a consolidation of these recommendations, guidelines, or

standards into a cohesive document that can be operationally employed by commercial operators, passengers and the FAA.

The anticipated outcome of this FAA COE-CST research project is two-fold:

1. A consolidated set of recommendation for crew medical standards that will be useful to the FAA in its regulatory responsibility for crew medical standards and safety.
2. A consensus set of passenger acceptance guidelines that can serve as advice to commercial operators as they develop their own medical programs.

Commercial companies will have the opportunity to incorporate these guidelines into their operations and adjust them as appropriate to meet their individual flight parameters, safety standards and risk profiles. Companies currently are required to inform spaceflight participants about the mission-related risk, but the specific risk of certain medical conditions has yet to be determined. The crew medical standards and SFP guidelines developed in this project are considered the minimum recommended and governmental agencies and operators have the option for additional medical and operational constraints.

This project was conducted in three phases:

1. Phase I: Collect and review the existing documents addressing orbital and suborbital crew member medical certification, SFP medical evaluation and acceptance guidelines, and develop recommendations for medically-related testing and training for both crew members and SFPs.

Phase II: Prepare a preliminary document incorporating the various guidelines and recommendations as outlined in Phase I and obtain input and comment from those involved in the commercial space flight industry, NASA, and the FAA. Convene a working group of experts in aerospace medicine and physiology, operations, training, safety, government, and the public to consider the comments from phase II; and

2. Phase III: Prepare a consolidated set of recommendations for the medical certification of crew members, medical acceptance guidelines for SFPs, and recommended appropriate training procedures. This document will be provided to the FAA as part of the COE CST task. Later, when additional medical data are available, SFP specific medical risk and informed consent

information can be presented to those flying on orbital and suborbital missions.

**Overview of Phase I meeting:** The participants met at Wyle Houston on June 14-15, 2011. Prior to this meeting, the participants reviewed previously published documents that address medical guidelines, standards, and recommendations for commercial SFPs and flight crew (listed in references section). It was determined that this project would focus on both orbital and suborbital flight, create recommendations for the medical certification of flight crew, and develop recommendations for SFP medical acceptance guidelines instead of standards. By creating SFP guidelines, the commercial space flight industry can self-regulate and create acceptance criteria based on the best practice guidance set forth by this project. The fourth component of this project is the development of a model participant “informed consent” document for use by commercial space launch operators to convey the risks related personal medical status of their participants. However, the Phase I team postponed discussion of this component until more clinical information could be gathered from other FAA COE-CST medical task areas, particularly the medical data collection and risk mitigation tasks.

A document was created by the Phase I group for the medical screening of sub-orbital and orbital crew and medical guidelines for SFPs. It was decided to most-closely reference the document entitled “Guidance for Medical Screening of Commercial Aerospace Passengers,” published in January 2006 by the FAA. Other published documents as well as expert opinion from panel members were utilized to arrive at the consensus recommendations outlined below. This document was distributed to the community for input and served as the basis for the Phase II document that follows.

**Overview of Phase II Meeting:** The Phase II meeting was held at Wyle Houston on March 6, 2012. Attendees included representatives from NASA, FAA, Wyle, UTMB, Baylor, and the commercial spaceflight industry. Prior to the meeting, the participants were allowed to review the Phase I document and make either written input or attend the meeting and provide input real-time. The attendees at the Phase II meeting created the following Phase III recommendations for flight crew medical standards for sub-orbital and orbital spaceflight and SFP medical guidelines for use in sub-orbital and orbital flight. Following final approval, these recommendations will be submitted to the FAA as part of the FAA COE CST process.

## Section II: Spaceflight Participant Medical Acceptance Guidelines Suborbital

A: Reference mission – Guidelines for operators for sub-orbital SFPs assume that the spacecraft will normally provide a shirt-sleeve cabin environment with the appropriate temperature, pressure (not less than 10.91 psi, equivalent to a maximum pressure altitude of 8,000 ft), oxygen, and humidity parameters.

1: G-Profile – Acceleration in sub-orbital spacecraft should not exceed  $+6G_x$ ,  $\pm 1G_y$ , and  $+4G_z$ . If the acceleration profile will expose SFPs to greater than  $+4G_z$ , then the SFPs should be medically-screened according to the guidelines outlined for orbital passengers (see section III).

2: Number of flights per day – Guidelines will assume SFPs will only participate in one sub-orbital flight per day. Payload scientists or flight crew may make multiple flights per day. Repeated flights to the acceleration limits listed above and with 4 minutes of zero-g exposure between launch and entry have not been accomplished before, and caution will be indicated until an experience base is acquired.

3: Time limit in spacecraft – Time within the spacecraft will be defined as door(s) closed prior to flight to door(s) open upon return. The time requirement to complete a flight will be short enough to avoid negatively impacting a passenger medical condition, interrupting their medical mitigation or treatment needs, and take human physiological needs into consideration (refer to section II, C).

4: Radiation limits: Radiation dose will not exceed the yearly commercial airline passenger dose, defined as no more than 1 mSv/year

B: Guidelines for screening sub-orbital SFPs – The content and extent of a screening medical questionnaire and physical exam should be related to each operator's flight profile. SFPs participating in sub-orbital spaceflight should complete a medical questionnaire, physical exam by a qualified physician with specific knowledge of the spaceflight environment, and laboratory analysis as necessary. SFPs are assumed to be 18 years of age or older to comply with the FAA requirement to sign an informed consent document. The suggested content of the medical questionnaire and physical exam shown below may be modified by each operator to account for differences in their specific flight profile.



1. Questionnaire – SFPs should complete a medical questionnaire indicating a history of any of the following conditions:

Otitis, sinusitis, bronchitis, asthma, or other respiratory disorders	Mental disorders, anxiety, or history of hyperventilation
Dizziness or vertigo	Claustrophobia
Fainting spells or any other loss of consciousness	Attempted suicide
Seizures	Use of medications
Tuberculosis	Alcohol or drug dependence or abuse
Surgery and/or other hospital admissions	Current pregnancy, recent post-partum (less than 6 weeks), or recent spontaneous or voluntary termination of pregnancy
Visits to a health care provider in the last 3 years	Recent significant trauma
History of decompression sickness (DCS) or the “bends”	Diabetes
Anemia or other blood disorders	Cancer
Heart or circulatory disorders, including implanted pacemaker or defibrillator	Rejection for life or health insurance
Disability or deformity requiring accommodation	Given the specific flight parameters, are there any known medical conditions that may require possible accommodation

2. Physical Examination – A physician trained or experienced in aerospace medicine should perform a physical examination with the following components:

Vital signs (heart rate, blood pressure, respiratory rate, and temperature)	Upper extremities
Head, face, neck, scalp exam	Lower extremities
Nose, sinuses, mouth, throat, and ears (including eardrum integrity & function and Eustachian tube function)	Spine
Ophthalmologic evaluation (including pupil function and ocular motility)	Lymphatics
Lungs and chest	Rectal, pelvic, and breast exams will be performed only if indicated by medical history
Heart (including precordial activity, rhythm & rate, sounds, and murmurs)	General neurological evaluation
Peripheral vascular system	General psychiatric evaluation (appearance, behavior, mood, communication, and memory)
Abdomen and viscera (including hernia)	Genitourinary system

3. Medical Testing – Additional medical testing may be recommended by the examining physician and should be obtained if clinically indicated.
4. Timing of Medical Screening – The SFP’s age and medical complexity should be considered in determining the timing for medical screening. Generally initial screening should be performed within 6 months prior to the SFP’s sub-orbital flight. Follow-up medical screening, including updating the medical

history and physical exam, may be advisable prior to initiation of training activities and/or spaceflight.

5. Self-Certification – SFPs should indicate to the examining physician and operator if they know or have reason to know of a medical condition that would impair their ability to 1) safely perform a sub-orbital flight without compromising the safety of other occupants and 2) safely perform an emergency egress without assistance.
6. Post-Flight Medical Debriefing – Given the novel flight environment experienced by sub-orbital SFPs, a post-flight medical debrief is recommended to collect post-flight medical data, inquire about health effects of the flight, and provide for follow-up, if necessary.

C: Disposition of Medical Findings-The medical screen may determine that a potential suborbital SFP has medical problems that need additional consideration. While there are no specific medical standards, guidance for problems that the aerospace medicine physician and operators may consider problematic include conditions that:

1. May result in in-flight death or injury
2. Cause functional defects or disabilities that may interfere with the proper use of personal protective equipment
3. May interfere with emergency egress in the event of a flight or landing-related contingency
4. May result in an in-flight medical emergency
5. May prevent a passenger's ability to follow crew instructions
6. May be exacerbated or cause health deterioration due to the operational environment or flight-related stress.
7. May put the individual at risk for harm to him/herself, the other SFPs, or the crew
8. Might present a serious communicable illness threat to the other SFPs
9. May result in injury to an unborn child

D: Risk Mitigation Strategies – In the event a prospective sub-orbital SFP does not meet the recommended guidance criteria noted above, the aerospace medicine physician and operators may recommend a mitigation strategy. The operator and aerospace medicine physician must ensure that the condition and the mitigation process will not impair the ability of the SFP to safely perform activities required for the flight including emergency egress from the spacecraft and that the condition will not compromise the safety of other SFPs and flight crew. Training or high performance environment exposures for SFPs may be part of the medical risk mitigation strategy or prudent practice given specific flight profiles. Training that may be considered includes parabolic flight, hypoxia (altitude) exposure, centrifuge (high G) exposure, egress practice, or other potentially beneficial training.

Training may also be provided for the use of equipment such as: communications devices, personal hygiene / sanitation, flight crew equipment, and vehicle support systems, SFPs with medical deficiencies may elect to be medically monitored during exposure to analog environments as part of the risk mitigation strategy. In addition, certain SFPs may elect to participate in medical flights where more extensive medical capabilities are available during the flight. In the event that a risk remains for a given condition, the physician and operator will provide the best information available at the time for informing the SFP of the risk of their proposed flight. It is possible that medical conditions determined to be unstable (such as uncontrolled hypertension or angina) can be successfully treated to permit a SFP to be approved for a later flight.

## Section III: Spaceflight Participant Medical Acceptance Guidelines-Orbital

A: Reference mission – Guidelines for orbital SFPs assume that the spacecraft will provide a shirt-sleeve cabin environment with the appropriate temperature, pressure (not less than 10.91 psi, equivalent to a maximum pressure altitude of 8,000 ft) , oxygen, and humidity parameters to make this possible. Mission-related medical risk to SFPs will vary depending on mission length, G forces of launch and entry, onboard medical capabilities, emergency return capability, and their overall preflight health status. It is assumed the medical monitoring capabilities will be minimal; however, medical monitoring capability is encouraged.

1: G-Profile – Acceleration in orbital spacecraft should not exceed  $+6G_x$ ,  $\pm 1G_y$ , and  $+4G_z$  during nominal re-entry, with allowances of up to  $+8G_x$  during ballistic re-entry.

2: Assumptions – No docking to the International Space Station or other government-controlled orbital facility, minimal medical diagnostic or treatment capability, no physician, nurse or paramedic, and a 24 hour emergency return-to-earth capability. The spacecraft will include a small generic medical kit with over the counter medications for common episodic illnesses, and each SFP will be required to carry their own prescription medications in a personal medical kit.

3: Time limit in spacecraft – Time within the spacecraft will be defined as door(s) closed prior to flight to door(s) open upon return. The time limit for a SFP in the spacecraft will not exceed a medical requirement for that SFP based on their medical mitigation strategy (refer to section III, C). As deconditioning increases with flight time, appropriate controls and countermeasures should be utilized such that SFPs are able to perform or have a mitigation strategy to perform emergency egress procedures (refer to section III, F).

4: Radiation limits: Radiation dose will not exceed the yearly commercial airline passenger dose, defined as no more than 1 mSv/year.

B: Guidelines for screening orbital SFPs – SFPs participating in orbital spaceflight will be held to the same guidelines and medical philosophy as those for suborbital SFPs (Section II, B and C) with the following additions:

1. Questionnaire – All passengers should complete a medical questionnaire indicating a history of any of the following conditions:

Otitis, sinusitis, bronchitis, asthma, upper respiratory infections, or other respiratory disorders	Mental disorders, anxiety, or history of hyperventilation  *Refer to section IIIB2
Severe hay fever or allergies	Attempted suicide
Dizziness or vertigo	Use of medications
Significant motion sickness requiring medication	Alcohol or drug dependence or abuse
Fainting spells or any other loss of consciousness	Date of last menstrual period, current pregnancy, recent post-partum (less than 6 weeks), or recent spontaneous or voluntary termination of pregnancy
Seizures, convulsions, epilepsy, stroke, muscular weakness, or paralysis	History of pneumothorax (collapsed lung)
Tuberculosis, hepatitis, AIDS, or other chronic infectious disorder	Kidney stones or blood in the urine
Surgery and/or other hospital admissions	Gallstones or gallbladder disease
Recent significant trauma	Diabetes
History of decompression sickness (DCS)	Cancer
Anemia or other blood disorders	History of radiation treatment or occupational exposure to radiation
Heart or circulatory disorders, including implanted pacemaker or defibrillator	Rejection for life or health insurance
Uncontrolled high or low blood pressure	History of disability requiring accommodation or functional impairment

Visits to a health care provider in the last 3 years	History of previous space flights
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2. Mental Health Evaluation – Spaceflight is associated with significant psychological stressors due to factors such as living in confined spaces, lack of privacy, isolation, risk of injury or death, and exposure to cultural differences. Underlying behavioral or psychiatric problems can negatively impact a passenger’s ability to perform critical functions including nominal and emergency procedures and effectively communicate. Given this risk, particular attention should be focused on screening for behavioral and psychiatric problems which include:

- a) Psychiatric problems such as personality disorders, adjustment and psychosomatic reactions, anxiety disorders and phobias (i.e. fear of flying), claustrophobia, major depression, acute psychotic reactions, bipolar disorder, or a history of a suicide attempt
- b) Nicotine addiction
- c) A history of recent or current alcohol and drug abuse that could lead to craving or withdrawal effects during the early days of the mission
- d) Disruptions in sleep, circadian rhythm, and cognitive performance

3. Physical Examination – A physician trained in aerospace medicine should perform a physical examination consistent with Section II. In addition, a dental examination within 6 months of the flight must be reviewed and accepted by the physician.

4. Medical Testing – In addition to assuring that U.S. national preventive medical screening appropriate for age and gender is completed, prospective SFPs should complete the following medical tests:

Hematology	Chest X-rays (PA and lateral)
Serum Chemistry	Visual Acuity (corrected)
Urinalysis	Pregnancy Testing
Resting ECG	Audiometric Testing

Additional medical testing may be recommended by the aerospace medicine physician and should be obtained if clinically-indicated, including but not limited to: tympanometry, tonometry, drug testing, pulmonary function testing, exercise cardiovascular testing, echocardiography, and infectious disease screening

5. Timing of Medical Screening – Initial screening should be performed within 6 months of the SFP’s orbital flight. A follow-up, face-to-face medical interview and brief physical examination may be indicated prior to initiation of training activities and is recommended within one week prior to flight. It is recommended that the SFP coordinate with an aerospace medicine physician to design a personal medical kit that addresses frequently occurring medical problems in zero gravity and the SFP’s specific medical needs.
6. Self-Certification – Orbital SFPs should indicate to the aerospace medicine physician if they know or have reason to know of a medical condition that would impair their ability to 1) safely perform an orbital flight without compromising the safety of other occupants and 2) safely perform an emergency egress without assistance.
7. Pre and Post-flight medical briefings – Given the novel flight environment experienced by orbital SFPs, a pre-flight briefing discussing mitigation strategies for various medical issues such as space motion sickness, neurovestibular problems, fluid shift, head and back aches, and urinary retention is strongly recommended. A post-flight medical debriefing is also recommended to collect post-flight medical data, inquire about health effects of the flight, and provide for follow-up if necessary.

C: Risk Mitigation Strategies – In the event a prospective orbital SFP does not meet the recommended guidance criteria noted above, the aerospace medicine physician and operators may recommend a mitigation strategy. The operator and aerospace medicine physician must ensure that the condition and the mitigation process will not impair the ability of the SFP to safely perform activities required for the flight including emergency egress from the spacecraft and that the condition will not compromise the safety of other SFPs and flight crew. Training or high performance environment exposures for SFPs may be part of the medical risk mitigation strategy or prudent practice given specific flight profiles. Training that may be considered includes parabolic flight, hypoxia (altitude) exposure, centrifuge (high G) exposure, or egress practice.

Training may also be provided for the use of equipment such as: communications devices, personal hygiene / sanitation, flight crew equipment, and interface with vehicle



support systems. SFPs with medical deficiencies may elect to be medically monitored during exposure to analog environments as part of the mitigation strategy. In addition, certain SFPs may elect to participate in medical flights where more extensive medical capabilities are available during the flight. In the event that a risk remains for a given condition, the physician and operations team will provide the best information available at the time for informing the SFP of their risk should the flight proceed. It is possible that medical conditions determined to be unstable (such as uncontrolled hypertension or angina) can be successfully treated to permit a SFP to be approved for a later flight. Orbital spacecraft may be forced to land in remote areas at great distance from the operator’s base of operations. It is advisable to provide SFPs with land and water survival training in the event this occurs. Water survival training is highly recommended since some commercial vehicles will nominally land in water, while all spacecraft may be forced to land in the water in an emergency.

D: Space Medicine Briefing – It is recommended that SFPs receive a briefing prior to flight regarding the medical aspects of spaceflight. Topics should include: space physiology, known medical risks, mitigation strategies, on-orbit medical capabilities/checklists, and operational medical factors for each SFP.

E: Countermeasures Based on Mission Duration – Given the different spacecraft and mission profiles being designed by the commercial spaceflight industry, SFPs will be exposed to certain risks at different phases of a mission. Given these different risks, it is advisable to recommend countermeasures to SFPs depending on the duration of the mission and particular phase of the mission encountered. The following table outlines medical risks at different phases of a mission and recommends countermeasures for SFPs during each phase:

Mission Duration	Risks	Countermeasures
< 3 days	Space Motion Sickness	Education Analogue Training In-Flight Medication
	Sinus Congestion	Medication
	Decreased GI Motility	Hydration and/or Medication
	Urinary Retention	Auditory Aids (sounds of running water) Urinary catheters

<p>5 – 7 days</p>	<p>Post-flight Orthostatic Intolerance</p> <p>Post-flight Disequilibrium</p> <p>Circadian Rhythm Disruption</p>	<p>Isotonic fluid loading Anti-G suit or counter pressure garment (Kentavr)</p> <p>Restrict Driving</p> <p>Scheduling mechanical sleep aids (Light) Medication</p>
<p>&gt; 30 days</p>	<p>Bone &amp; Muscle Loss Cardiovascular Deconditioning</p> <p>Nephrolithiasis</p> <p>Psychiatric</p> <p>Decreased Immune Function</p>	<p>In-flight exercise</p> <p>Screening maintain hydration medication</p> <p>Education &amp; Training Private family conferences Time off from duties</p> <p>Hygiene Clean &amp; cover breaks in skin</p>

## Section IV: Standards for Medical Certification Pilots-Suborbital

A: Reference Mission: Guidelines will assume that sub-orbital pilots will fly the same reference mission as sub-orbital passengers (see section II, A). However, pilots and payload scientists may participate in multiple flights in a single day. For pilots, radiation dose will be limited per OSHA standards.

B: Medical Guidelines for Sub-Orbital Pilots – Current FAA guidelines require an FAA Class II medical certificate from a designated Aviation Medical Examiner (AME) to pilot sub-orbital spacecraft. Our recommendation is for an FAA Class I medical certificate, and that a cadre of senior AMEs with advanced knowledge of the space flight environment be utilized. This requirement dictates examinations every 6 months and includes a periodic ECG based on the pilot's age.

C: Medical Testing – Hemoglobin and hematocrit testing is recommended to ensure normal physiologic capability in the event a sub-orbital pilot is exposed to an off-nominal cabin atmosphere. Tuberculosis testing should be conducted annually. Pilots should meet the drug and alcohol testing requirements put forth in 14 CFR Part 121 for commercial transport pilots.

D: Waiver Process – Medical waivers or special issuance of the medical certificate will be considered in accordance with FAA policy as outlined in 14 CFR Part 67: Medical Standards and Certification.

E: Additional Training – Operators are currently required by the DOT Human Space Flight Requirements for Crew and Space Flight Participants; Final Rule to provide training to familiarize pilots with the sub-orbital flight environment as outlined in section IID. Pilots should also receive training in emergency procedures necessary to ensure the health and safety of passengers, including but not limited to: land and water survival training, CPR, basic first aid.

F: Pilots of Remotely-Piloted Sub-Orbital Spacecraft – Medical requirements for pilots of remotely-piloted sub-orbital spacecraft should be the same as those for piloted spacecraft.

## Section V: Standards for Medical Certification of Pilots- Orbital

A: Reference Mission: Guidelines will assume that orbital pilots will fly the same reference mission as orbital passengers (see section III, A). For pilots, radiation dose will be limited per OSHA standards. Orbital pilots will be monitored using passive dosimeters. As de-conditioning increases with flight time, appropriate controls and countermeasures should be utilized such that pilots are able to perform emergency egress procedures (refer to section V, G).

B: Medical Guidelines for Orbital Pilots – As with sub-orbital pilots, our recommendation is for an FAA Class I medical certificate from a special cadre of senior AMEs with expertise in the spaceflight environment. This would dictate increased frequency of medical screening and include a requirement for ECG based on the pilot's age. As with orbital SFPs, orbital pilots should undergo dental screening in accordance with Section III, B, 2.

C: Medical Testing – Orbital pilots will have physicals in accordance with FAA Class 1 policy as defined in 14 CFR Part 67. In addition, pilots must meet orbital passenger standards per Section III, B, 4. Additional testing for orbital pilots should include: non-contact eye tonometry, annual fundoscopic examination, initial archival DNA profile and an annual radiation exposure evaluation (conducted by a Radiological Health Officer) including medical and aerospace flight radiation exposure cumulative history. Tuberculosis testing should be conducted annually. Pilots should meet the drug and alcohol testing requirements put forth for commercial transport pilots.

D: Waiver Process – Medical waivers and special issuance of medical certificates will be considered in accordance with FAA policy as outlined in 14 CFR Part 67.

E: Additional Training – Operators are encouraged to provide training to familiarize pilots with the orbital flight environment as outlined in section II, Pilots should also receive training in emergency procedures necessary to ensure the health and safety of passengers, including but not limited to: first aid, land and water survival training, CPR, EMT-basic or equivalent.

F: Pilots of Remotely-Piloted Orbital Spacecraft – Medical requirements for pilots of remotely-piloted orbital spacecraft should be the same as those for piloted spacecraft.

G: Countermeasures Based on Mission Duration – Pilots should be aware of the same risks given mission duration as passengers, and appropriate countermeasures should be undertaken (Refer to section III, F). It should be noted that there are no data on pilot landing performance in spacecraft beyond 18 days, and particular attention should be paid to the risk of orthostatic intolerance and neurovestibular disturbances among orbital pilots, since they may be required to actively fly entry and landing in a seated position.

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## Glossary

**SPACEFLIGHT PARTICIPANT (SFP):** Spaceflight participants are non crewmembers that participate in suborbital or orbital spaceflight. These missions are operationally different than the typical experience of passengers on a commercial airliner or other modes of transportation such as cars or trains. SFPs are not physically separated from the crew, are exposed to increases in gravitational forces beyond commercial aircraft flight, and may be exposed to off nominal cabin environmental parameters for a considerable time period. They have to integrate into required flight crew equipment, restraint systems, and vehicle egress systems. SFPs may be flying for pleasure or could be scientists conducting microgravity research or providing medical care/monitoring for other SFPs.

**FLIGHT CREWMEMBER:** This term refers to the individuals or pilots that have physical control of the spacecraft and are responsible for the safe conduct of the flight. Flight crewmembers can fly in the spacecraft or control the spacecraft remotely.

**FLIGHT CREW EQUIPMENT:** Any personal protective equipment necessary for the safe conduct of the flight. This can include pressure suits, helmets, parachute assemblies, medical systems, emergency breathing devices, or other equipment required for safe operations.

**PAYLOAD SCIENTISTS:** Individuals that fly for the purpose of conducting scientific investigations on themselves, other spaceflight participants, or scientific payloads. While most spaceflight participants would fly only one time per day, it is possible that payload scientists could fly on multiple missions in a single day or on repetitive days. Payload scientists normally are screened as SFPs, but certain operations or operators may require additional medical screening.