

2027 RULEBOOK

World Space Elevator Competition 2027

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WSPEC
WORLD SPACE ELEVATOR COMPETITIONS

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WSPEC 2027 North America Regional Competition v.1.0

Rulebook

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Revision History

Revision 1.0 (10.29.2026) - *Ohno S.*: Initial Document and requirements

1. Introduction

This document is the official rulebook of the 2027 WSPEC 100m scale competitions. It will briefly explain what a Space Elevator is, the history of the organizers and the mission of WSPEC for context, before elaborating on the rules of the competition itself and the requirements for participation.

Space Elevator History

The idea of a space elevator traces back to when Konstantin Tsiolkovsky, scientist and aerospace engineer famous for things like the rocket equation, in 1895 suggested building a tower that reached from the surface of the Earth all the way into geostationary orbit, almost 36000 km away. Almost a century later, in 1960, Russian engineer Yuri Artsutanov suggested constructing a "Cosmic Railway", a tensile structure and physical bridge extending into space.

How does it work?

The main concept is to have a structure, mostly a tether of sorts, in tension between earth and an orbit past the geostationary orbit (35,786 km), with the center of force of the system in a geostationary orbit, causing the elevator to orbit the earth at the same rate as the earth rotate around itself.

On this rope, the climber would then transport payloads, goods, materials, and astronauts up into orbit using electrical energy instead of using chemical energy like rockets. This could allow the space elevator to become a very attractive alternative to using rockets to reach space.

The World Space Elevator Competitions (WSPEC)

WSPEC is an international non-profit organization with a mission to drive innovators toward solving pressing technological issues. By hosting strategic competitions, WSPEC aims to advance critical technologies, foster innovation, and inspire the next generation of scientists and engineers. The organization unites previous international efforts to create a coordinated, global approach to development. As an educational resource and a force for scientific advancement, WSPEC's vision is to inspire students in STEAM fields, encourage teamwork, and promote the pursuit of long-term goals. The organization relies on sponsors and partners to help advance its mission of driving early progress on monumental challenges.

The focus of this competition is mainly set on the efficiency of the climbers and their payload capacity. Our goals for this competition are to inspire young and aspiring engineers with the idea of a space elevator, share experience with other teams around the world developing space elevator systems, and to create an opportunity to apply theoretical knowledge in practice to solve a problem. To this end, the WSPEC will be held on a yearly basis.

WSPEC will be expanded on in the coming years, creating new competition classes, more engineering challenges, and bringing the potential for a space elevator closer to reality.

2. Participation

2.1. Application and Eligibility

There is no requirement for the size of a team or the age and education levels of its members, aside from the requirement of at least one member in each team to be 18 years of age or older.

We reserve the right to accept applications submitted past the deadline in certain cases and to reject an application in case the number of applications exceeds the capacity of the event or for any other valid reason.

2.2. Registration Fee

All teams wishing to participate in the competition will be required to pay a registration fee. This fee is mandatory and must be submitted upon confirming participation. The registration fee will be used for operational expenses and pooled for award distribution to top-performing teams.

Additionally, a per-person admission fee will be required to be paid upon arrival at the competition, which will include insurance, food and drinks.

2.3. Application Process

The application form is open on the WSPEC Website. The application will be split into two phases. In the first phase, a general concept of the climber is to be submitted to the competition organizers for the purposes of gauging the climbers and teams that will be competing. In the second phase, 2 months before the competition date, a more detailed report document shall be submitted, explaining the climber in detail. As well as a “proof of life” video of the climber successfully driving on a test tether shall be submitted. It is at this stage that teams get approved for the final competition and the fees are due.

2.4. Safety and Procedures Handbook

Applicants will be provided with a handbook containing rules and procedures that must be followed during the competition. The handbook will be released during phase two of the application and will describe the processes and safety guidelines to be followed during the competition. Adherence to this handbook is not optional, and teams not following these rules will be disqualified upon substantial or repeated offenses.

3. Basic Policy

To ensure the safety and fairness of the competition, each team and the constructed climber must meet the requirements specified in these rules.

The rules are intended to advance technologies expected to be necessary for future actual space elevator climbers, on the premise of ensuring safety.

3.1. Premise

- Many of the rules were created based on experience gained in technical competitions previously held in each region.
- The rules assume climbers that perform ascending/descending drive primarily using frictional force against the tether.
- Climbers compete on performance by ascending and descending on a 100m vertical tether suspended by a tethered balloon (the tethered balloon system may incline due to wind).
- Climber performance is evaluated primarily based on the climber's payload ratio and vertical ascent speed.
- The unit system shall be the SI unit system (mm, m, kg, N, MPa, kPa, °C, kW, etc.).

3.2. Required Items and Recommended Items

The functions and operations of the climber described in the rules include required items for competition participation and non-mandatory recommended items that contribute to smooth competition progress, trouble avoidance, and space elevator technology development.

3.3. Operation

WSPEC retains sole and exclusive authority over all rules without external interference. However, since innovation is considered the most important element, even if a design does not strictly conform to the rules, designs that fulfill its purpose while understanding its intent are welcomed. In such cases, please contact WSPEC. For questions or points of ambiguity, please contact WSPEC organizers directly.

3.4. Public Order and Morals

Participants shall not make statements or displays that cause discomfort to other participants, spectators, or officials, or that impair social decency (e.g., discriminatory or insulting remarks, obscene expressions, harassment of others, etc.). Acts deemed by WSPEC to be contrary to common social decency may be subject to warnings, removal from the venue, or disqualification.

3.5. Revisions

If there are changes to the rules, participating teams will be notified and provided with a revised version.

3.6. Disputes

If disputes or issues arise among participating teams regarding equipment/material loans, technical cooperation, or other mutual relationships, the parties concerned shall first consult in good faith to resolve them.

If resolution between the parties is difficult, or if the organizers determine that it interferes with the progress of the competition, WSPEC will make the final ruling (conclusion).

Participating teams shall abide unconditionally by the ruling made by WSPEC without filing any objections.

4. Classification

Target climbers for this competition shall be Class 2 / Category 1.

Climber Classes:

Class	Weight	Size *1	Operation Method
1	5.0kg or less	Within 500mm	Remote and/or Autonomous control
2	8.0kg or less	Within 1,000mm	Remote and/or Autonomous control
3	10.0kg or less	Within 1,000mm	Autonomous control *2
4	20.0kg or less	Within 1,500mm	Autonomous control *2

*1 Size that fits inside a regular cube having sides of this length.
*2 Partial remote control can be added to autonomous control (e.g., remote control for stopping position during descent).

Categories:

Category	Energy	Overview
1	Internal Energy	Category in which a climber carries an internal energy source such as a battery for ascent/descent. However, to simulate future operation in space, mechanisms that generate power or combustion by taking in outside air (oxygen, etc.) from the exterior (internal combustion engines, etc.) are prohibited.
2	External Energy	Category in which the climber carries no energy source for ascent/descent, but receives energy externally via wireless power transfer (laser, microwave, etc.) to travel.

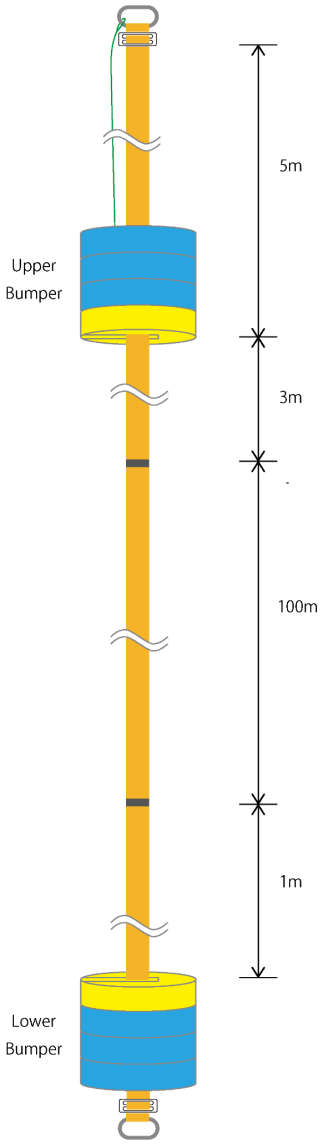
5. Vertical Tether

5.1. Weight Limit

Due to the buoyancy of the balloon, the surplus buoyancy remaining after subtracting the weight of the tether and all other equipment attached to the balloon is 15kg (a larger surplus buoyancy is desirable to prevent competition interruption caused by excessive tilt of the whole system due to wind).

To increase the verticality of the entire balloon-tether system inclined by wind, the upper limit of the climber's weight, including payload, shall be 8.0kg (7.5kg, which is half of the surplus buoyancy, plus a 0.5kg MPU).

5.2. Tethered Balloon System



- Balloon
  ・The balloon has an inner layer made of TPU material and an outer layer made of PVC material, with a volume of 63m³ and a buoyancy of 24.5kg after subtracting its own weight (main body + hardware).
  ・In addition to the belt tether, a 120m Technora anchor rope (Φ6mm, 16g/m) weighing 2kg is attached between the ground and the balloon as a secondary mooring line.

- Belt Tether
  ・The belt tether is made of Technora (para-aramid fiber) manufactured by Teijin (Japan), with a width of 35mm, thickness of 2mm, and weight of 43g/m (4.7kg for 110m).
  ・Due to stretching, the width of the belt tether varies by about ±5mm.

- Bumpers
  ・At the top and bottom ends of the tether, bumpers weighing 1kg made of Styrofoam or sponge are attached to restrict the climber from ascending or descending further.
  ・Climbers can ascend and descend only between the lower and upper bumpers.
  ・Bumpers act like wheel stops indicating positions beyond which ascent or descent is impossible, aiming to prevent damage from contact between climber and hardware on the tether such as buckles or carabiners. In principle, climbers are expected not to contact the bumpers.
  ・If considering stopping the climber's ascent by a switch installed at the top of the climber detecting contact with the bumper, prior consultation with the executive committee is required.



- Tether Top End
  ・The bumper at the top end of the tether is suspended by a cord about 5m below the position where the balloon and tether are connected by hardware; even if the climber contacts the top bumper during ascent, it can be pushed up to 5m on the tether.

- Tether Bottom End
  ・The bumper at the bottom end of the tether is attached in direct contact with the fixture connecting the tether to other equipment, so it cannot be pushed down.

6. Evaluation

6.1. Score Calculation

The performance evaluation of the climber is ranked according to the score calculation results using the following formula:

Pr: Payload ratio Pw: Payload weight Cw: Climber weight

Ap: Adjustment point Avas: Average vertical ascend speed

$$Pr\ [\%] = \frac{Pw\ [kg]}{Pw\ [kg] + Cw\ [kg]} \times\ Ap\ [\%]$$

$$Score\ =\ Avas\ [m/s]\ \times\ Pr\ [\%]$$

・Adjustment point is a qualitative evaluation item added/subtracted in % units relative to 100%.
・Weight and speed shall be rounded to one decimal place (rounding off from two decimal places).
・Payload ratio and score shall follow the number of significant digits.

Example) Pw: Payload weight 1.2[kg] Cw: Climber weight 5.0[kg]
Ap: Adjustment point 95[%] Avas: Average vertical ascend speed 1.5[m/s]

$$Pr\ = \frac{1.2\ [kg]}{1.2\ [kg]+5.0\ [kg]} \times\ 0.95\ =\ 0.18$$

$$Score\ =\ 1.5[m/s]\ \times\ 0.18\ =\ 0.27$$

・In the event that multiple teams achieve the same Score, ranking will be determined as follows:
・The team with a higher Adjustment point takes priority.
If still tied:
・The team with a higher count of positive addition items in the adjustment items takes priority.

- Payload Weight (Pw: Payload weight)
  ・The payload must be weighed in a detached state from the climber before the window starts, and then secured to the climber.
  ・The MPU provided by the executive committee immediately before the window starts has the same shape as the payload and is also regarded as part of the payload weight.
  ・If no payload other than the MPU is loaded, the payload transported by the climber can be the MPU (weight 0.5kg).

- Climber Weight (Cw: Climber weight)
  ・The climber must be weighed with the payload removed before the window starts.
  ・Attaching the payload can be done either before or after installing the climber onto the tether.
  ・Equipment and tools related to the climber's ascent/descent operation (e.g., push-up devices fixed to the belt tether) are included in the climber weight.
  ・Equipment and tools not related to ascent/descent operation (installation tools, etc.) are not included in the climber weight.

- Average Vertical Ascent Speed (Avas: Average vertical ascend speed)
  ・The average vertical ascent speed is calculated by the following formula from the time recorded in the built-in memory of the MPU and the ascent/descent altitude difference measured by the barometric altimeter:

Avas: Average vertical ascend speed Fa: Finish altitude
Sa: Start altitude Ft: Finish time St: Start time

$$Avas\ [m/s] = \frac{Fa[m] - Sa[m]}{Ft\ [time] - St\ [time]}$$

・Average vertical ascent speed is the vertical distance measured and recorded by the barometric altimeter, not the distance (length) of tether traveled by the climber.
・Time/seconds and altitude shall be rounded to one decimal place (rounding off from two decimal places).
・Average vertical ascent speed shall follow the number of significant digits.

Example) Fa: Finish altitude 97.5[m] Sa: Start altitude 1.5[m]

St: Start time 12:32’45.2’’[hh:mm’ss.0’’] Ft: Finish time 12:33’49.6’’[hh:mm’ss.0’’]

$$Avas = \frac{97.5[m] - 1.5[m]}{33'49.6''[\mathrm{m}'ss.0''] - 32'45.2''\ [\mathrm{m}'ss.0'']} = \frac{96.0[m]}{64.4[s]} = 1.5[m/s]$$

- Adjustment Point
  ・Qualitative items adjusting quantitative evaluations by multiplying the score, adding/subtracting in % units starting from 100%.
  ・Adjustment points are set based on desirability in climber ascent/descent operation and safety management:
  ・Items and additions/subtractions may be subject to change due to future adjustments.

Qualitative Evaluation Item	Addition/Subtraction	Rationale
Emergency brake is negative type	+5%	Higher safety
Emergency brake acts directly on tether	+5%	Higher safety
Equipped with multiple status lights	+2%	Easier situation assessment during trouble
Main power supply equipped with circuit breaker	+2%	Easier recovery from trouble
Contact with top bumper during ascent	-5%	Must stop prior to bumper for safety
Contact with bottom bumper during descent	-10%	Must stop prior to bumper for safety
Loss of safety/protection measures	-10%	Safety/protection measures must be maintained until the end of window
Fall of minor parts of 10g or less	-25%	Loss of competition safety
Failure to reach ascent altitude (100m) during ascent	-20%	Ensuring fairness of evaluation conditions
Failure to reach origin altitude (0m) during descent	-20%	Ensuring fairness of evaluation conditions

- Climber Scoring Simulator
  ・A simulator to check the tradeoff between climber payload and ascent/descent speed will be provided; please make use of it.



6.2. Measurement Payload Unit (MPU)

・Size: Cube of 100mm x 100mm x 100mm, outer dimension tolerance ±2mm.
・Weight: 0.50kg.
・Outer material: ABS material produced by 3D printer (planned).
・Measured data: 3-axis acceleration, 3-axis angular acceleration, 3-axis geomagnetism, GPS (UTC, latitude, longitude, altitude, number of locked satellites), temperature, barometric pressure.

・Fix the MPU to the climber using a mechanical fixing method (fixing with double-sided tape or adhesive tape is prohibited).
・Direct screwing into the MPU or penetration by rods is not permitted.
・When fixing the MPU, ensure no metallic shielding exists above the top 80x80mm plane perpendicular to the tether for GPS positioning (shielding by resin that does not block radio waves is fine).
・Since the MPU basically uses GPS signals to acquire time information, ascent/descent cannot be performed when signals from satellites cannot be received.

- Handling of MPU
  ・Participating teams receive the MPU from WSPEC before the competition window starts and return it to WSPEC after the window ends.
  ・WSPEC retrieves data stored in the memory inside the returned MPU to obtain time and altitude information for the ascent/descent.

7. Climber

7.1. Dimensions / Weight

・Climbers shall be sized to fit within a cube of 1,000mm on each side.
・Climber weight, including payload, shall be up to 8.0kg (about half of the balloon's surplus buoyancy; minimum payload weight is the 0.5kg MPU).

7.2. Deformation / Separation

・Shape changes or structural division due to functions during ascent/descent are permitted, but the size before start and after deformation at completion must fit within the above dimensions.

7.3. Prohibition of Tether Damage

・Mechanisms that wear or degrade the tether (e.g., during friction generation) must not be used; elastic materials like rubber or resin are assumed.
    ・In the past, metallic rollers with sharp protrusions on the surface spun freely and broke the tether.
・Parts contacting the tether, such as tether guides, must not have mechanisms that damage the tether; smooth materials or roller shapes must be used.
    ・In the past, tether guides made of sharp spring steel touched the tether and split it vertically over several meters

7.4. Side Loading

・Climbers must be installable onto an already tensioned tether.
・Climbers must be installable from midway along the tether without threading the tether through.

7.5. Payload

・Payload refers to a 100mm cube object whose removal does not affect the properties or performance of the climber.
・As long as safety standards and total weight limits are met, there are no restrictions on quantity, individual weight, or mounting position of payloads.
・Combustibles, corrosive substances, living organisms, etc., cannot be loaded inside the payload.
・Items whose weight can change by 0.01% or more during the window cannot be loaded inside the payload.
・The payload must be weighed detached from the climber before the window starts and loaded onto the climber before ascent/descent begins.
・Except during emergencies, payload attachment/detachment and other operations are assumed to be performed by team members.

・The MPU provided by the executive committee immediately before the window starts has the same shape as the payload and is part of the payload weight (minimum payload weight).
・It is fine not to load any payload other than the MPU.
・Payloads cannot be used as structural members.
・The payload must have at least two surfaces where the measured weight can be written with an oil-based marker.
・Payload quantity can be changed for each ascent/descent (e.g., reducing count for re-ascent if ascent failed), but MUST be recorded and confirmed by WSPEC before ascent/descent.
・Payloads require sufficient strength to withstand multiple ascents/descents and related work without structural deformation or damage.
・Payloads other than the MPU shall be prepared by each team.

7.6. Prohibition of Bumper Contact

・Climbers basically cannot contact either top or bottom bumpers during ascent/descent, and must be able to stop prior to them via proximity detection or climber-measured tether length control, remote control, etc.
・It is acceptable for the climber to contact the lower bumper during installation prior to starting ascent/descent.
・Fixtures assisting climber installation on the tether (e.g., hardware temporarily attached to the lower side of the climber to fix its position on the tether during installation, removed after installation) may be used.
・The climber must stop once after ascending and hold its position for at least 5 seconds and no more than 1 minute.

7.7. Wireless Equipment

・To avoid mutual interference with frequencies used by other teams, prior adjustment of frequencies to be used must be conducted with WSPEC.
・Using uncoordinated wireless control equipment causes accidents and MUST be strictly avoided.

7.8. Energy Source

・Category 1 (Internal Power) assumes energy sources like batteries, capacitors, fuel cells, high-pressure tanks, etc., but mechanisms generating energy by taking in outside air (oxygen, etc.) (combustion engines, air-intake fuel cells, etc.) cannot be used.
・Energy regeneration during descent is permitted.
・If intending to use energy sources or mechanisms not assumed above, such as reaction propulsion, consultation with WSPEC is required.

- Emergency Brake
  ・Equipping climbers with an emergency brake mechanism to prevent

falling on the tether is recommended.
・The emergency brake mechanism is recommended to be a negative brake system (a system that operates immediately when power supply ceases, including depletion of carried energy source).
・The emergency brake mechanism is recommended to be an independent mechanism capable of reliably exerting braking force directly on the tether even if driving friction force decreases/is lost due to wear of rollers, etc.

- Control Energy Source
  ・Equipping climbers with a separate energy source for the control system apart from the ascent/descent operation is recommended.
  ・This avoids situations where a climber becomes uncontrollable on the tether due to depletion of high-consumption ascent/descent batteries.

7.9. Descent

・During descent, climbers may actively reverse driving mechanisms or passively use weight to descend.
・Past experience shows passive descent tends to take longer; please confirm actual climber descent speed in advance.
・Descent speed tends to be slower when the overall tether system is inclined by wind, etc.
・Assuming time required for ascent and descent within the competition window leads to calculating how many trials can be made.

7.10. Operation Status Indication

・Climbers are recommended to feature high-brightness LED indicator lamps clarifying ascent/stop/descent or power state, or buzzers indicating operational milestones to allow external identification.

7.11. Emergency Stop

- Emergency Stop Button
  ・Climbers must be equipped with an easily operable emergency stop button that completely stops the drive unit when pressed.
  ・The emergency stop button cannot serve dual purpose with top or bottom limit switches.
  ・Installing a conspicuous push-button switch in an easily accessible location on the climber is recommended.
  ・If operating personnel would have to go around to the opposite side of the tether due to climber structure, multiple emergency stop buttons should be installed allowing operation from left and right sides.

- Top Limit Switch
  ・A contact switch must be attached to the top of the climber that immediately stops ascent upon contact with the bumper, and starts descent after a stop time of 5 seconds to 1 minute.

- Bottom Limit Switch
  ・A contact switch must be attached to the bottom of the climber that immediately stops descent upon contact with the bumper.

- Signal Loss Stop
  ・When controlling the climber via ground radio, the climber must stop on the spot if there is no control input.

7.12. Environmental Resistance

- Tether Vibration
  ・Belt tethers vibrate laterally and torsionally due to wind and other factors, which can be very strong; climbers must withstand such vibrations.

- Climate
  ・As competitions are held outdoors, climbers must withstand the following severe environmental conditions:
    ・Temperature: 5 to 45°C
    ・Humidity: 10 to 90%
    ・Solar radiation: 1,000 W/m^2
- ・In particular, shielding metal parts, energy sources, and electronic circuits from solar radiation may be necessary to protect against malfunctions or excessive temperature rises.

7.13. Climber Safety

- Climber Fall Prevention
  ・Even if ascent/descent energy sources are lost, climbers must be prevented from falling, including sliding fall on tether or detachment from tether.

- Part Fall Prevention
  ・Screws, bolts, and other fasteners must be attached to the climber so they do not loosen and drop off.
  ・Parts shall basically be mechanically joined to prevent loosening and falling off.
  ・When using tapes, consider the effects of vibration and humidity.

- Sharp Edges
  ・Climbers shall have no sharp edges. R-rounding, C-chamfering, or

protective members must be provided on sharp edges or protrusions that may be touched (guideline: not painful when pressed against palm).

- Electric Shock
  ・Climber surfaces shall have no energized parts in locations reachable by hand from the exterior.

- Entanglement
  ・All moving parts of the climber/payload system (rotators, etc.) must have covers so fingers or wiring are not entangled in the mechanism.

- Burns
  ・Surface temperature of parts with accidental contact possibility shall not exceed 50°C; covers must be provided for parts expected to reach higher temperatures.

- Overcurrent Prevention
  ・To prevent battery or motor driver ignition, a function to stop drive upon detecting overcurrent (current detection, fuse, etc.) must be equipped (bring spare fuses).

7.14. Naming

Teams shall name the team itself and the competing climber for identification, registering them upon entry.

Once registered, names cannot be changed except when WSPEC recognizes justification due to competition preparation.

7.15. Exceptions

If the executive committee determines safety is ensured by means different from the rules, climber ascent/descent including elements outside rule scope may be permitted. Check points of ambiguity with WSPEC in advance.

7.16. Compliance with Regulations

When using radio equipment, compliance with regulations on frequencies and power levels established by the country/region is required.

When transporting energy sources by aircraft, pay special attention to compliance with aviation-related regulations.

8. Inspection

Only climbers passing inspection can perform ascent/descent.

If non-compliant items are found during inspection, the team must perform rectifications per WSPEC instructions, pass re-inspection, and obtain "Passed Inspection" status.

Items frequently pointed out during inspection are published as "Climber Inspection Point Casebook"; please refer to it during fabrication.

Inspection items may be revised at any time before/during the competition to ensure safety and fairness based on basic policies.

Teams should pre-verify compliance with inspection items internally before inspection to answer questions from inspectors.

- Inspection Timing
  ・Climbers must undergo inspection by assigned inspectors along inspection items after competition start and before assigned window start (timing coordinated between WSPEC and team).
  ・If changes affecting inspection items are made to equipment configuration after passing inspection, declaration to organizers and re-inspection are required.

- Inspection Items

No.	Inspection Item	Inspection Content	Participant	Inspector
1	Class/Category Compliance	・Complies with specified class and category		
2	Emergency Stop Switch Operation	・Drive unit stops / Switch position and identification appropriate		
3	Top Detection Function Operation	・Stops ascent upon bumper contact and transitions to descent		
4	Bottom Detection Function Operation	・Stops descent upon bumper contact		
5	MPU Mounting State	・Securely mounted in appropriate direction / Receives GPS		
6	Payload Mounting State	・Can be securely mounted, fixed, and removed		
7	Climber Fall Prevention	・Does not fall upon loss of drive energy source		

8	Part Fall Prevention	・Securely mechanically joined		
9	Protrusion Protection State	・Protective measures taken for protrusions and burrs		
10	Entanglement Prevention	・Measures taken to prevent entanglement in driving parts		
11	Heated Part Protection	・Protective measures taken for parts that may heat above 50°C		
12	Battery Mounting State	・Securely fixed / No collision danger with exterior (ground, etc.) / Shielded from heat-generating equipment		
13	Battery Condition	・Scratches, swelling, wiring, and connector condition good		
14	Wiring Condition	・Connector connection/insulation reliable and not easily disconnected / Wire sheath and harness condition good / No entanglement in drive/moving parts / Appropriate wires for expected current		
15	Other Safety Assurance	・Items where necessary functions for safe ascent/descent are deemed unassured		

・If even one non-compliant item exists, it must be resolved and re-inspection passed to proceed to the competition window.
・Inspection items may be added, deleted, or modified at any time primarily for safety assurance.

■ Inspection Personnel
・Inspection is conducted by personnel appointed by WSPEC.
・Photos or video recordings may be taken during inspection to record inspection items and climber status.
・Inspectors cannot be designated by teams.
・If there is objection to inspection content, window start cannot proceed.

9. Competition

9.1. Field

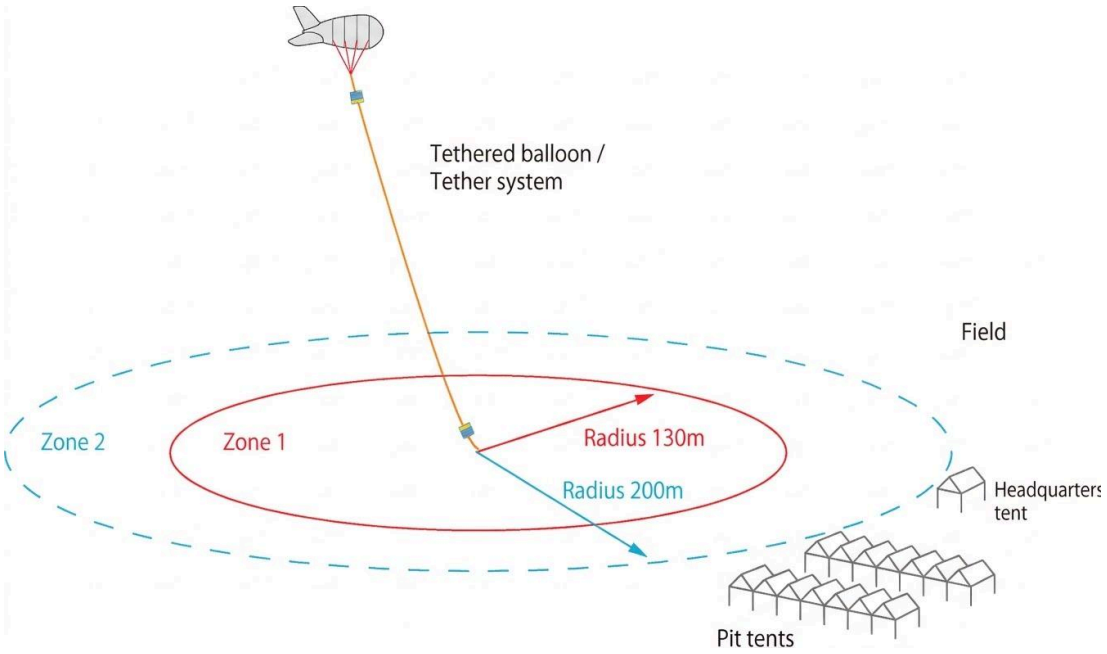
・The field for competition contains the following areas/equipment:
・Zone 1 is identified by ropes placed on the ground, etc.

- Zone 1
  ・Tethered balloon system operates, and climber ascending/descending takes place on the vertical tether at its center.
  ・Personnel access is restricted; entry requires approval by the safety manager.
  ・Teams must obtain Zone 1 entry permission via headquarters at window start.
  ・Zone 1 assumes fallen objects of 500g+ from above or overturning of tethered balloon system itself.
  ・PPE required for Zone 1 entry: long sleeves, long pants, protective gloves, safety shoes, safety glasses, helmet.

- Zone 2
  ・Entry into this range requires wearing a helmet as PPE.

- Headquarters
  ・WSPEC personnel are stationed to handle basic WSPEC responses.
  ・Window dispatch, climber/payload weight measurement conducted here.
  ・Various meetings held in front of headquarters tent.

- Work Pit
  ・Tents, desks, chairs, etc., placed for pit work assigned to participating teams.



- Work Environment
  ・No equipment or tools (including batteries) other than the MPU are provided by event organizers.
  ・Commercial power (120V, max 10A, 1 outlet per team) is provided in work pits for battery charging.
  ・If larger power capacity is required, bring a generator.
  ・Power strips with appropriate capacity must be prepared by teams.
  ・Low-speed, unstable temporary WiFi internet connection is provided around work pits; shared within field, WSPEC assumes no security responsibility.
  ・WSPEC assumes no responsibility for theft or loss of equipment/materials.

- Radio Interference
  ・When checking functions using radio waves outside team competition window, perform it at sufficient distance outside field if radio interference to other teams is anticipated.

9.2. WSPEC Personnel

・Operations Manager: Manages climber installation, start/interruption/finish of ascent/descent at tether base.

・Safety Manager: Monitors tether system and field, manages safe progress of entire competition.

・Operations Dispatcher: Coordinates window assignments.

・Measurement Personnel: Handles weight measurement of climber/payload, MPU, and measurement data.

・Tether Manager: Operates entire tether system.

・Recorder: Records image/video as competition progresses.

・Overall Coordinator: Oversees progress of entire competition.

9.3. Window

・Window is time frame for actual climber ascent/descent; teams may attempt multiple ascents/descents within 1 window time frame.
・In past experience, teams typically conduct short test ascents first, then actual ascents, and re-ascents with varied parameters if time remains in window.

- Window Dispatch
  ・Windows are not scheduled in advance using timetables; assigned as needed by WSPEC Operations Dispatcher (similar to air traffic control for passenger planes).
  ・Operations Dispatcher adjusts assignments for efficient, fair allocation.
  ・Teams inform Operations Dispatcher when ready for ascent/descent to receive window allocation (start time).
  ・Then, during preceding window, perform climber/payload weight measurement and receive MPU.
  ・If planned window ascent becomes impossible, immediately request window cancellation or postponement to Operations Dispatcher.
  ・Windows can be acquired multiple times during event period, but if competing with other teams, allocation priority is set by:
    ・Teams with fewer windows since competition start
    ・Teams with fewer last-minute window cancellations since competition start
    ・Judgment of Operations Dispatcher and Overall Coordinator (remaining time, weather, situation changes)

  ・Multiple windows cannot be requested simultaneously.
  ・Time reservations are generally not set, but communication of status updates outside window requests is recommended for efficient allocation.

- Time
  ・Standard window duration is 30 minutes.
  ・WSPEC may change individual competition window durations due to various factors.
  ・Competition window duration is measured by competition manager.
  ・Overtime caused by team activities may be deducted from team's next competition window by dispatcher.
  ・Competition manager may gradually suspend time measurement at

their discretion.

- Competition Cycle
  ・Multiple ascents/descents are allowed within set window duration.
  ・After window starts, install climber onto tether and load payload (order of installation and payload loading is flexible).
  ・Ascent Request: When ready, team leader conveys ascent conditions (target speed, height, etc.) to competition manager and requests safety check.
  ・Safety Check: Competition manager checks climber status, conveys conditions to safety manager, and requests ascent permission.
  ・Ascent Announcement: Upon receiving safety manager permission, competition manager broadcasts team name, climber name, ascent conditions over field.
  ・Ascent Start Approval: Competition manager grants ascent permission to team leader.
  ・Countdown: Team members count down broadcast over field, then perform ascent.
  ・Anytime Interruption: Ascent manager and safety manager may order ascent/work suspension at any time for safety.
  ・Ascent Completion Declaration: After ascent, team leader declares to ascent manager whether to attempt another ascent or end window.

9.4. Emergency Response

- Warnings
  ・Warnings for falling objects, etc., within field.

- Stuck Climber
  ・If climber becomes stuck on tether, WSPEC lowers entire tether system by required height to remove stuck climber from tether.
  ・After lowering tether system and ensuring safe removal conditions, team removes climber per WSPEC instructions.
  ・If climber gets stuck, window ends at that point.
  ・Stuck team must identify cause, address it, and report/obtain approval from inspector before receiving next window allocation.
  ・Resolving stuck state handled by Operations Manager, Safety Manager, Tether Manager.

- Fire Extinction
  ・If fire, smoke, or burning odor occurs on climber, operators evacuate, and fire extinguisher put out per Operations/Safety Manager instructions.
  ・WSPEC assumes no obligation for recovery or compensation for

climber damage/soiling from firefighting.

- Energy Source Isolation
  ・On climber, energy sources must be shielded from ignition sources (motor drivers, etc.) with non-combustible materials.
  ・Mount in position that does not contact ground if climber falls on tether.
  ・When using batteries as energy sources, observe the following (similar handling for other energy sources):
    ・Always stay present during charging; do not leave unattended.
    ・Check battery condition (voltage/swelling/damage) before use.
    ・Store in non-combustible case when storing.
    ・Take home from venue at night.
    ・If dropped or exposed to high temperatures, evacuate surrounding flammables and contact Safety or Operations Manager.

9.5. Suspension / Cancellation Requirements

・Wind speed (average): 10-min average at 5m ground level exceeds upper limit (5 m/s)
・Wind speed (instantaneous): Instantaneous value at 5m ground level exceeds upper limit (7.5 m/s)
・Angle of attack: System angle of attack 45° or less
・Weather conditions: Rain/snow, lightning, poor visibility
・Accident, injury, major trouble occurrence
・Suspension/cancellation instructions from administrative agencies including aviation authorities
・Other suspension/cancellation per WSPEC judgment

10. Safety

10.1. Safety Management Structure

・Field safety management is handled by Safety Manager, who holds authority over suspension/continuation of all activities in field for safety.
・All personnel entering field must follow Safety Manager instructions.
・Activities of all personnel (WSPEC, teams, spectators, media) in field require direct/indirect Safety Manager approval.

10.2. Tether Contact

・To prevent injury, touching belt tether with bare hands without WSPEC authorization is prohibited.
・Tether may move suddenly with large force; follow WSPEC instructions when approaching tether or installing climber.
・Filming personnel for work records must also follow WSPEC instructions.

10.3. Stuck Management

10.4. Zoning

- Zones
- Entry and Exit

10.5. Personal Protective Equipment (PPE)

・Participants entering field are required to wear protective gear.
・Long sleeves, long pants, protective gloves, safety shoes, safety glasses, helmet are mandatory.
・Protective gloves may be temporarily removed during installation if approved on spot by WSPEC to prevent entanglement.
・Attire should be work clothes; avoid clothing that easily gets entangled (mufflers, hoodie strings) or exposes bare skin (ankle socks).

10.6. Health Management

・Working under inadequate physical condition (e.g., lack of sleep) is extremely dangerous; get adequate sleep and ensure good health before participating.
・Entry into field by teams containing members under influence of alcohol or

drugs is prohibited.

10.7. First Aid / Medical

・First aid kit, stretcher, AED available at headquarters tent.
・In case of illness or injury in field, contact headquarters first.

10.8. Safety Education

・All personnel entering field must receive safety education (approx. 15 min) at headquarters upon first entry and check off personnel list at headquarters.
・Basic safety education takes about 15 minutes.

10.9. Briefing

・On competition days, general morning briefing held for all field personnel in front of headquarters tent; mandatory attendance.
・In addition, team leader meetings called via broadcast as needed to explain tether system or window progress status (proxies allowed; tracked via list check).