31 Oct 2023 Rev-0

TB–265 TECHNICAL BULLETIN

High Altitude Wingsuit Flight above 22,000 feet MSL

Introduction

The skydiving discipline of wingsuit flight has increased dramatically over the last several decades. In recent years, wingsuit flyers have been ascending to altitudes greater than 22,000 ft MSL. These altitudes require the use of specialty oxygen equipment that provides supplemental and 100% aviators-grade oxygen via an oral facial mask.

Background

As wingsuit flyers attain higher exit altitudes, temperatures drop quite rapidly. The extreme cold environment (-20 to -70°F) poses many challenges for the skydiver. The expected consequences of extreme cold and how it affects hand/finger dexterity can be a serious issue. Sustained freefall and the resultant wind-chill factor (-70 to -160°F) should also be considered. Additionally, placement of the oxygen bottle(s) and the routing of the hose to the oxygen mask, all the while allowing the wingsuit to maintain a high level of aerodynamic form, pose additional challenges.

Objective

This document will provide important information that will assist wingsuit flyers as they plan and safely execute high-altitude wingsuit jumps. This "living document" will be revised as new information is added. The latest revision of this technical bulletin can be found at https://www.pia.com/resources/public-documents/TB-265.pdf

Most standard wingsuit procedures commonly used at lower altitudes are not covered here. The wingsuit flyer should carefully consider how the following guidance to safely negotiate higher altitudes shall be integrated into their normal procedures. When a procedural conflict exists, it is recommended that the jumper obtain guidance from experienced wingsuit flyers who have gone to higher altitudes previously.

The following information will cover equipment, procedures and environmental considerations.

Equipment Considerations

1. The jumper should carry an oxygen supply sufficient to survive a premature canopy deployment and a descent to a safe altitude (16,000' MSL). Whichever canopy in their parachute system has the slowest descent rate is the worst-case scenario.
2. Positioning of the jump bottle(s) and routing of the hose from the bottle(s) to the regulator:
    a. How and where the bottle(s) are located to maximize access.
    b. How the bottle(s) are mounted and held in place.
    c. How and where the bottle(s) and hose are located to minimize the potential for the jump bottle(s)/hose/mask to interfere with main deployment and/or emergency procedures.
    d. Mount the bottle(s) in such a way to avoid injury to the jumper during the exit, opening and landing.
    e. To minimize changing the airflow over the wingsuit, an internal placement of the jump bottle(s) is recommended.
    f. Bottle(s) have been placed in purpose-built pockets in the wingsuit and supported from the main lift web.

g. How and when the jump bottle(s) are activated before exit.

3. Where and how to route the hose from inside the suit to the outside.
    a. The zippered opening centerline in some suits is an easy access point but the zipper will need to be modified to ensure that the zipper cannot open in flight.
    b. Alternatively, a buttonhole can be placed in the suit to allow passage of the hoses.

4. When the temperature is below minus 40° C/F, there is a very good chance the exhaust valve in a pilot style mask will freeze shut, especially with a prolonged pre-breathe. The Mbu 5/p and Mbu 12/p are especially susceptible due to the exhaust valve placement. The Mbu 20/p masks are also affected.

5. The oxygen mask may restrict visibility due a decreased downward field-of-view. This may cause a diminished view of the 3-Ring System, emergency handles and chest area.

6. Consider the use of metal or loop handles instead of pillow-style cutaway and reserve handles to ensure that the jumper can properly carry out emergency procedures with very cold hands. Keep in mind, cold hands lose dexterity and strength rapidly.

7. Use of wrist or hand-mounted altimeters combined with an audible altimeter is advisable. The mask may restrict the view of a chest-mounted altimeter.

8. During wingsuit flights in low temperatures, the use of heated gloves is highly recommended for protection from extended exposure to extreme temperatures. If heated gloves are not used, then consider using heat packs on the back of the hands inside the gloves. You will be leaving the gloves off during prebreathe and will not need to activate the heat packs until near the end of prebreathe. Leave the gloves off until they are needed during the climb to altitude. Caution: Heat packs have failed at high altitudes so electrically heated systems are preferred.

9. Ensure the jumper is able to wear adequate clothing to maintain warmth under their wingsuit for the temperature range they will experience. Wearing bulky clothing under a tight-fitting wingsuit will reduce the normal range of motion and may partially restrict the ability to breathe fully. If there is an issue with clothing thickness, consider using heated clothing to minimize thickness.

10. Consider wearing a base layer of clothing that wicks moisture away from the body. A base layer that is flame resistant / fire retardant will benefit the jumper in the event of an aircraft fire.

Procedural Considerations

1. Choose a wingsuit exit position that avoids the possibility of an aircraft tail-strike.
    a. Ensure maximum separation from the aircraft's tail section during the exit.
    b. A sitting position is recommended for side-door exits, while a standing position should be avoided. Practice unfamiliar exit positions at lower altitudes before going higher.

c. Use a seated exit with wings collapsed, roll out the door into the relative wind and then symmetrically extend the wings once clear of the aircraft. Avoid gear contact with the door edge to reduce the chance of premature canopy deployment.
d. Achieve stability as quickly as possible. Unstable exits should be avoided.
e. Higher airspeeds and thinner air contribute to the jumper's inability to quickly recover controlled flight. Wingsuit exits and stability are very different at high altitudes.

2. Inability to use the Valsalva or other mechanical methods to close the nose to equitize your ears during wingsuit flight.
    a. Practice different methods of equalizing the ears before the high altitude flight and do not jump if your ears are blocked or you are congested.
    b. There is a potential to rupture an eardrum if you cannot equalize.

3. Do not activate the heating system on the clothing until it is needed during the climb. Leave access to the switch on the clothing when considering how to use the heated clothing.

4. Due to the potential for sweating because of the time spent on the ground and during the early portion of the flight…
    a. The wingsuit may be left partially open with wings unzipped until the temperature drops.
    b. The suit is only closed up enough to keep the jumper warm while still allowing access to the oxygen bottle(s) and switches for heated clothing.
    c. The suit can be closed up and then partially opened to access the inside as needed.
    d. The jumper may need assistance in closing up the wingsuit, activating the bottle(s) and disconnecting from the onboard O2 supply to ensure that nothing gets missed.
    e. These procedures should be practiced in the aircraft being used, with the O2 systems being used, several times before the high altitude flight is attempted.
    f. A written checklist can be useful as a reference.

5. Due to the extremely low temperatures to which the wingsuit jumper will be exposed, the valve of the mask may freeze shut; this is due to the collection of water vapor with each exhaled breath. However, oxygen is readily available from the inhalation valve, the feeling of suffocation may occur because all exhaled air is trapped within the mask.

a. If possible, it may be necessary to abort the flight, descend to a lower altitude while trying to exhale. When safe to do so, deploy the main parachute if the valve does not thaw.

b. The jumper may attempt to distort the shape of the mask in order to break the exhaust valve free. Proceed with caution to ensure minimal inhalation of ambient air while above 18,000 ft MSL to sustain protection from hypoxia.

TB–265 TECHNICAL BULLETIN

c. On a freefall jump (w/o wingsuit), the jumper would normally reach-in symmetrically with both hands to stay balanced and prevent turning, while breaking the seal with their finger(s) to exhale. Because of the arm position required for typical wingsuit flight, this is not always possible. However, rolling over into a “back-flying position” and then reaching in symmetrically to manipulate the mask has proven successful, when practiced.

Environmental Considerations

1. Wind chill in freefall is a serious factor that is often ignored.
2. Frostbite sets in quickly… Exposed skin can freeze in 30 seconds.
3. The following chart displays various wind speed/temperature comparisons.

Wind Speed (MPH)	Temperature (Degrees Fahrenheit)																				
	50	45	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	48	42	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63	-69
10	46	40	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72	-78
15	45	38	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77	-83
20	44	37	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81	-88
25	43	36	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84	-91
30	42	35	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87	-94
35	41	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89	-96
40	41	34	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91	-98
45	40	33	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93	-100
50	40	33	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95	-102
55	40	32	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97	-104
60	39	32	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98	-105
65	39	32	24	17	10	2	-5	-12	-19	-27	-34	-41	-49	-56	-63	-70	-78	-85	-92	-99	-107
70	38	31	24	16	9	2	-6	-13	-20	-27	-35	-42	-49	-57	-64	-71	-79	-86	-93	-101	-108
75	38	31	23	16	9	1	-6	-13	-21	-28	-36	-43	-50	-58	-65	-72	-80	-87	-95	-102	-109
80	38	30	23	16	8	1	-7	-14	-21	-29	-36	-44	-51	-59	-66	-73	-81	-88	-96	-103	-111
85	38	30	23	15	8	0	-7	-15	-22	-30	-37	-44	-52	-59	-67	-74	-82	-89	-97	-104	-112
90	37	30	22	15	7	0	-8	-15	-23	-30	-38	-45	-53	-60	-68	-75	-83	-90	-98	-105	-113
95	37	29	22	14	7	-1	-8	-16	-23	-31	-38	-46	-53	-61	-68	-76	-84	-91	-99	-106	-114
100	37	29	22	14	6	-1	-9	-16	-24	-31	-39	-47	-54	-62	-69	-77	-84	-92	-100	-107	-115
105	37	29	21	14	6	-1	-9	-17	-24	-32	-40	-47	-55	-62	-70	-78	-85	-93	-100	-108	-116
110	36	29	21	13	6	-2	-10	-17	-25	-32	-40	-48	-55	-63	-71	-78	-86	-94	-101	-109	-117
115	36	28	21	13	5	-2	-10	-18	-25	-33	-41	-48	-56	-64	-71	-79	-87	-94	-102	-110	-117
120	36	28	20	13	5	-3	-10	-18	-26	-33	-41	-49	-57	-64	-72	-80	-87	-95	-103	-111	-118
125	36	28	20	12	5	-3	-11	-18	-26	-34	-42	-49	-57	-65	-73	-80	-88	-96	-104	-111	-119
130	35	28	20	12	4	-3	-11	-19	-27	-34	-42	-50	-58	-65	-73	-81	-89	-97	-104	-112	-120
135	35	28	20	12	4	-4	-11	-19	-27	-35	-43	-50	-58	-66	-74	-82	-89	-97	-105	-113	-121
140	35	27	19	12	4	-4	-12	-20	-27	-35	-43	-51	-59	-67	-74	-82	-90	-98	-106	-113	-121
145	35	27	19	11	4	-4	-12	-20	-28	-36	-44	-51	-59	-67	-75	-83	-91	-98	-106	-114	-122
150	35	27	19	11	3	-5	-12	-20	-28	-36	-44	-52	-60	-68	-75	-83	-91	-99	-107	-115	-123

~ Chart - Courtesy of Google Search ~

31 Oct 2023 Rev-0

TB–265 TECHNICAL BULLETIN

Summary

High-Altitude skydiving operations (HASO) are risky, especially when combined with the discipline of wingsuit flight. All parties involved must understand and acknowledge that there is a significant risk of injury or death, even when all precautions are taken. The PIA intends for this technical bulletin to provide best practices in order to reduce the risk associated with wingsuit HASO.

Due to the variables concerning the types of oxygen equipment, parachute systems and aircraft used, as well as the planned exit altitude, this document cannot be comprehensive; as such, multiple questions should come to mind. Write these questions down and contact your HASO service provider to ensure they can answer each question to your satisfaction. This process will likely determine whether the service provider is appropriately prepared for this activity.

The current version of this safety advisory was developed with input from multiple wingsuit experts with experience in high-altitude operations. This living document shall be updated as the industry and sport adopts new technologies and procedures. This is not a comprehensive guide, but rather a source of knowledge for those who wish to take part in this activity.

~~~~~~~~

Reference Materials and Documents

1. TB-263 – PIA-High Altitude Best Practices – 2-25-23 Rev-0
   https://www.pia.com/resources/public-documents/technical bulletins
2. NZ-PIA High Altitude Course
   https://www.pia.com/resources/public-documents/external documents
3. Oxygen Equipment Use in General Aviation Operations. Federal Aviation Administration Report OK-09-439.
   https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/oxygen_equipment.pdf
4. 14 CFR Part 135.89 Pilot requirements: Use of Oxygen
5. FAA AC105-2E Sport parachuting
6. FAA AC-120-43 The influence of beards on oxygen mask efficiency
7. FAA AM-400-95/2 Altitude Induced Decompression Sickness
8. FAA AM400-91/1 Hypoxia
9. FAR Part 91.2.11
10. USAF Manual 11-409 High Altitude Airdrop Mission Support Capability Program (2020)
11. 14 CRF Part 105 Parachute Operations
12. USPA SIM 6-7: High Altitude and Oxygen Use
13. FAA Airman Information Manual, Medical Facts for Pilots, 8-1-2 Hypoxia,
    https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap8_section_1.html#:~:text=For%20optimum%20protection%2C%20pilots%20are,above%205%2C000%20feet%20at%20night
14. FAA Pilot Safety Brochure Hypoxia,
    https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hypoxia.pdf

~~~ End of Document ~~~