POSITION STATEMENT OF THE AEROSPACE MEDICAL ASSOCIATION
MEDICAL CERTIFICATION FOR COMMERCIAL SPACE PILOTS:
SUBORBITAL FLIGHTS
MARCH 16, 2009

Introduction

A Working Group (WG), tasked by the President, CDR Andrew Bellenkes, convened in the Aerospace Medical Association (AsMA) Home Office on Friday, October 31, 2008 with the objective of preparing a position statement on commercial space pilot medical certification for suborbital flight. (Members of the WG are listed below.*) This effort was prompted by the expected surge in space tourism during the next 2 – 5 years. The discussion of medical certification was divided into two areas: medical standards; and, the medical examination. Prior to its deliberations, Dr. Melchor Antuñano, Director of the Federal Aviation Administration (FAA) Civil Aerospace Medical Institute (CAMI), was asked to provide the WG with an overall description of the stresses of suborbital flight. The Society of NASA Flight Surgeons and the Space Medicine Association were requested to review the position paper. Both organizations graciously accepted this request and provided the WG with a number of constructive suggestions.

It must be emphasized that this position paper is not the final word. Commercial space flight is very fluid because it is in its infancy. As the industry matures, the recommendations put forward will have to be revisited and changed as circumstances and new knowledge require.

The heart and soul of this position paper is not so much in the narrative, but rather in the recommendations. The WG believes its recommendations are reasonable as we know the commercial space industry today.

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Stresses of Suborbital Flight

There are currently a number of companies throughout the world in varying stages of development of space vehicles to provide suborbital flights for space flight passengers. The duration of the flight is expected to be between 1.5 – 2.5 hours with one excursion of 3 – 4 minutes in microgravity. Depending upon the type of space vehicle, there will be 1 or 2 pilots. It is anticipated that such flights would become readily available within the next several years and that increasing numbers of space flight passengers would purchase tickets, particularly as they become more affordable. Although most suborbital flights will be dedicated to space tourism, there will be some for other commercial purposes such as satellite insertion into orbit, reconnaissance, weather observation, research, etc. (Regarding research, the 3 – 4 minutes of microgravity should be adequate for testing and developing certain hardware compared to the existing 25 second windows afforded by aircraft parabolic flights.) Because commercial companies are building space vehicles of different design, capabilities, and flight profiles, the stresses will vary from one space vehicle to the other. Therefore, the recommendations for pilot medical standards and for the medical examination must be flexible giving allowance for these differences. The stresses of suborbital flight include:

a. Acceleration

After liftoff, acceleration will peak between 2.5 and 4.0 Gx and 3.0 to 3.5 Gz as the space vehicle climbs to suborbital altitude. On reentry, acceleration may peak at 5.5 – 6 G (although some space vehicles are being designed to impose only 2.2 – 2.5 G), which, depending on the design of the specific vehicle, may be imposed predominantly in either the z-axis or x-axis. For passengers in vehicles that provide tilt-back seating, most of the acceleration on launch and reentry will likely be in the Gx axis with a duration expected to be no longer than 30 seconds. However, for pilots, the G vector may be predominantly +Gz. Because of tilt-back seating and the flight profile, most of the acceleration on launch and reentry will be in the Gx axis with a duration expected to be no longer than 30 seconds. There are currently no definitive plans to utilize anti-g-suits during these flights (although some companies are considering its use). At this time, the onset rate of the accelerative forces has not yet been released by any of the operators.

b. Barometric Pressure

Some companies are planning a sea-level, mixed gas atmosphere allowing a maximum cabin altitude equivalent to 8,000 ft., similar to that of current commercial airlines flight operations. Other companies are planning a pure hypobaric oxygen environment. The use of pressurized space suits may be utilized by some companies as additional safety/risk mitigation in event of cabin depressurization.

c. Microgravity Effects

Although the long term effects of microgravity are well known, this is not considered a significant factor in that exposure to microgravity will only be of 3 to 4 minutes for each flight. Nevertheless, there is always the possibility of symptoms of space adaptation syndrome/space motion sickness for sensitive individuals. Likewise, even with a short exposure to microgravity, some individuals might experience other neurovestibular alterations, particularly after landing.

d. Ionizing Radiation

For the most part, there is no concern regarding ionizing radiation because of the short duration of the flight and the fact that launch date/time can be controlled depending upon solar/atmospheric conditions. Also, ionizing radiation is considered an occupational health rather than a medical certification issue. However, all flight crew, particularly for those flying several times per week, should be required to wear personal dosimeters as do radiation and medical imaging personnel to ensure compliance with National standards.

e. Non-Ionizing Radiation

Non-ionizing radiation is not considered a significant factor for medical certification.

f. Noise

Some of the space vehicles do generate loud internal noise for brief periods although the exact decibel level is not known.

g. Vibration

The vibration associated with launch and aerodynamic loading of a space vehicle is significantly greater than standard aircraft operations. Transient vibrational loads of >0.5 g peak for <1 minute and cumulative vibration loads of the vehicle could transiently interfere with the pilot’s ability to promptly institute corrective actions. However, it was felt that vibration is not considered a specific standard for medical certification.

h. Cabin Air Quality

The cabin will be sealed with recirculated air. Although there could be some concerns regarding off gassing of internal materials, this is not considered a significant medical certification issue.

i. Spatial Disorientation

There is the possibility of spatial disorientation particularly with different G vector transitions. This has been experienced in prior suborbital flight.

Discussion

With Dr. Antuñano's briefing as background, the WG addressed, in turn, two specific areas of medical certification: medical standards and the medical examination. Consideration in both areas began with an understanding that, although efficiencies would be required for profitability, safety is paramount and every effort must be taken to ensure safety.

The WG felt it would be impractical to determine medical standards with a line-by-line review of each system of the body. Rather, it was felt that the current Federal Aviation Administration (FAA) Class I medical standards were reasonable for crews flying suborbital flight. Furthermore, it was felt that a responsive waiver system would be crucial so as to avoid unnecessary disqualification. Such a waiver system already exists for most flying organizations throughout the world giving regulatory authorities flexibility and this is what is suggested for this new program. Many pilots today in commercial aviation, general aviation, military aviation, and the space program do have waivers and have flown without compromising flying safety. However, it must be kept in mind that there will be, at least in the beginning, a limited number of space pilots and each mission will be very high profile. Consequently, the waiver authority must exercise discretion in its decisions taking into consideration the unique environment of space.

From a medical perspective, overly strict medical standards could lead to unnecessary disqualification of pilots. But at the same time, at least in the beginning of this new endeavor, an overly liberal policy could be an added threat to flying safety. As experience is accrued, medical standards could be revised by regulatory agencies accordingly. Space flight and the space environment both have unique stressors and unique aeromedical concerns that require an additional level of vigilance until a larger body of commercial suborbital flight experience is attained.

The WG next discussed the medical examination requirements for suborbital space pilots. The purpose of the examination is to ensure the pilot meets medical standards only during the period of validity of certification, i.e., 6 – 12 months depending upon age, and to detect the more common illnesses that could cause sudden incapacitation. No tests or procedures were recommended outside this parameter such as those for long term health monitoring. However, other tests were discussed including treadmill, electron beam computed tomography (EBCT), and lipid profile. The WG opted against these procedures because of the high false-positive rate anticipated for a treadmill test on relatively young individuals. Coronary calcium scoring is a part of established cardiac risk stratification protocols at some institutions and has an established body of literature justifying its use on coronary risk assessment. However, there are currently no guidelines stipulating the use of coronary calcium for risk assessment. Although a lipid profile might be desirable, it really is a marker for long-term health and not for aerospace medical certification.

What the WG recommended should be considered the minimum examination requirements. Undoubtedly, opinions would vary regarding laboratory/procedures requirements. However, the WG did reach consensus on those that had a reasonable probability of detecting a potentially incapacitating condition. Any company or regulatory authority could enlarge the scope of the medical examination including laboratory tests and procedures. If any abnormalities were found, the regulatory authority would have to determine the clinical significance and subsequent aeromedical disposition. Companies may stipulate additional medical testing if they so choose and even make the physical examination more frequent at their discretion. Medical examinations should be performed by a physician trained (preferably board certified) in aerospace medicine. It has also been suggested that any crewmember expecting to fly passengers to zero-g should obtain experience in parabolic flight and G-training.

This WG considered only suborbital flight because it is anticipated it will be a reality in the near future. Undoubtedly, there will eventually be orbital flights offered to space flight passengers, but these probably will not occur for at least another 5 – 10 years. Because orbital flight will impose stresses different from suborbital flight, it must be given special consideration accordingly. It was anticipated that a similar WG might convene in the near future to determine the medical standards and the extent of the medical examination for pilots flying commercial orbital flights.

RECOMMENDATIONS:

I. Adopt the FAA Class I medical standards (or other consistent standards) for suborbital space pilots.

II. Establish a flexible waiver system.

III. Appoint designated aerospace medical examiners trained (preferably board certified) in aerospace medicine to perform the medical examinations.

IV. Perform the medical examination every 6 months for those over age 40 and annually for those under age 40.

V. Perform a history and physical examination and the following limited laboratory tests/procedures.

  a. Urinalysis
  b. Hemoglobin/hematocrit
  c. Hemoglobin A_{1C} (fasting blood glucose could also be considered)
  d. ECG

VI. Convene a WG in the near future to develop a policy statement on commercial space pilot medical certification for orbital flights.