U.S. Department
of Transportation

**Federal Aviation
Administration**

**Transport Airplane Directorate
Aircraft Certification Service**

1601 Lind Avenue, S. W.
Renton, Washington 98055-4056

To: Mr. Peter H. Diamandis
CEO
Zero Gravity Corporation
2708 3rd Street, No. 6
Santa Monica, California 90405

Date: October 20, 2005

Subject: Correction to Exemption No. 8306

Limitation Paragraph No. 13

FAA Regulatory Docket No. FAA-2004-17474, Zero Gravity Corporation

Action:

___ Per Your Request	___ Discuss With Me	___ Take Appropriate Action
X For Your Information	___ For Your Approval	___ Please Answer
___ Per Our Conversation	___ For Your Signature	___ Prepare Reply For:
___ Note and Return	___ Comment	

Remarks:

The National Aeronautics and Space Administration (NASA) recently contacted the Federal Aviation Administration (FAA) regarding Limitation No. 13 contained in Zero Gravity Exemption No. 8306, on Boeing Model 727-200 airplanes. Limitation No. 13 states:

“13. Each person who will occupy the passenger cabin must sign a liability waiver that discusses the risks associated with parabolic flight and activities in the floating area. These persons must be trained in flight physiology and the hazards associated with a decompression event before signing the waiver. This waiver must also explain that exemptions from certain FAA airplane design and operational requirements have been granted.”

Zero Gravity wanted to use a liability waiver to provide notice to its customers of the risks associated with this operation. The FAA's only interest in this paragraph is to ensure that customers receive this notice. There is no public interest in requiring a liability waiver as a condition for this exemption. Therefore, limitation no. 13 of the exemption is hereby revised to read:

"13. Each person who will occupy the passenger cabin must sign a form that discusses the risks associated with parabolic flight and activities in the floating area. These persons must be trained in flight physiology and the hazards associated with a decompression

event before signing the form. This form must also explain that exemptions from certain FAA airplane design and operational requirements have been granted."

All other provisions of Exemption No. 8306, together with its conditions and limitations, remain the same and are applicable to this correction. This letter is part of, and must be attached to, Exemption No. 8306.

We are sorry for the error and hope it has not inconvenienced you.

/s/
Kalene C. Yanamura
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service

Attachment

CORRECTED COPY
(Revised Exemption Limitation No. 13 on October 20, 2005)

Exemption No. 8306

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of **Zero Gravity Corporation** for an exemption from §§ 25.785(j) and 25.1447(c)(1) of Title 14, Code of Federal Regulations	Regulatory Docket No. FAA-2004-17474

GRANT OF EXEMPTION

By letter dated April 2, 2004, Mr. Peter H. Diamandis, Zero Gravity Corporation, 2708 3rd Street, #6, Santa Monica, California 90405, petitioned the Federal Aviation Administration for an exemption from §§ 25.785(j) and 25.1447(c)(1) of Title 14, Code of Federal Regulations (14 CFR). The requested exemption, if granted, would permit relief from these regulations to allow an interior configuration that includes an area where persons could experience a reduced gravity (including no gravity) environment on a specially modified Boeing Model 727-200 airplane.

Additionally, part 25 does not contain adequate or appropriate safety standards for an interior configuration which includes an area where persons could experience a reduced gravity environment. Special conditions are typically issued that contain such safety standards, but special conditions must establish a level of safety equivalent to that established in part 25. The FAA considers that an appropriate level of safety may be provided which justifies an exemption, but that the proposed configuration would not provide a level of safety equivalent to that established in part 25. Therefore, this exemption is also being requested to implement new safety standards to provide an adequate level of safety, but not a level equivalent to that established in part 25.

The petitioner requests relief from the following regulations:

Section 25.785(j), Amendment 25-88, requires, in pertinent part, that there be a firm handhold to enable occupants to steady themselves when moving through the aisles in moderately rough air.

Section 25.1447(c)(1) at Amendment 25-87 requires, in pertinent part, that oxygen masks must be immediately available to each seated occupant, be automatically deployed with manual backup, and exceed in number the quantity of seats by ten percent, with the extra units distributed evenly throughout the cabin.

The petitioner's supportive information is as follows:

"SUMMARY

"Pursuant to 49 U.S.C. §§ 40113(a) and 44701(f) and 14 CFR Part 11, Zero Gravity Corporation ("ZERO-G") petitions the Federal Aviation Administration for exemption from 14 CFR §§ 25.785 and 25.1447(c)(1) to the extent necessary to permit certification of a specially-modified B-727 aircraft intended to be used to allow participants (which ZERO-G understands the FAA considers to be 'passengers' for purposes of 14 CFR Part 25 and which will hereinafter be referred to as 'participants') to experience weightless flight in a 'floating area' of the airplane. ZERO-G further seeks expedited relief and requests that the FAA abbreviate the period for comments on this petition to fourteen days." In support of its petition, ZERO-G attaches letters [available in the Docket] from, among others, the Chairman of the House Aviation Subcommittee; the Executive Director of the Florida Space Authority; the Director of the Center for Space Power, Texas A&M; the Executive Director of the Texas Aerospace Commission; the Director of the Reduced Gravity Student Flight Programs, Texas Space Grant Consortium; and the Executive Director of the National Space Society (NSS).

"BACKGROUND

"In May 1993, ZERO-G began developing a plan to provide commercial parabolic flight services in the U.S. Throughout 1993 and 1994, ZERO-G carefully established the foundation for its planned commercial operations and assembled an experienced management team, which now includes several former astronauts with 25 years of experience in parabolic flight operations, to support the successful launch of its venture.

"In 1995, ZERO-G obtained technical clearances from Boeing Customer Service regarding aircraft airworthiness and operational issues. ZERO-G also partnered with Hamilton Aviation to perform modifications of the B-727 aircraft that are necessary to conduct parabolic flight safely and obtain the appropriate supplemental type certificate (STC) for those modifications. Between 1996 and

2000, ZERO-G worked on developing and proving these modifications. This culminated in successful test flights in January 2000 and issuance of STC #ST01051LA in June 2000. (The FAA reissued the STC in ZERO-G's name in October 2002.) In September 2000, ZERO-G partnered with a major movie studio to conduct a series of demonstration parabolic flights.

"At this time, ZERO-G has entered into a long-term operations agreement with Amerijet, a Part 121 all-cargo carrier, and has a contract to provide parabolic flights to its first client starting in May 2004.

"The service to be offered by ZERO-G involves providing participants, including aerial work clients (researchers and photographers), with a reduced gravity environment.

"During a normal maneuver, participants in the floating area will experience a reduced gravity ranging from Martian Parabolas (1/3-g), to Lunar Parabolas (1/6-g) to-Weightless Parabolas (0-g). The parabolic maneuver is an instrument maneuver conducted by the Captain controlling the pitch of the aircraft while the First Officer controls the aircraft thrust in order to minimize any longitudinal accelerations. Because the transition from high-g to reduced-g is a gentle maneuver that takes place over several (3 – 5) seconds and the Captain is trained to enter the reduced-g condition in a gentle fashion without overshooting, the participants are not subjected to any significant negative gravity that might otherwise bring them to the ceiling.

"Up to 28 participants will be accommodated in 30 seats in the rear Seating Area of the aircraft. During the reduced gravity portion of the flight, these 28 participants will be divided into three groups of participants. Each group will be placed into a Floating Zone. Each flight will have one Flight Director stationed in the forward portion of the Floating Area and a Flight Attendant stationed at the rear of the Floating Area. In addition two Coaches will oversee the participants. In some cases, to increase the enjoyment of the experience for its participants, ZERO-G may, at its option, choose to add a third Coach in place of a paying participant and fly with three Coaches and 27 participants.

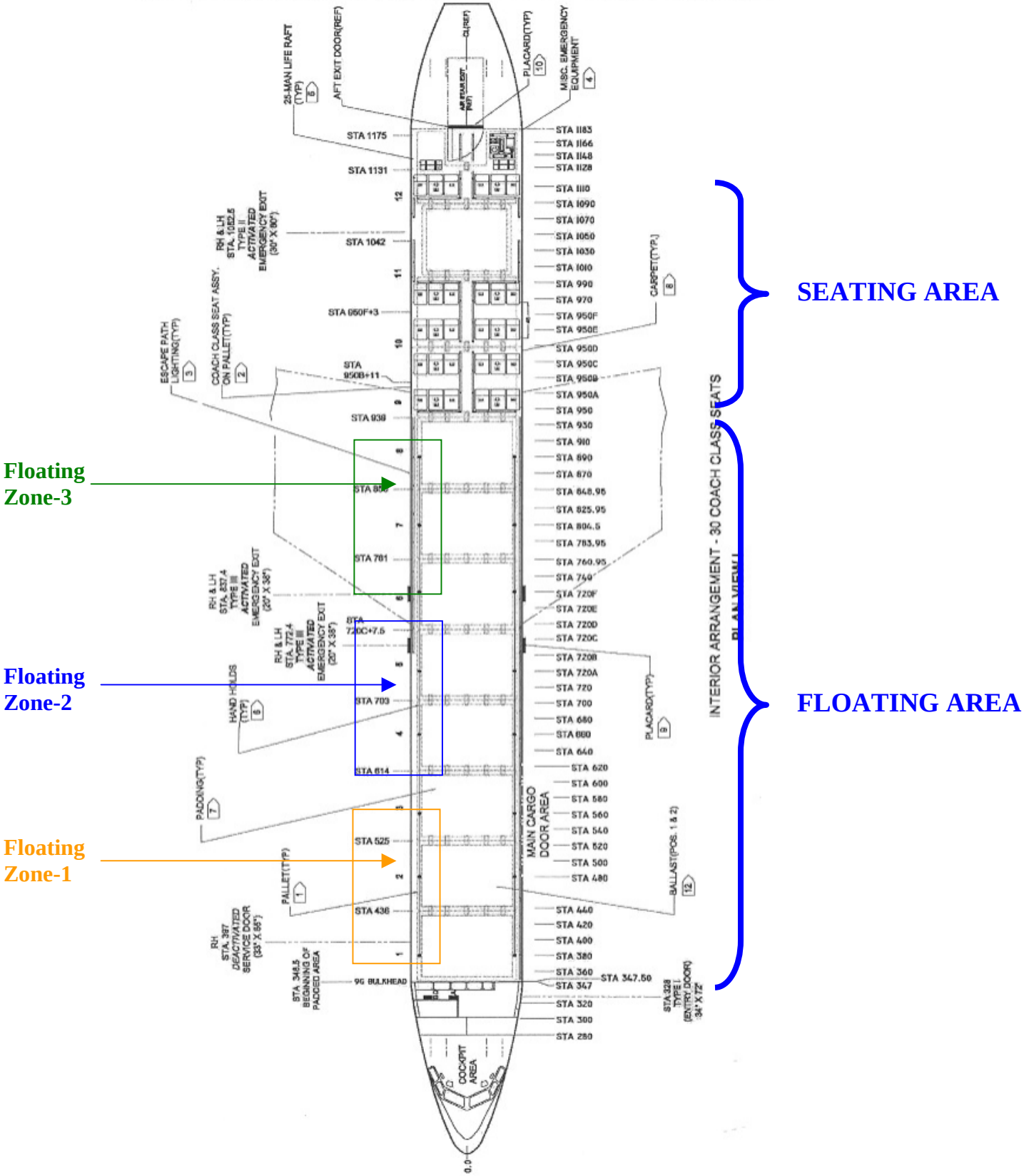

SEATING AREA
FLOATING AREA
Floating Zone-3
Floating Zone-2
Floating Zone-1
INTERIOR ARRANGEMENT - 30 COACH CLASS SEATS
PLAN VIEW
25-MAN LIFE RAFT (TYP)
AFT EXIT DOOR(REF)
PLACARD(TYP)
MISC. EMERGENCY EQUIPMENT
STA 1175
STA 1131
STA 1042
STA 950F+3
STA 950B+11
STA 938
STA 701
STA 720C+7.5
STA 703
STA 614
STA 525
STA 436
STA 347.50
STA 348.5 BEGINNING OF PADDED AREA
96 BULKHEAD
MAIN CARGO DOOR AREA
COCKPIT AREA
ESCAPE PATH LIGHTING(TYP)
COACH CLASS SEAT ASSY. ON PALLET(TYP)
HAND HOLDS (TYP)
PADDING(TYP)
PALLET(TYP)
CARPET(TYP.)
BALLAST(POS. 1 & 2)
STA 328 TYPE I (ENTRY DOOR) 34" X 72"

Figure #1

"EXTENT AND JUSTIFICATION OF RELIEF SOUGHT

"Regulation: § 25.785 Seats, berths, safety belts, and harnesses.

> (j) If the seat backs do not provide a firm handhold, there must be a handgrip or rail along each aisle to enable persons to steady themselves while using the aisles in moderately rough air.

"ZERO-G will address the requirements of § 25.785(j) by providing the below features:

"Compensating features that ensure that an exemption would not adversely affect safety:

"(1) ZERO-G has installed 1.5-inch energy absorbing Ensolite padding on the floor throughout the entire floating zone. Should a participant fall due to turbulence, this foam would adequately cushion his fall.

"(2) Any equipment mounted in the aircraft as part of its type design will be "made safe" in a fashion that sharp corners are eliminated or covered with protective foam padding.

"(3) ZERO-G's normal operations require participants to be seated or kneeling during the high-gravity 'pull-out' of parabolic maneuver. In this fashion they are already on the floor during the high-gravity segment of the maneuver and will not be adversely affected by moderate turbulence.

"(4) ZERO-G implements a preflight medical questionnaire of all of its participants to insure that they are physically fit and do not have any musculoskeletal conditions which might make them frail.

"(5) ZERO-G's standard procedure includes both an aural and visual annunciation by the Captain, Flight Director or Flight Attendant at the onset of turbulence directing the participants to return to their seats.

"(6) ZERO-G's participants are required to sign a liability waiver, which discusses the risks involved in parabolic flight and makes them clearly aware that parabolic flight is operated under certain exemptions from the Federal Aviation Regulations (FAR).

"(7) ZERO-G's interior configuration includes handhold straps along both sides of the fuselage to allow participants to stabilize themselves. This replicates the design in the NASA KC-135 that has been refined for over 35 years. The primary handholds are located approximately 50 inches above the floor, and run continuously down both sides the length of the airplane interior from frame 350 to frame 960. The handhold is connected to the

sidewall of the aircraft through D-rings every 88-inches. In addition, a secondary handhold runs the length of the aircraft along the floor, 6-inches from side wall. The primary and secondary handholds are made of a single continuous strip of red nylon webbing, which is 1-inch wide.

"Regulation: § 25.1447(c)(1) Equipment standards for oxygen dispensing units.

> (c) If certification for operation above 25,000 feet is requested, there must be oxygen dispensing equipment meeting the following requirements:
> (1) There must be an oxygen dispensing unit connected to oxygen supply terminals immediately available to each occupant, wherever seated, and at least two oxygen dispensing units connected to oxygen terminals in each lavatory. The total number of dispensing units and outlets in the cabin must exceed the number of seats by at least 10 percent. The extra units must be as uniformly distributed throughout the cabin as practicable. If certification for operation above 30,000 feet is requested, the dispensing units providing the required oxygen flow must be automatically presented to the occupants before the cabin pressure altitude exceeds 15,000 feet. The crew must be provided with a manual means of making the dispensing units immediately available in the event of failure of the automatic system.

"Oxygen in the Seated Area:

"ZERO-G seeks relief from § 25.1447(c)(1) in the Seating Area based upon the following features that ZERO-G believes will ensure that safety is not adversely affected and provide an acceptable level of safety to occupants of the Seated Area:

- "Supplemental oxygen equipment with connect masks will be located so that each person can don a mask and activate the oxygen flow while seated. The means of activating the flow will be simple.

- "An automatically activated aural decompression signal will be provided which is immediately recognizable through the cabin.

- "All participants and crew will go through extensive ground training in the use of the oxygen equipment.

- "Procedures will be established so that Flight Attendants are trained and aware of the location and use of emergency oxygen bottles available to them.

- “All participants have undergone additional medical screening through a pre-flight questionnaire, which will ensure that they are reasonably physically fit and capable of assisting themselves as needed.

- “All participants have been warned in advance through a signature of a Liability Waiver of the increased risks involved with Parabolic flight and are aware that parabolic flight is offered under Part-121 with certain exemptions from Part-91 and Part-25 which the FAA has determined do not adversely affect safety.

- “ZERO-G’s oxygen units are sized adequately for continuous and uninterrupted use during worst-case flight duration following a decompression. The oxygen generators are able to provide oxygen continuously for 15 minutes. In the case of a decompression, ZERO-G will bring the aircraft down to below 15,000 feet within 3-5 Minutes.

- “ZERO-G’s design provides 30 oxygen masks to the 30 individuals seated in the Seating Area of the aircraft. These masks are easily reachable to all seated participants. The need for a 10% overage in the total number of dispensing units results from the following circumstances:

  “(1) If there is a lap child.
  “(2) If an individual reaches for [and] takes a mask from the row in front of them or behind them by mistake.
  “(3) If a mask is not working.
  “(4) So that Flight Attendants have access to extra masks in order to move about the cabin.

- “ZERO-G addresses each of the above circumstances as follows:

  “(1) Lap children will not be allowed on any ZERO-G flights.
  “(2) Because the masks are extracted by the seated participants from a box underneath the center seat in front of them, there will be little confusion with participants reaching for a mask that is not designated for them. In addition, ZERO-G has an extensive ground training program for its participants prior to flight. This training program includes detailed instructions on safety issues such as returning to seats, locating and donning the supplemental oxygen masks.
  “(3) The Flight Attendant has two oxygen bottles available, which can be provided to any participants who are not able to access their masks, or in the case that a mask is not functioning. ZERO-G’s interior design also includes a series of oxygen boxes in the floating area to provide interim oxygen, if needed, prior to the participants’ return to their seats. In this fashion, ZERO-G plans to meet the requirement of a 10% overage in oxygen masks.

"(4) The Flight Attendant and Flight Director have access two oxygen bottles available to them to allow them to move freely about the cabin. Further they are trained in the use of these oxygen bottles.

"Oxygen in the Floating Area:

"No oxygen requirements currently exist for the Floating Area. ZERO-G, however, will use the data and procedures described below to ensure that an exemption would not adversely affect safety and would provide an acceptable level of safety under § 25.1447(c)(1) in the Floating Area:

"Reduce Gravity Profiles & Determination of Worst-Case Scenario:

"In the process of determining the requirements/standards for supplemental oxygen on the ZERO-G aircraft, it is important to understand the profile of the different maneuvers that ZERO-G plans to fly.

"ZERO-G plans to fly several different acceleration level maneuvers to allow our customers to experience not only zero gravity (0-g), but also Lunar (1/6-g) and Martian (1/3-g) environments. All maneuvers will start at approximately 24,000 feet, but with different pull-up accelerations, pitch angles and maximum altitudes reached during the maneuver. For both the Martian and Lunar maneuvers, the participants experience reduced, but positive g-levels so that they would always be able to immediately return to their seats and don the supplemental oxygen masks. In addition, these maneuvers will peak at lower altitudes than the 0-g maneuver.

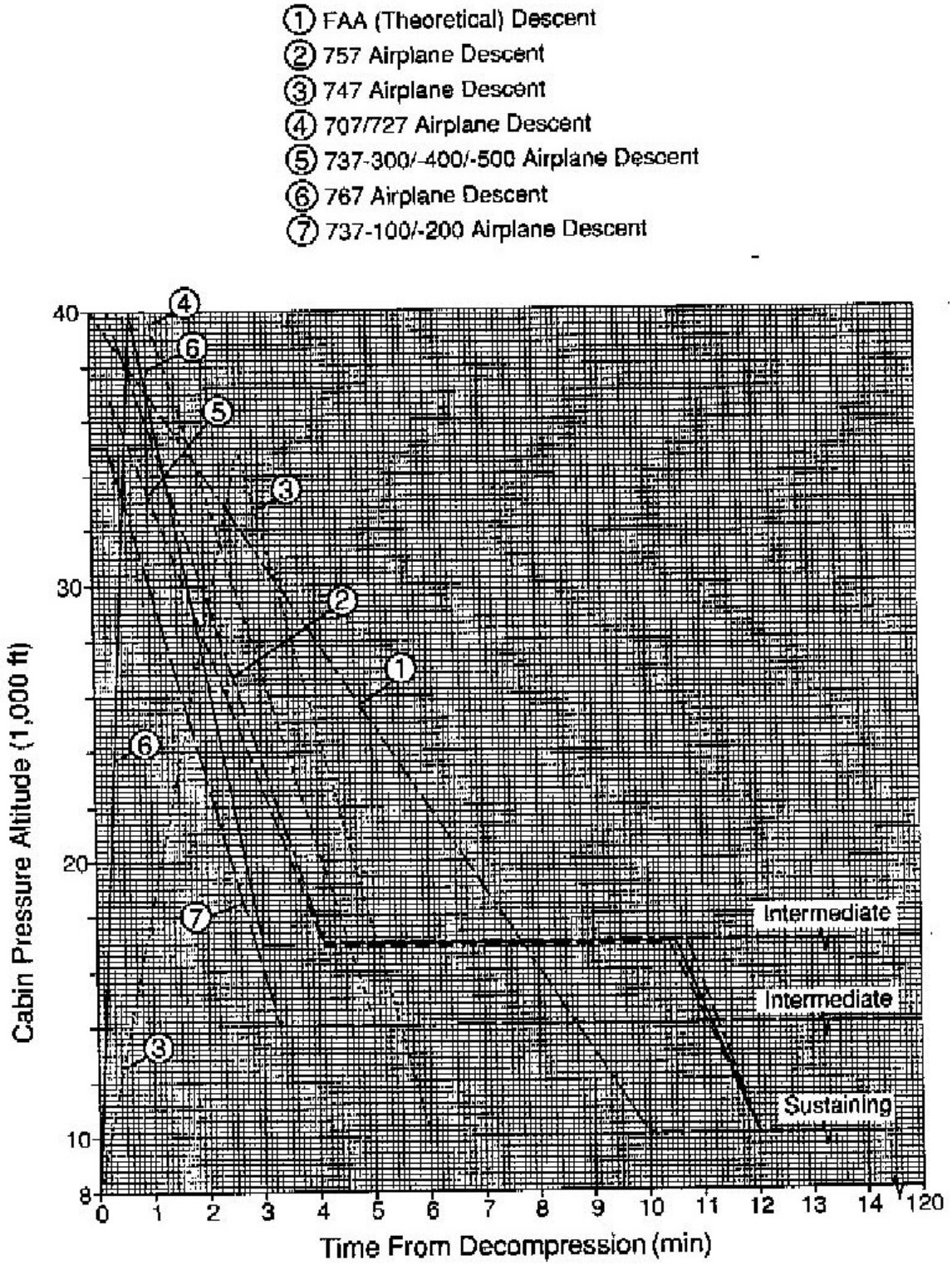
"For these reasons, we believe the worst-case scenario is a decompression at the point of push over for the 0-g parabola. At that point, the aircraft is in an approximately 45 degree nose up attitude, and the only way to safely recover from this is to continue the push over to 0-g until the nose is below the horizon, and the aircraft is gaining speed descending. A normal, full-duration parabolic maneuver can only sustain 0-g for about 25 seconds and results in approximately 45 degrees nose low attitude. In the case of a decompression, the pilot will discontinue the parabolic maneuver once the aircraft is nose-low and gaining speed, and transition to a slightly positive g-force so that the participants can make their way back to their seats. The estimated time for that to occur is about 15 seconds. At this point, the aircraft will already be in a nose low, descending flight path, and the pilots can transition to an emergency descent profile.

"The following data and procedures are given below in order to ensure that an exemption would not adversely affect safety and would provide an acceptable level of safety under § 25.1447(c)(1) in the Floating Area:

"(1) ZERO-G proposes to limit the entry altitude of any maneuver that provides reduced gravity to 24,000 feet. The maneuver that provides the greatest altitude

gain is the parabolic, 0-g maneuver. During this maneuver, the aircraft can peak at altitudes of approximately 32,000 feet. In normal conditions, the cabin altitude remains constant at about 8,000 feet. In the worst case of a rapid depressurization at the maximum altitude of about 32,000 feet, the cabin altitude would go to the aircraft altitude. At this point in the maneuver, the aircraft is nose level with the horizon, and already in a pitch rate that continues to move the aircraft to a nose low, descending attitude. Therefore, the worst-case scenario would still limit the cabin altitude to 32,000 feet or less.

"(2) ZERO-G has obtained data on the B-727 emergency descent capability and is submitting that in support of their request for exemption. Figure 2, cabin emergency descent profiles, shows the time to descend from various altitudes for a variety of Boeing aircraft. From the chart, it can be seen that the time from 32,000 feet to 25,000 feet is approximately one minute. In the worst-case scenario, the depressurization would take place just as the aircraft is beginning the 0-g pushover at about 45 degrees nose high. In this case, the safest maneuver is to continue the parabolic profile until the nose goes below the horizon. This places the aircraft at about 32,000 feet. Assuming worst case that the cabin altitude goes immediately to the outside altitude, the time that the cabin altitude stays above 25,000 feet is approximately one minute."



"Figure-2: Cabin Emergency Decent Profiles. From page 14 (figure 2) of the book, 'Breathing Oxygen Requirements for Boeing Commercial Jet Transport Aircraft,' Published in 1991 by Boeing Aircraft Co."

"(3) From the chart in Figure-2, it can be determined that the steady state descent rate during an emergency descent conducted at V_{mo} and full speed brakes is about 8,000 feet per minute. From this data, it would take about 1.3 minutes to descend from 25,000 feet to 15,000 feet. Therefore, the total time from 32,000 feet cabin altitude to 15,000 feet cabin altitude is about 2.5 minutes.

"(4) The recommended emergency descent procedures for Boeing aircraft are to:

"a. Don emergency oxygen masks.
  "(i) First Officer & Flight Engineer will immediately don oxygen mask;
  "(ii) Captain will continue to flying the aircraft;
  "(iii) As soon as the First Officer is on oxygen, the Captain will transfer control of the aircraft to the First Officer;
  "(iv) Captain will don his oxygen mask; and,
  "(v) Captain will resume control of the aircraft.
"b. Establish crew communication.
"c. Attempt to control the cabin.
"d. If not successful, begin emergency descent which is:
"e. Announce emergency descent.
"f. Start switches to flight.
"g. Thrust levers to close.
"h. Speed brake extend.
"i. Emergency descent start.
"j. Target airspeed M_{mo}/V_{mo}.
"k. Approaching level off altitude or MEA whichever is higher, reduce descent rate and retract speedbrakes.

"This procedure is part of the non-normal checklists, and is practiced and known by the flight crews. This procedure provides the most rapid descent rate for the aircraft. This entire procedure will reduce the cabin altitude to the desired level off altitude of 10,000 feet in less than 6 minutes from the beginning of the emergency descent.

"(5) The preflight training plan for ZERO-G's participants includes instruction on the physiology of hypoxia, and rapid decompression indications. Included are symptoms of hypoxia and the appropriate measures to be taken in case of a decompression. All the flight attendants, flight directors, and coaches have successfully completed FAA-approved courses, which include the measures to be taken in case of a depressurization. These courses include emergency medical training including CPR and the use of onboard defibrillators.

"(6) The time of useful consciousness (TUC) at different altitudes can be found from standard textbooks of aerospace medicine (See Table-1 below -- Reference: High Altitude Respiratory Physiology, Chapter 2, Table 2-8, revised

by Paul W. Fisher, Ph.D./ US Air Force--Brooks:
www.brooks.af.mil/af/files/fsguide/HTML/Chapter_02.html)

"At about 30,000 feet, the TUC is 1-2 minutes. At 25,000 feet, it is 3-5 minutes and, at 18,000 feet, it is 20-30 minutes. It should be noted that the TUC for decompression could be about ½ of the chart values. These times reflect the time that a person could be reasonably expected to perform flying duties. Further, these charts have been derived from data based on military flight crews that are expected to perform critical duties of flight. It should be noted that the participants have no such critical duty, and even if they were unable to don oxygen masks prior to losing the capability to do so, ZERO-G has trained personnel in the cabin to assist our clients in getting to their seats and donning oxygen masks. Further, the cabin has a padded floor to minimize the risk to any participant, should he not be able to make it all the way back to his seat. No risk to life or limb exists in this case. Finally it should be noted that all ZERO-G participants will sign a liability waiver, which will explicitly outline the risks involved, including that of decompression and loss of consciousness. The waiver will explain that, while the probability of an explosive decompression on the ZERO-G aircraft is similar to any other Part-121 operation, the implications of not getting on oxygen immediately could be significant."

Altitude	Time of Useful Consciousness
FL 180	20 to 30 Min
FL 220	10 Min
FL 250	3 to 5 Min
FL 280	2.5 to 3 Min
FL 300	1 to 2 Min
FL 350	0.5 to 1 Min
FL 400	15 to 20 Sec
FL 430	9 to 12 Sec
FL 500 and above	9 to 12 Sec

"TIMES OF USEFUL CONSCIOUSNESS
TABLE-1:
Chapter 2: HIGH ALTITUDE RESPIRATORY PHYSIOLOGY
(Table 2-8)

revised by Paul W. Fisher, Ph.D./ U.S. Air Force (Brooks):
Source: http://www.brooks.af.mil/af/files/fsguide/HTML/Chapter_02.html"

"(7) ZERO-G recognizes that an explosive decompression could occur because of an Uncontained Engine Rotor Failure (UERF). While the FAA does not permit

the use of probability as the sole means of providing an exemption, it is worth noting that, according to material available from the Society of Automotive Engineers (SAE) and their associated Aerospace Information Reports (AIRs) AIR1537, AIR4003, and AIR4770 (Draft), the occurrence of UERF are extremely rare. The likelihood of a UERF is no greater in ZERO-G flight than normal operation of JT8D engines in regular operations and therefore safety is not adversely affected for ZERO-G's passengers. In addition, there is an Airworthiness Directive [AD] for the installation of containment rings on the JT8D engine to minimize explosive decompression as a result of UERF. ZERO-G's aircraft will abide by this AD.

"ZERO-G proposes and the following AFM limitation be incorporated:

"All ZERO-G maneuvers (0-g, Lunar, and Martian) will be started at an altitude no higher than 24,000 feet with a peak (transient) altitude of 32,000 feet +500 feet (to accommodate minor excursions). No continuous operation above 30,000 feet while engaged in ZERO-G revenue flights is allowed.

"Other features that show that an exemption would not adversely affect safety and would provide an acceptable level of safety include:

- "ZERO-G's pilots are actively maneuvering the airplane and can take immediate action in the case that a decompression event occurs.

- "At the apex of a 0-g maneuver the airplane is perfectly situated to do a rapid descent to 15,000 feet or below.

- "ZERO-G's pilots are trained to handle a decompression event of this type and bring the aircraft down safely within the prescribed time allocated.

- "ZERO-G's participants are fully briefed and trained on the procedures for immediately returning to their seats, donning a mask and activating oxygen flow as part of their pre-flight briefing.

- "ZERO-G's standard procedure includes both an aural and visual annunciation by the Captain, Flight Director or Flight Attendant telling participants to return to the seats immediately and don their oxygen masks in the case of decompression.

- "For its flights, ZERO-G has four (4) trained employees onboard (1 Flight Director, 1 Flight Attendant, and 2 coaches) to support 28 total participants. This is a ratio of 1 trained individual for every 7 participants. This ratio is far better than the requirement of 1 flight attendant per 50 passengers for a Part 121 operation.

"Regulation**:** § 25.791(a) Passenger information signs and placards.

> (a) If smoking is to be prohibited there must be at least one placard so stating that is legible to each person seated in the cabin. If smoking is to be allowed, and if the crew compartment is separated from the passenger compartment, there must be at least one sign notifying when smoking is prohibited. Signs which notify when smoking is prohibited must be operable by a member of the flight crew and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.

"ZERO-G will comply with § 25.791(a) in the participant seating area. In addition, procedures will be established to require a preflight briefing that will inform the occupants that there is no smoking allowed at any time onboard ZERO-G's aircraft.

Regulation: § 25.791(b) Passenger information signs and placards

> (b) Signs that notify when seat belts should be fastened and that are installed to comply with the operating rules of this chapter must be operable by a member of the flightcrew and, when illuminated, must be legible under all probable conditions of cabin illumination to each person seated in the cabin.

"ZERO-G will comply with § 25.791(b) in the seating area. Section 25.791(b) is not applicable to the floating area. ZERO-G, however, will provide voluntarily the following precautions to help ensure safety:

"(1) ZERO-G has installed five Participant Service Units throughout the Floating Area, which include illuminated 'Fasten Seatbelt,' 'Return to Seat,' and 'Use Oxygen' signs, which are operable by a member of the flight crew.

"(2) ZERO-G's participants will be fully briefed and trained to return to their seats and fasten their seatbelts when instructed by a member of the flight crew.

"(3) ZERO-G's standard procedure includes both an aural and visual annunciation by the Captain, Flight Director or Flight Attendant to return to the seats and fasten seatbelts.

"(4) The following constitute adverse conditions where participants will be required to return to their seats:
"(a) Onset of moderate turbulence;
"(b) Any airplane malfunction that would cause the Captain to make the decision to return to the airport before completing the mission.

"(5) For all flights, ZERO-G has a minimum of four (4) trained employees onboard (1 Flight Director, 1 Flight Attendant, and 2 coaches) to support 28 total participants. This is a ratio of 1 trained individual for every 7 participants. This ratio is far better than the requirement of 1 flight attendant per 50 passengers for a Part-121 operation.

"Safety Features Incorporated into the Interior Design and Operations

"ZERO-G proposes to include the following features to ensure that an exemption would not adversely affect safety and to provide an acceptable level of safety to occupants of the floating area:

"Padding

"ZERO-G covers the floor of the Floating Area with energy absorbing 1.5" Ensolite foam. This foam is sufficient to cushion participants should they fall during the pullout from weightlessness. This approach replicates the design of floor padding used in the NASA KC-135 that has been refined for over 35 years.

"ZERO-G has determined that padding on the ceiling or walls is not necessary. While padding on the ceiling was used in some of NASA's earlier aircraft, padding was not required in the DC-9 or most recent KC-135 conversions. The reason for this is that the airplane is not put into any significant negative gravity and the transition from 1.8 g to weightlessness is a gentle process occurring over the course of several seconds. In addition, the pilots are trained to use the accelerometer display to accurately pitch over to zero-g in a gentle fashion.

"We propose the standard be: The floor of the entire weightless area must be covered in an energy absorbing foam.

"Attire

"ZERO-G has studied the attire to be worn by the participants and determined that a Flight Suit with pockets allowing the easy stowage of motion sickness bags and experiments is ideal. In addition, street shoes will be removed and stowed and thick socks will be issued and used by all participants.

"We propose the standard be: Participants should not wear shoes, but should instead wear socks.

"Cabin Crew Complement

"ZERO-G carries the following Cabin Crew Complement:

"(a) One Flight Director: The Flight Director is responsible for overall safety of the cabin and communicates directly with the Captain. The Flight Director will

be typically stationed in the forward portion of the cabin and will be trained to identify any issues related to cabin safety, specifically: participants inappropriately floating outside of their prescribed floating area, participants who may become injured in some fashion or become overly motion sick and require being returned to their seat. In addition, the Flight Director will pass along instructions from the Captain to the individuals in the cabin, and inform the Captain on the status of participants in the cabin. The Flight Director will determine at any point if straight and level flight is needed and inform the captain of this request and also determine if any conditions within the cabin warrant a return to the airport.

"(b) One Flight Attendant: The Flight Attendant is responsible for the aircraft during the sterile cockpit period (below 10,000 feet) and who is responsible for the seated areas of the aircraft during the parabolic flight maneuvers. The Flight Attendant will typically be stationed in the rear of the aircraft just forward of the seating area. His or her primary responsibility is to ensure safety and to ensure that no participant inappropriately floats out of the Floating Area. This responsibility for containment is also shared by the Coach located in Floating Zone-3. During straight and level flight between parabolas, the Flight Attendant may also assist any motion sick participants requiring assistance in returning to their seat or being otherwise made comfortable.

"(c) Two Coaches: Each of the two Coaches oversees the activities of up to fourteen participants. Coaches and their group of participants are located in the Floating Zones. Each Coach is responsible for supporting the safety and well-being of the participants in their group and will promptly inform the Flight Director of any problems. The Coach located in the rear Floating-Zone-3 will assist the Flight Attendant in ensuring the participants do not inappropriately float into the Seating Area. The Coach located in the forward portion of the aircraft will assist the Flight Director in ensuring that participants do not inappropriately float into past the 9-g bulkhead. Safety responsibilities of the Coaches include identifying if participant is injured in any fashion, or overcome by motion sickness, and returning them to the Seating Area (between parabolas) if necessary. Note: In some cases, to increase the enjoyment of the experience for its participants, ZERO-G may, at its option, choose to add a third Coach in place of a paying participant and fly with three Coaches and 27 participants.

"We propose the standard be: An AFM limitation should be established to require that a minimum flight crew consisting of a Flight Director, a Flight Attendant, and up to 2 Coaches (one Coach per group of 14 participants) must be onboard.

"The Flight Director is responsible for overall safety in the cabin and communicates directly with the Captain. The Flight Director will be typically be stationed in the forward portion of the cabin and will be trained to identify any issues related to cabin safety. In addition, the Flight Director will pass along

instructions from the Captain to the individuals in the cabin, and inform the Captain on the status of participants in the Cabin. The Flight Director will determine at any point if straight and level flight is needed and inform the captain of this request and also determine if any conditions within the cabin warrant a return to the airport.

"The Flight Attendant is responsible for the aircraft during the sterile cockpit period (below 10,000 feet) and is responsible for the seated areas of the aircraft during the parabolic flight maneuvers. The Flight Attendant will typically be stationed in the rear of the aircraft just forward of the seating area and will also be responsible for assisting any participant to return to his seat for any reason.

"One trained coach should be allocated per group of up to 14 participants. Each Coach is responsible for supporting the safety and well-being of the participants in their group and will promptly inform the Flight Director of any problems. The Coach located in the rear Floating-Zone-3 will assist the Flight Attendant in ensuring the participants do not inappropriately float into the Seating Area. The Coach located in the forward portion of the aircraft will assist the Flight Director in ensuring that participants do not inappropriately float into past the 9-g bulkhead. Safety responsibilities of the Coaches include identifying if participant is injured in any fashion, or overcome by motion sickness, and returning them to the Seating Area (between parabolas) if necessary.

"Crew Training

"ZERO-G has established an FAA approved Flight Director training program.
"ZERO-G has established an FAA approved Flight Attendant training program.
"ZERO-G has established an FAA approved Coach training program.

"Both Flight Directors and Flight Attendants have successfully complete an FAA-approved Flight Attendant training program, which includes both CPR and defibrillator use, along with other FAA required medical training.

"We propose the standard be: Any individuals identified as required crewmembers for ZERO-G operations must successfully complete an FAA-approved training course.

"Handholds

"ZERO-G's interior plan includes handhold straps along both sides of the fuselage to allow flyers to stabilize themselves. This replicates the design in the NASA KC-135 that has been refined for over 35 years. The primary handholds are located approximately 50 inches above the floor, and run continuously down both sides of the length of the airplane connected to the sidewall of the aircraft through a D-rings every 88-inches. The handhold is made of a single continuous strip of red nylon webbing, which is 1-inch wide.

"We propose the standard be: A set of handholds must be provided as to minimize the risk of injury during turbulence. The handholds should run the entire length of the airplane, on both sides, at shoulder height (approximately 50 inches above the floor) and should be composed a durable material such as a 1-inch wide nylon strap.

"Medical Questionnaire

"ZERO-G requires that all participants complete preflight medical questionnaires to insure that they are physically fit and do not have any musculoskeletal conditions, which might make them frail.

"We propose the standard be: An appropriate preflight medical questionnaire should be completed by all participants to assess them as fit to fly parabolic flights. Any medical condition, which might be exacerbated by the 1.8g pull-up, should be cleared in advance by their family physicians.

"Liability Waiver

"ZERO-G requires that each participant to sign a liability waiver, which notifies him about the dangers involved with parabolic flight and also makes him aware that these flights are being conducted based upon certain exemptions from the Federal Aviation Regulations (FAR). The waiver will also outline the risks involved in decompression and loss of consciousness. The waiver will explain that, while the probability of an explosive decompression on the ZERO-G aircraft is similar to any other Part-121 operation, the implications of not getting on oxygen immediately could be significant.

"We propose the standard be: An appropriate Liability Waiver should be signed by all participants in advance of the flight. The waiver must make the participants aware of any unique dangers which they might be exposed to by the flight, including that of decompression and hypoxia, and should inform them that the flight is being conducted under Part-121 with certain exemptions from the FAR, which the FAA has found do not adversely affect safety.

"Class Room & Pre-Flight Training

"All participants will participate in both a classroom and preflight safety briefing. The classroom briefing takes place on the ground and provides details on the following areas:

- "History and physics of parabolic flight
- "The parabolic flight maneuver
- "Mission profile
- "The modifications to the 727 aircraft

- “Motion sickness
- “Oxygen system and hypoxia
- “Crew member positions and responsibilities
- “Moving around in weightlessness
- “General safety and final rules
- “Mission abort and return to airport criteria

“The pre-flight briefing takes place onboard the aircraft just prior to flight and covers all of the Part-121 required participant information including, but not limited to:

- “No Smoking
- “Fasten seatbelts
- “Location and use of oxygen system
- “Communications
- “General rules for participant conduct during reduced gravity conditions

“This pre-flight briefing has already been approved by the Ft. Lauderdale Flight Standards District Office (FSDO).

“We propose the standard be: An appropriate pre-flight training program must be conducted, which meets the Part-121 standards and also briefs all participants on the unique aspects of the parabolic flight aircraft, issues related to motion sickness, oxygen system, hypoxia, crew responsibilities and other elements which will make their flight safe.

“Cool Lighting to Prevent Burns

“ZERO-G has selected a minimal heat, Light Emitting Diode system (LED) designed for aircraft interiors, which is only warm to the touch and is shield by Plexiglass and can safely be used with weightless participants in the Floating Area. Use of such a system prevents burns of any type. In addition, the normal incandescent lights in the cabin area will be kept off. In addition, ZERO-G has implemented a battery-powered emergency lighting system to illuminate the cabin in the event of a power failure.

“We propose the standard be: Low heat light systems or systems with appropriate grates must be used to prevent participants from making contact with hot light bulbs, which might cause burns.

“Covering or Removal of Sharp Objects

“Any equipment mounted in the aircraft as part of its type design will be ‘made safe’ in a fashion that sharp corners are eliminated or covered with protective foam padding.

"We propose the standard be: Any equipment mounted in the aircraft as part of its type design will be 'made safe' in a fashion that sharp corners are eliminated or covered with protective foam padding.

"Headsets & Interphone System for Flight Director and Flight Attendant for Cabin Communications

"A total of 5 interphone units will be installed approximately 20 feet apart throughout the cabin. The interphone system will provide two-way communication between flight attendants, flight directors and the flight crew. As part of ZERO-G proposed interior, the interphone jacks will be installed as part of the five (5) Participant Service Units to be located throughout the cabin. This system will be independent of the public address system except for handsets, headsets, microphones, selector switches, and signaling devices.

"In addition, the Flight Director is wearing a headset and is constant communication with the cockpit crew.

"We propose the standard be: An interphone system must be installed that provides two-way communication between flight attendants, flight directors and the flight crew. The interphones must be installed at regular intervals throughout the participant cabin approximately every 20 feet. This system should be independent of the public address system except for handsets, headsets, microphones, selector switches, and signaling devices. In addition, the Flight Director should wear a headset and is constant communication with the cockpit crew.

"Public Address System

"ZERO-G has installed a public address system that is audible from anywhere within the cabin of the airplane and can be activated from the flight deck, the participant seating area or the floating area. The public address system will comply with § 25.1423.

"We propose the standard be: A public address system should be installed that is audible from anywhere within the cabin of the airplane and can be activated from either the flight deck, the participant Seating Area or the Floating Area. The public address system must comply with § 25.1423.

"Positioning of Crew Members to Control Participant Floating Areas

"Cabin Crew members are used to ensure that participants will not float outside the prescribed Floating Area. In particular, the Flight Attendant is stationed at the boundary between the Seated Area and the Floating Area to ensure that participants do not inadvertently float into the Seated Area. Also, one Coach will be located in the rear Floating Zone-3, to contain the participants near the seated

area, and one Coach will be located near the 9-g bulkhead to contain the participants in the forward Floating Zone. Finally, the Flight Director is located adjacent to the 9-g bulkhead to prevent inappropriate entry of any participants beyond the 9-g bulkhead.

"We propose the standard be: Cabin crewmembers must be appropriately stationed to prevent participants from inadvertently floating into the Seating Area or past the 9-g bulkhead.

"Emergency Exits

"ZERO-G's emergency exit design complies with applicable FAR for the number of seats and configuration.

"We propose the standard be: The Emergency Exit design should comply with applicable FAR for the number of seats and configuration.

"Emergency Equipment

"ZERO-G's emergency equipment complies with applicable Part 121 and Part 25 regulations.

"We propose the standard be: The emergency equipment should comply with applicable Part-121 and Part 25 regulations.

"PUBLIC INTEREST

"The availability of parabolic flight services in the U.S. will only be achieved if relief is granted from § 25.785 handhold requirements, 25.791(a) no smoking placards, 25.791(b) fasten seat belt placards, and 25.1447(c)(1) oxygen requirements. Therefore, a grant of this petition for exemption is in the public interest because it would enable the creation of a viable commercial parabolic flight service in the U.S." As discussed by the Chairman of the Aviation Subcommittee, *'It is in the public interest to stimulate both the scientific and educational work that can be accomplished through parabolic flight, and public interest in space flight, so that the U.S. can maintain its preeminent positioning the aerospace industry. Moreover, commercial parabolic flight can supplement NASA's operations at a lower cost.'* [This letter is available in the Docket]

"To expand on these points, the availability of such a service is in the public interest for the following reasons:

"NASA has operated parabolic flights for over 40 years to simulate the weightlessness of space travel for training and experimental purposes. Access to these flights, however, has been very limited. The availability of commercial parabolic flight services would permit members of the general public in the

U.S. — including individuals and entities in the business, government, educational, and scientific communities — to experience weightlessness for the first time.

"Further, based on findings that no justification existed for NASA to continue maintaining its own fleet of aircraft for parabolic flight operations and that commercial parabolic flight operations would service NASA's needs more efficiently, the U.S. House of Representatives indicated its desire that NASA privatize its parabolic flight operations when a commercial provider becomes available. (See National Aeronautics and Space Administration Authorization Act of 1996, H.R. 2043, 104th Cong. § 212 (1995)). In indicating its desire that NASA seek a private operator for parabolic flight operations, the House of Representatives also expressed a desire to encourage the development of a new commercial space-related industry. (See H.R. Rep. No. 104-233, at 67 (1995)).

"In addition, there is currently a large, pent-up demand for parabolic flight services among private entities and other public institutions in the U. S. such as:

- "Motion picture film and advertising companies;
- "Aerospace companies;
- "Scientific laboratories and individual scientists;
- "Educational institutions and students engaged in microgravity studies;
- "Corporations with employee incentive programs; and
- "Adventure travel and tourism companies.

"Commercial parabolic flight operations in the U.S. could fill these requirements.

"Finally, commercial parabolic flight is a stepping stone to the development of commercial space travel, because it provides critical training, experimental, and other testing opportunities to the scientific and educational communities. As the House of Representatives has indicated, commercial parabolic flight could stimulate public interest in the domestic commercial space industry. At this time, the only country that permits public access to commercial parabolic flight is Russia. Commercial parabolic flight in the U.S. could help the U.S. further its pre-eminence in space exploration and development.

"REQUEST FOR EXPEDITED PROCESSING

"ZERO-G further seeks expedited relief and, for the following reasons, requests that the FAA abbreviate to 14 days the time allowed for comments under the procedure outlined in 14 C.F.R. §§ 11.85 and 11.89.

"First, in 1996 the FAA published for public comment a ZERO-G petition for exemption from other portions of the FAR to permit parabolic flight services for the general public. The FAA received no comments in response to that

publication, indicating that an abbreviated comment period of fourteen days should be adequate for this petition as well.

"Second, ZERO-G has multiple clients (6 – 8 flights) who desire to purchase flights in May 2004. The company stands to loose between $420,000 and $600,000 of revenue if operations are not started on or near May 1st. The principal customer for May 2004 is the National Space Society" [The letter is available in the Docket] "who has their annual national convention in May. In order to provide commercial parabolic flights to this client, ZERO-G's schedule requires completing the necessary modifications, training, testing, proving flights, and documentation prior to May 1st, 2004. The expeditious granting of this petition is necessary to offer the National Space Society these flights.

"Third, a delay beyond May 1st will be financially detrimental and will jeopardize the existence of the company. Based upon meetings and schedule discussions with the FAA in December 2003, ZERO-G fully staffed the company and committed to all long-range hardware purchases. The company expected to have its STC issued and to be in operation by early April 2004." As a small, start-up company, the one month delay has added the additional cost of $200,000 - $250,000 and the loss of early revenue ($420,000 - $600,000) that jeopardizes our ability to be an on-going concern.

"Fourth, ZERO-G has obtained Participant Liability Insurance from the London insurance markets. A delay in beginning operations will potentially jeopardize ZERO-G's relationship with underwriters whose participation is essential to ZERO-G in order to operate.

"Fifth, delay would be contrary to the public interest, because it would postpone the availability in the U.S. of commercial parabolic flight operations and their benefits to the public, including NASA and other members of the scientific and educational communities.

"In summary, ZERO-G seeks to become operational no later than May 1st, 2004.

"CONCLUSION

"The operations conducted pursuant to the relief requested would not adversely affect safety and would provide an acceptable level of safety. Further, an exemption would be in the public interest because it would permit, for the first time in the U.S., the operation of commercial parabolic flights. Parabolic flights are critical for microgravity research and training conducted by NASA (particularly during this period of recovery from the Columbia accident) and other scientific and educational institutions that help advance scientific understanding and foster the domestic commercial space industry. In addition, commercial parabolic operations would fulfill the currently unsatisfied demand for microgravity experiences by other institutions, such as motion picture film and

advertising companies, corporations with employee incentive programs, and adventure travel and tourism companies.

"Furthermore, the FAA should abbreviate the time for comments on this petition to 14 days because the FAA previously published for comment a petition, which addressed providing parabolic flight services to the general public by ZERO-G and no comments were received, indicating that a longer comment period likely would not be necessary. Moreover, the delay resulting from a longer comment period on this substantially similar petition would greatly harm ZERO-G and its clients and be contrary to the public interest."

Notice and Public Procedure Provided

On April 13, 2004 (69 FR 19607), the FAA published notice of the petition for exemption in the Federal Register and requested comments from the public. No comments were received in response to the notice.

The FAA's analysis/summary is as follows:

The certification regulations for transport category airplanes address airplane occupants as being either "crew" or "passengers." The petition refers to a flight director and coaches. These persons are passengers in regards to part 25.

Section 25.785(j) requires handholds to enable persons to steady themselves when moving about the cabin, in the event of moderate turbulence. The floating area must be considered in regards to this requirement since the intended operation of the airplane will include persons in and moving about the floating area. The FAA recognizes that it would be impractical to require handholds in the floating area to the extent needed to meet § 25.785(j). The petitioner has proposed several safety features that we consider will provide an acceptable level of safety and will be implemented as part of the limitations associated with this exemption.

Section 25.1447(c)(1) requires that supplemental oxygen be provided to persons at their seats. This rule was developed based on typical interior configurations, which did not include an open area that passengers would occupy for a significant portion of a flight, such as a floating area. For this reason, the floating area is novel in regards to this requirement, and § 25.1447 does not contain standards to provide supplemental oxygen to persons in the floating area. An appropriate standard must be implemented as a limitation to this exemption to ensure that persons in the floating area will be provided an adequate level of safety during a possible decompression event. The FAA considers that it would be impractical for an oxygen system to be installed in the floating area that would meet § 25.1447(c)(1). After considering various options, we consider that certification of this unique feature should primarily be based upon limiting the maximum operating altitude to 32,500 feet and a swift descent to an altitude where sufficient oxygen is provided. Additionally, the pre-flight briefing must instruct occupants to return to their seats during a decompression event. The petitioner has proposed

to install six oxygen boxes, which contain three masks each, uniformly throughout the floating area that could be used to assist occupants, as needed, in getting to their seats. Crew and passengers must be trained in the location and use of the oxygen equipment.

The petitioner and the FAA have exchanged correspondence on the design features and airplane performance capability to assess the level of safety that would be provided during a decompression event. The FAA has determined that an acceptable level of safety can be provided for justifying a grant of exemption. This determination is based mainly on the Cabin Emergency Descent data for the Boeing Model 727-200 airplane, which shows that the airplane is capable of descending rapidly from an altitude of 32,500 feet to an altitude below 25,000 feet within 2 minutes, and continuing descent to 10,000 feet within 6 minutes. Actual time spent in an emergency descent from 32,500 feet to 25,000 feet is approximately 75 seconds based upon continuation of the parabolic flight trajectory used by the applicant in the "zero-g" or "low-g" maneuvers. Actual time spent in an emergency descent starting from cruise at a maximum altitude of 32,500 feet to 25,000 feet is approximately 90 seconds.

By limiting maximum exposure to the rarified atmosphere following a decompression to ambient pressure per this decent profile, even those occupants who are unable to properly don an oxygen mask should be able to survive this event with no permanent physiological harm. However, it must be understood that there is no guarantee that an occupant will survive a decompression event. The FAA has sought information from many medical experts, and the consensus is that there is no medically sound method to ascribe a quantitative level of the severity of exposure to a hypoxic environment. All that can be said is that some people will be at an increased level of risk due to various physical factors including age, health, etc. Properly donning an oxygen mask will lower an individual's risk, while not properly donning an oxygen mask will increase the level of risk in the event of a decompression. It is possible that a number of occupants could suffer permanent physiological harm (i.e., neurological damage) in the event of a rapid decompression at high altitude.

The petitioner has provided the following supportive information:

- Oxygen masks will be provided in the passenger cabin.
- Occupants will undergo pre-flight medical screening to determine that they are physically fit for reduced gravity operations.
- Occupants will be trained in the hazards of decompression and the use of the oxygen systems.
- A sufficient number of personnel trained in assisting persons who will participate in floating activities will be required to be onboard the airplane.

While the FAA does not accept the use of probability as the sole means of compliance to the hazards of a rapid decompression, the worst-case scenarios are rare. Most loss-of-cabin pressure events are benign, that is, there is a relatively

slow leak that affords the crew and passengers ample time to take steps to protect the airplane and occupants. These types of failures should provide ample time for the flightcrew and occupants to safely return to their seats and/or immediately don their oxygen masks. However, the worst-case loss-of-cabin pressure (i.e., a rapid decompression) event can be caused by an uncontained engine rotor failure (UERF) event, where large fragments from the engine penetrate the pressured fuselage creating a large hole that causes a sudden reduction of cabin pressure to ambient pressure. This type of failure may not provide sufficient time for all the occupants to return to their seats and don a mask resulting in the possibility that some may become unconscious. Per Society of Automotive Engineers (SAE), Aerospace Information Report (AIR) 4770 there were 65 uncontained engine failures involving the fan, compressor and turbine stages (1st generation engines) during 59 million hours of operation between 1976 through 1989. The intent of § 25.841 which regulates the cabin pressure environment was to ensure survival of all occupants, even those who were unable to properly don an oxygen mask in the event of a decompression event.

The FAA has reviewed the petitioner's proposal and the corroborating data. While the applicant intends to screen all passengers in order to ensure their relative fitness, all passengers are at some level of risk for permanent physiological harm. Due to numerous physical factors, including age, etc., some passengers will face greater levels of risk than others. The FAA has reviewed data provided by an Aviation Rulemaking Advisory Committee (ARAC) recommendation from the Mechanical Systems Harmonization Working Group. These data show that the number of reported loss-of-cabin pressure events from 1959 through 2001 in transport category airplanes over 60,000 pounds maximum takeoff weight were attributed to failures that occurred within the environmental control system (e.g., pressure controller failures, valve failures). The next most likely sources were from the airplane structure (e.g., loss of door seal integrity), and the least likely from the engine (e.g., an uncontained engine failure).

Amendment No. 25-87, "Standards for Approval for High Altitude Operation of Subsonic Transport Airplanes," amended §§ 25.1447(c) (oxygen equipment) and 25.841(a) (pressurization) to provide airworthiness standards that allow subsonic airplanes to operate at their maximum achievable altitudes. As discussed in the Notice of Proposed Rulemaking for this rule, the maximum achievable altitude is the highest altitude for which an applicant chooses to demonstrate compliance to the regulation. This compliance must show that the airplane provides protection against permanent physiological damage after a cabin decompression, even for those occupants that are unable to properly don supplemental oxygen systems. This compliance must be demonstrated for decompressions attributed to all single failures or combination of failures that are not shown to be extremely improbable. The petitioner has noted, and FAA acknowledges, the rarity of rapid decompression events at high altitude on transport category airplanes. Historically, the FAA has stressed the need for consideration of certain specific threats. The justification for this approach was due to the seriousness of the

damage to the airplane that results in a degraded ability for safe flight and landing or survival of the occupants, regardless of the probability of occurrence. One goal of the regulation would be to ensure the cabin environment would be safe enough to prevent loss of life or brain damage for all occupants, even those unable to don oxygen masks. Preliminary results from the ARAC working group, however, indicate that certain occupants—especially the elderly, young children, and those suffering from specific medical conditions—are at some risk in the event of any decompression. The petitioner has stated that all occupants will undergo medical screening, as previously noted. This restriction will help lower the risk of permanent physiological harm in the event of decompression.

The petitioner has requested relief from some of the § 25.1447(c)(1) requirements for oxygen equipment at each seat location. The airplanes the petitioner is proposing to use under this exemption are currently operated as freighters and are not equipped with automatically deployable oxygen systems. These airplanes will continue to be operated as freighters when not being used to fly parabolic maneuvers as discussed in this exemption. Therefore, as an alternative to an automatically presented system, the petitioner has proposed a fully effective manually deployable system. The FAA has previously allowed similar systems for supernumeraries who are trained in the use of the oxygen equipment on freighters, and the petitioner has proposed to require similar training for the occupants of their airplanes. In addition to this training, the maximum operating altitude will be limited to 32,500 feet, which provides additional support for granting relief from the requirement. Section 25.1447(c)(1) only requires automatically presented oxygen if certification above 30,000 feet is requested. Most of the parabolic maneuver will be conducted below 30,000 feet. Only temporary excursions above 30,000 feet to a peak altitude of no greater than 32,500 feet will occur during parabolic maneuvers.

Section 25.1447(c)(1) requires that oxygen be immediately available to each occupant, wherever seated. The petitioner's design in the passenger cabin consists of oxygen bottles with masks connected to the bottles. Each occupant must be able to don a mask and activate the oxygen flow while seated. Additionally, the means to activate oxygen flow must be simple (for example, turning a knob on an oxygen bottle).

As indicated above, § 25.1447(c)(1) requires automatic presentation of the oxygen dispensing units. For seated occupants in typical passenger airplanes, the automatic presentation of masks throughout the cabin indicates the need to don an oxygen mask. Occupants on the petitioner's airplane will not have this indication. To provide an acceptable level of safety, an automatically activated aural decompression signal must be immediately recognizable throughout the passenger cabin. Operation of this signal must be automatic with flightcrew manual action as a backup.

Persons in the passenger cabin must be trained on the location and use of the oxygen equipment and the signals for its use. Additionally, oxygen units must be sized adequately for continuous and uninterrupted use during worst-case flight duration following a decompression.

Section 25.1447(c)(1) requires that there be ten percent more oxygen masks than occupants in the main seating area. On typical airplanes, the extra masks hang from the ceiling and are visible and easily accessible to flight attendants moving along the aisle. The masks are proposed to be in boxes underneath seats in the main seating area and would not be easily accessible to a flight attendant moving along the aisle. Limiting the maximum operating altitude to 32,500 feet, establishing procedures for conducting a swift descent to an altitude where sufficient oxygen is provided, and the unique operation of this airplane support a grant of relief from this requirement.

Passengers will experience a changing force against their bodies during parabolic maneuvers, which could cause them to loose their balance when standing. In order to provide these passengers an adequate level of safety, appropriate procedures and limitations must be established to ensure that each passenger, who is not a flight director or coach, is in his/her seat or is in a sitting or kneeling position on the floor of the floating area during the non-floating phase of the parabolic maneuver. The flight director and coaches may stand during this phase of flight due to their higher level of training. These procedures may allow passengers to perform necessary functions (for example, move to their seats if they are feeling nauseous or perform necessary lavatory functions) during this phase of flight.

The petitioner has indicated that smoking will be prohibited during flight. The FAA concurs that this restriction is appropriate. Section 25.791(a) requires at least one placard stating that smoking is prohibited that is legible to each person <u>seated</u> in the cabin. This rule was developed based on an understanding that passengers would primarily be in their seats. However, the proposed design is unusual in that passengers will occupy an area without seats (the floating area) for a significant portion of the flight. In order to provide an acceptable level of safety on this airplane, a pre-flight briefing must inform passengers that smoking is prohibited when on the airplane.

Section 25.791(b) requires fasten seat belt signs to be legible to each person seated in the cabin. This rule was also developed based on an understanding that passengers would primarily be in their seats. The FAA considers that persons in the floating area must be provided a level of safety similar to that intended by § 25.791(b). Hence, a flightcrew operated aural annunciation that is recognized (considering ambient noise during flight) in the floating area must be installed to indicate during an adverse condition (such as moderate turbulence) that persons must return to their seats. Appropriate procedures and limitations must be established to ensure that the flightcrew signals persons in the floating area to

return to their seats at the onset of an adverse condition and prior to landing. The pre-flight briefing must explain this annunciation to persons that will be in the floating area.

The petitioner proposes to have onboard each flight one coach per each group of up to 14 persons who will participate in "floating," a flight director and a flight attendant. These persons must successfully complete FAA approved training programs, developed specially for this unique type of operation, to provide an adequate level of safety to occupants during parabolic maneuvers.

The FAA considered requiring a barrier to prevent persons from floating out of the floating area and then possibly landing on items (such as seats) that may cause injury. The petitioner proposed to have the flight director, coaches and flight attendant ensure that persons do not float out of the floating area. Procedures for the flight director, coaches, and flight attendant (as appropriate) must be established to ensure that persons do not float out of the floating area during reduced gravity conditions. The FAA approved training programs must include training in these procedures.

Where necessary, means must be provided to protect persons in the floating area from obtaining burn injuries from hot objects, such as hot lights. Additionally, projecting objects that could injure persons in the floating area must be padded.

The FAA contacted Zero Gravity Corporation on April 13, 2004, to obtain clarification of their proposal for a public address system and an interphone system. The petitioner proposes to install a public address system that is audible from anywhere within the passenger cabin of the airplane and can be activated from the flight deck and a microphone which would be readily accessible to the seated flight attendant at his/her station aft of the main passenger seating area. The public address system would be designed to meet § 25.1423. The FAA concurs with this proposal.

The petitioner proposes to install an interphone system that provides two-way communication among the flight attendant, flight director, and flightcrew. The system would consist of interphone jacks installed at regular intervals of approximately 20 feet throughout the length of the passenger cabin. The flight director and flight attendant would carry headsets that could be quickly plugged into a jack when needed. The petitioner proposes to require either the flight director or flight attendant to have their headset plugged into a jack at all times when persons are participating in reduced gravity activities in the floating area. This would provide instantaneous communication between the flightcrew and a trained person who would be monitoring the activities in the floating area. We agree that this proposal will provide an acceptable level of safety during floating activities for supporting the petition. Note that this finding does not address FAA operational requirements for interphone systems.

The petitioner has provided several arguments that demonstrate that this exemption would be in the public interest. As stated by the petitioner, this exemption will enable the creation of a viable commercial parabolic flight service in the United States. Additionally, the petitioner submitted a letter dated May 15, 2002, from the Chairman of the Aviation Subcommittee, U.S. House of Representatives Committee on Transportation and Infrastructure, which supports their petition and states the following:

> *It is in the public interest to stimulate both the scientific and educational work that can be accomplished through parabolic flight, and public interest in space flight, so that the U.S. can maintain its preeminent position in the aerospace industry. Moreover, commercial parabolic flight can supplement NASA's operations at a lower cost.*

The FAA considers that the granting of an exemption would provide an acceptable level of safety, but that this level of safety would not be equivalent to that provided by part 25 for airplanes that operate in a typical manner. The petitioner has proposed to require persons to sign a liability waiver that would notify them about the risks associated with activities in the floating area and that exemptions from certain Federal Aviation Regulation have been granted. The FAA considers that informing persons of these issues provides further justification for granting an exemption.

The Grant of Exemption

In consideration of the foregoing, we find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, Zero Gravity Corporation is hereby granted an exemption from §§ 25.785(j) and 25.1447(c)(1). The petition is granted to the extent required to permit type certification of Boeing Model 727-200 airplanes that contain an interior configuration that includes an area where persons could experience a reduced gravity environment (including no gravity). The following limitations apply and, except for limitations numbered 5 through 9, must be documented in the limitations section of the Airplane Flight Manual (AFM):

1. A flightcrew operated aural annunciation system that can be heard (considering ambient noise during flight) in the floating area must be installed to indicate during adverse conditions (such as moderate turbulence) that persons must return to their seats. Appropriate procedures and limitations must be established to ensure that the flightcrew signals persons in the floating area at the onset of an adverse condition and prior to landing to return to their seats. The pre-flight briefing must explain this annunciation to persons that will be in the floating area.

2. An automatically activated aural decompression signal immediately recognizable (considering ambient noise during flight) throughout accessible areas aft of the

flight deck must be provided to notify persons to return to their seats and don oxygen masks. Operation of this signal must be automatic with flightcrew manual action as a backup. This signal and the accompanying procedures for persons to return their seats, don masks, and activate oxygen flow must be included in the pre-flight briefing.

3. The maximum operating pressure altitude is 32,500 feet. Upon a cabin decompression event which does not occur during a parabolic flight maneuver, the pilots must make an emergency descent in accordance with Boeing Model 727 AFM procedures to 10,000 feet pressure altitude (terrain permitting) and land at the nearest suitable airport. Upon a cabin decompression event during a parabolic flight maneuver, the pilots must terminate the maneuver in a safe manner (minimizing the initial positive g-load on the occupants to enable those in the floating area to regain their footing) and then make an emergency descent in accordance with Boeing Model 727 AFM procedures to 10,000 feet pressure altitude (terrain permitting) and land at the nearest suitable airport.

4. Supplemental oxygen equipment with connected masks must be located so that each person in the passenger cabin can don a mask and activate the oxygen flow while seated at their seat. Additionally, six sets of supplemental oxygen equipment, each of which contains three connected masks, must be uniformly distributed throughout the floating area. The means of activating the flow must be simple. Crew and passengers must be trained in the use of the oxygen equipment.

5. The oxygen units in the passenger cabin must be sized adequately for continuous and uninterrupted use during worst-case flight duration following a decompression.

6. The floor of the floating area must be covered with at least 1.5 inches of energy absorbing protective padding (foam or equivalent), such as Ensolite.

7. Each projecting object that would injure persons in the floating area must be padded. Means must be provided to prevent persons from obtaining burn injuries in the floating area.

8. Handholds must be provided continuously along the length of both sides of the fuselage in the floating area to enable persons to steady themselves. The handholds must be located approximately 50 inches above the floor.

9. A public address system must be installed that is audible from anywhere within the passenger cabin and can be activated from the flight deck and a microphone which would be readily accessible to the seated flight attendant at his/her station aft of the main passenger seating area. The public address system must comply with § 25.1423 at Amendment 25-79.

10. An interphone system must be installed that provides two-way communication among the flight attendant, flight director, and flightcrew. The interphone system must be independent of the public address system except for handsets, headsets, microphones, selector switches, and signaling devices. Interphone jacks must be installed at regular intervals of approximately 20 feet throughout the length of the passenger cabin. Appropriate procedures and limitations must be established that require the following at all times when persons are participating in reduced gravity activities in the floating area:

    - The flight director and flight attendant must carry a headset that can be quickly plugged into an interphone jack.
    - Either the flight director or a flight attendant, who is monitoring activities in the floating area, must have his/her headset plugged into an interphone jack so that instantaneous communication with the flightcrew can be accomplished.

11. Appropriate procedures and limitations must be established to ensure that each passenger, who is not a flight director or coach, is in his/her seat or is in a sitting or kneeling position on the floating area floor during the non-floating phase of the parabolic maneuver. These procedures may allow passengers to perform necessary function (such as, move to their seats if they are feeling nauseous or perform necessary lavatory functions) during this phase of flight.

12. Smoking is prohibited on the airplane. The pre-flight briefing must inform passengers of this prohibition.

13. Each person who will occupy the passenger cabin must sign a form that discusses the risks associated with parabolic flight and activities in the floating area. These persons must be trained in flight physiology and the hazards associated with a decompression event before signing the form. This form must also explain that exemptions from certain FAA airplane design and operational requirements have been granted.

14. The operator must determine that each person who will occupy the passenger cabin is physically fit for reduced gravity operations.

15. There must be one coach per each group of up to 14 persons participating in activities in the floating area. In addition, one flight director and one flight attendant must be onboard each flight that will have persons experiencing a reduced gravity environment in the floating area. These persons must have successfully completed FAA approved training programs for this unique type of operation.

16. Procedures must be established for the flight director, coaches and flight attendant (as appropriate) to ensure that persons do not float out of the floating area during

reduced gravity conditions. The flight director, coaches, and flight attendant (as appropriate) must receive training in these procedures per FAA approved training programs.

Issued in Renton, Washington, on May 5, 2004.

/s/ Ali Bahrami
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service