Note to Reviewers:

This document contains proposed changes to the ANSI/ACCT 03-2019 Standards. Additions are underlined and shown in RED TEXT, deletions are shown with a ~~strikethrough~~. Black text is existing text in the same location in the document. BLUE TEXT is existing Standard language in a different location in the document. Additional notes and explanatory material are *italicized and GREEN TEXT*. Only the standards listed below are open for review and comment at this time. Explanatory material is supporting material to the standards, not for review and comment.

ACCT 03-202X DRAFT Standard

CHAPTER 1

DESIGN, PERFORMANCE, AND INSPECTION STANDARDS

A. GENERAL REQUIREMENTS

A.1 Scope: The ANSI/ACCT 03-2019 Standards: Design, Performance, and Inspection Standards (hereinafter referred to as "DPI Standard") establish requirements for the design, performance, and inspection of elements and associated equipment for Challenge Courses, Aerial Adventure/Trekking Parks, Canopy Tours, and Zip Line Tours (hereinafter referred to as "courses").

A.2 Purpose: The purpose of this DPI Standard is to:

- Represent a consensus of vendors, field practitioners, and any person with a direct and material interest
- Define minimum acceptable practices
- Establish sound structural design criteria while allowing for design creativity
- Establish assessment and interpretation criteria for professional inspection
- Standardize interpretation through explanatory material providing rationale or additional information
- Provide an acceptable industry standard for adoption by jurisdictional regulatory bodies

Explanatory Note to A.2. *A structurally sound element or course does not necessarily mean that the design is appropriate for every person, program or site. A structure may meet all strength requirements of the DPI Standard and still be inappropriate for use, as few standards relate to specific element or course configuration. For example, the height of a zip line above the starting platform or of a low element foot cable above the ground is not prescribed. Element configurations vary based on the particular element, population, terrain, local training practices, etc. and are difficult to quantify in a global standard. Design is the "art" of the field requiring considerable experience, understanding of program or client need, and sound judgment. This DPI Standard is not intended to be an instruction manual on how to design or install a course. It leads a knowledgeable designer, engineer, manufacturer, or installer in the direction of appropriate materials and practices. Proper element design, equipment use, training, and element sequencing are major considerations in overall course safety. The consideration of these factors in conjunction with this DPI Standard is*

essential when designing a course.

A.3 General Principles

A.3.1. Mandate: It is mandated throughout this DPI Standard that a course, its components, and equipment be designed by a qualified person and be manufactured and inspected by a competent person.

A.3.2. Critical Components and Systems: A qualified person shall determine when components and systems are to be considered critical. Special design and engineering consideration shall be given to individual critical components and systems where the consequence of failure is likely to lead to serious injury and/or death.

A.3.2.1. System Integrity: Critical ~~Life safety~~ systems shall be installed according to the designer or manufacturer instructions and integrity shall be assured in one or more of the following ways:

- **Proof Testing:** A non-destructive static test load ~~equivalent to two times the expected load~~ shall be applied simulating operational conditions of the system. The system is deemed to comply if no permanent deformation ~~or displacement in anchorage or components~~ results from the application of this load. Proof-testing requirements including and not limited to the test load are specified in the section to which they apply.
- **Specification Verification:** The system or component~~s~~ meets or exceeds an appropriate, applicable and verifiable life safety standard or ~~that make up~~ the system or component is ~~are~~ manufactured using a named and accepted, applicable and verifiable quality assurance process that includes testing by an independent laboratory. Specifications which meet the ACCT Standard are identified in the section to which they apply.
- **Redundancy:** A backup (redundant component or system) is implemented that has the same safety factor as that of the primary system.
- **Test Documentation:** Empirical information, verifiable data, and evidence is collected, including and not limited to, mathematical calculations, photos, video, and test recordings. Test documentation including methods and data shall be sufficient to allow for replication of the results. The designer shall specify the test methods and acceptable results in advance.

A.4. Application

A.4.1. New course installations completed after the publication date of this DPI Standard shall comply with the requirements of this edition of the DPI Standard.

A.4.1.1. The manufacturer shall provide the owner a document upon commissioning certifying that the course meets all the requirements of this DPI Standard and that it is ready for participant use.

A.4.1.2. Upon completion of a new element or course, the manufacturer shall provide a clear written description of the following to the owner regarding its operation:

- Normal operation and limitations
- Operational instructions and participant safety briefing procedures
- Recommended rescue procedures

- Maintenance, inspection and equipment replacement criteria
- Identification of critical components and systems
- For zip lines, brake system operational limits and reasonably anticipated hazards

Explanatory Note to A.4.1.2. *This documentation requirement is not a substitute for proper training in the use of the element or course, or proper monitoring of its operation, nor does it diminish the responsibility of the owner and operator in obtaining proper training or in the ongoing proper use of the element or course.*
The manufacturer is not responsible for the actions of the owner and operator after the element or course is commissioned.

A.4.1.3. An acceptance inspection shall be completed on a new element or course or major modification to a pre-existing element or course prior to commissioning. Criteria are established in Section B. "Inspection Requirements".

A.4.1.4. Commissioning of a new element or course or major modification to a pre-existing element or course shall be performed by a competent person and shall include owner and/or operator orientation, turnover, and sign-off.

Explanatory Note to A.4.1.4. *The commissioning process may include: provision of an operations manual; staff orientation, training, and certification; equipment supply and delivery; and manufacturer's instructions for periodic monitoring. Provided documentation should also contain wire rope mill certificate(s), critical component information, proof test results, etc. Client orientation is not to be construed as a substitute for proper training in the use of the element or course.*

A.4.2. Pre-existing element and course modifications completed after the publication date of this DPI Standard shall comply with the requirements of this edition of the DPI Standard.

A.4.2.1. On pre-existing elements and courses, "grandfathering" of materials and techniques is allowable only when such materials and techniques comply with the strength and performance requirements of the current edition of the DPI Standard. Non-compliant systems that have a history of reliability shall be given a grace period of twenty-four (24) months from the publication date of this DPI Standard to comply.

Explanatory Note to A.4.2.1. *Pre-existing materials and systems that have a history of reliability and meet the strength and performance requirements but do not have the accompanying documentation required of new installations are allowable by this DPI Standard. Common materials that have a history of reliability but where original documentation may not be available are: wire rope, wire rope clips and ferrules, or other critical fasteners.*

A.4.3. New innovations and alternative materials used in elements and completed after the publication date of this DPI Standard shall comply with the strength and performance requirements of this edition of the DPI Standard.

A.4.3.1. When a designer or manufacturer proposes to deviate from this DPI Standard and use alternative materials or designs, those materials or designs shall be clearly identified. Design and test information shall be provided to the owner. Properly designed structures that cannot be fully evaluated using this DPI Standard and have been reviewed and stamped by a licensed professional engineer may be

deemed structurally acceptable.

Explanatory Note to A.4.3.1. *Adoption of technological improvements in materials and systems are essential to progress. As such, strict application of provisions of this DPI Standard may not be appropriate in every instance.*

A.4.4. The DPI Standard may be superseded by regulations for design and operation of courses applied by the authority having jurisdiction.

B INSPECTION REQUIREMENTS

B.1. Types and Frequency of Inspection

B.1.1. Acceptance Inspection: An acceptance inspection shall be completed prior to commissioning a new element or course or a major modification of a pre-existing element. This inspection shall be performed by the installer or a qualified third party. An acceptance inspection may include testing of system(s) prior to commissioning and the creation of a deficiency list. The test shall be defined in advance and the expected results shall be quantified prior to the test.

Explanatory Note to B.1.1. *The acceptance inspection is a tool intended to verify that nothing has been neglected in the element or course installation and that it is operating as intended before being turned over to the owner. Complete independence (e.g., third-party status) is not a requirement for this procedure unless specified by contract or statute.*

B.1.2. Professional Inspection: A professional inspection by a qualified person (hereinafter named "*inspector*") is required at an interval specified by the designer, manufacturer, or other qualified person. At a minimum this inspection shall be done annually.

B.1.2.1. The designer, manufacturer, or other qualified person shall determine inspection frequency by considering the design of the systems, the number of participant cycles, and extent of environmental impact.

B.1.3. Periodic Internal Monitoring: The organization shall implement and document an on-going system of monitoring all components at an interval specified by the designer, manufacturer, or other qualified person.

Explanatory Note to B.1.3. *The inspector may be an employee of the owner but should have additional inspection training beyond that provided to employees who perform pre-use checks. Specifically, performing pre-use checks is part of regular operational duties and is NOT sufficient training for conducting periodic monitoring. Additionally, the in-house inspector typically has responsibility for operational decisions (see sections B.2.8. and B.2.11-B.2.16 of the Operation Standard).*

B.2. Professional Inspection Process

B.2.1. A professional inspection shall include a visual and physical inspection of low elements, high elements, associated life safety system equipment, and the condition of the environment around each element.

B.2.2. The designer, manufacturer, and/or inspector shall determine methods of evaluation. When an evaluation method requires that the inspector access a component, a safe means of access shall be available. A component shall not pass inspection until it has met evaluation requirements.

Explanatory Note to B.2.2. *Climbing is a standard practice because it is typically the best way for the inspector to be in close proximity with the element being inspected and to handle the materials or components. Access may sometimes be limited, precluding hands-on aerial inspection and*

requiring the use of alternative assessment methods such as the use of binoculars, drones or other technologies. There are times when an alternative method does not provide enough information for the inspector to properly judge the condition of an item. If the alternatives are inadequate and the item is a life safety system and/or critical component, then a plan should be developed to determine their pass/fail status on the inspection report.

B.2.3. The strength of elements and structures shall be evaluated by applying accepted engineering practice for appropriate resistance to live loads and dead loads for the material under consideration (e.g. wood, steel, concrete).

B.2.4 The inspector shall review provided relevant design and test documentation as part of the inspection process.

B.2.4.1 In the absence of other supporting information, the inspector may deem proof testing or engineering analysis necessary to properly assess the strength and suitability of the design.

Explanatory Note to B.2.4.1. *Load measurement and non-destructive testing are examples of verification techniques.*

B.2.5. Inspectors shall consult other qualified persons when issues or questions arise that fall outside the inspector's scope of expertise.

B.2.6. Inspectors shall communicate to the owner any physical conditions that indicate improper use of elements and equipment.

Explanatory Note to B.2.6. *Even though a standard professional inspection excludes assessment of course operations, improper use of elements or associated equipment may be apparent to the inspector.*

B.2.7. The inspector shall immediately notify the owner when element(s) or equipment fail inspection or if there is a finding that significantly impacts the safety of the system. The inspector shall inform the owner that items which have failed inspection are to be immediately removed from service.

B.3. Documentation for Professional Inspections

B.3.1. Professional inspections shall be documented in a written report and furnished to the owner within a reasonable time subsequent to the inspection.

B.3.1.1. Required Information: The following information shall be included in the written report:

- Inspection date(s)
- Inspection company and inspector name(s)
- Course installation history if available, including the original installation dates, manufacturer or entity name, and details of subsequent modifications and additions
- Previous inspection information if available, including the inspection entity name and date of the inspection
- A list of elements inspected
- A list of elements not inspected (if known) and explanation for omission

- Condition of each element at the time of inspection including a grade authorizing or prohibiting its use in that condition
- Concerns warranting continued observation which may be of a critical nature
- A list of life safety ~~system~~ equipment inspected
- A list of life safety ~~system~~ equipment not inspected and explanation for any omissions when apparent
- The condition of each piece of life safety ~~system~~ equipment at the time of the inspection including a grade authorizing or prohibiting its use in that condition

Explanatory Note to B.3.1.1. *Optional Information: The following information should be included in the written report:*

- *Minor modifications or repairs that are to be completed in a timely fashion and are not serious enough to prevent the operation of the element (for example, reattachment of a serving sleeve)*
- *Projected repair schedule (e.g. time frame for cable adjustment or replacement)*
- *Suggestions to improve the design or operation of an element considering the population served and industry advancements*
- *Concerns warranting continued observation which are not of a critical nature (ground surface condition, worn stairs, compromised health and integrity of trees, etc.)*
- *Photographs and drawings (if available)*

C SITE CONSIDERATIONS

C.1. Element Location

C.1.1 Element(s) shall be located with consideration given to their intended use and be clear of known hazards in the immediate area of the element when operated as designed and intended. Access for emergency response and rescue shall be considered as a factor in the location of the elements.

> ***Explanatory Note to C.1.1.*** *When locating outdoor elements, the following may need to be considered: terrain and topography, weather patterns, presence of existing structures and utilities, erosion potential, accessibility, overhead and underground utilities, environmental hazards, brush, limbs, roots, stumps, poisonous plants, etc.*
>
> *Project size, scope and character should trigger consideration for environmental impact and associated regulatory requirements. Considerations may include short- and long-term impact to surrounding environments, wildlife habitat, adjacent neighborhoods, etc.*
>
> *Other site selection considerations include adequate space for safe operation of the element, participants and group members, access to and from elements, spotting and belaying, landing areas, pendulum or swing zones around elements when used as designed and intended.*

C.1.2. Building and zoning codes and regulations for the authority having jurisdiction shall be followed.

C.1.3. **Access Limitation:** The need to limit access to elements by unauthorized personnel shall be evaluated for each element, course, or site by a qualified person. Where there is a likelihood of injury due to access by an unauthorized user, site and situation appropriate steps should be taken to identify, warn, and physically limit access to the element or course.

> ***Explanatory Note to C.1.3.*** *Many elements, particularly those involving climbing or activity at height, would be considered inherently dangerous if used by untrained and unsupervised persons. The designer, manufacturer, owner, and operator have the responsibility to take steps to limit access by unauthorized persons in a manner that is appropriate for the site. Access limitation may include, and not be limited to, fencing, removable components, and disabling of element function. The likelihood of unauthorized access due to environmental, social, or physical site characteristics should be considered in determining the type of access limitation required. When appropriate, access limitation should also be evaluated and implemented during the installation process.*

D ELEMENT SUPPORT STRUCTURES

D.1. General Requirements

D.1.1. A qualified person shall design element support structures with consideration given to all live and dead loads so the entire system, including all constituent components, operate within the working load limit required by accepted engineering practice for the material used.

D.2. Trees

D.2.1. Strength: Trees shall be selected based upon the expected load from element(s) and associated structures, including environmentally induced loads, multiplied by an appropriate safety factor determined by a qualified person. A qualified person shall determine the suitability of trees required to support the expected load and the need for supplementary support from guy systems.

Explanatory Note to D.2.1. *Assessment of trees may involve gathering information regarding species, size, health, terrain, erosion potential and root structure. The location(s), direction, and magnitude of loading on the tree are critical considerations in proper tree assessment. Environmental loads such as those from wind and snow are part of tree assessment.*

D.2.2. Environmental Considerations: Element installation and maintenance in live trees shall be performed in a manner that minimizes damage to support trees and the surrounding environment.

Explanatory Note to D.2.2. *Design and installation techniques that are appropriate on poles and columns may be destructive to living trees.*

D.2.3. Inspection and Evaluation: A tree inspection and evaluation shall be conducted by a qualified person.

Explanatory Note to D.2.3. *This assessment includes, and is not limited to, health and structural impact due to defects such as dead wood, cracks, weak branch unions, decay, cankers, exposed roots, root problems, diseases, excessive lean, lightning damage, poor tree architecture, and adjacent trees. Soil analysis and the impact of soil erosion and compaction may be included in this assessment.*

D.2.3.1. The inspector may deem verification necessary to properly assess the strength and integrity of a system.

Explanatory Note to D.2.3.1. *Load measurement and non-destructive testing are examples of verification techniques.*

D.3. Poles and Columns

D.3.1. Strength: A qualified person shall specify poles or columns based on the expected load and safety factor required by accepted engineering practice for the material used.

Explanatory Note to D.3.1. *Load capacities are available in recognized design*

codes for materials used.

D.3.2. Material Requirements: When specifying poles or columns that support elements, the designer shall consider environmental factors, location, anticipated life span, compatibility of materials, etc.

Explanatory Note to D.3.2. *Environmental factors include prevailing weather conditions (heat/cold extremes, wet/ dry cycles, etc.), proximity to salt spray or other corrosive atmospheric conditions, ground contact, etc.*

D.3.3. Wood Poles: Wood poles used as critical element support structures shall comply with prevailing editions of the American National Standard for Wood Products — Specifications and Dimensions (ANSI 05.1) or Structural Glue Laminated Timbers for Utility Structures (ANSI 05.2) or equivalent in the jurisdiction of use.

D.3.3.1. Fastener Placement: Fasteners for lifelines, guy cables, anchorages, or other critical components that penetrate wood poles shall be installed at least twelve (12) inches (305 mm) from the top of an unprotected pole, including a laminated pole, unless there is supplementary protection from the deterioration that normally occurs in this part of a pole.

Explanatory Note to D.3.3.1. *Examples of fasteners in this application are through-bolts and lag screws. Alternatives, such as an engineered steel pole cap, may be fastened closer to the top of a wood pole because the top is protected from deterioration.*

D.3.3.2. Inspection and Evaluation: On wood poles, the inspector shall visually inspect for vertical checks and through-splits, horizontal cracks, decay pockets, shakes, shell rot, and other defects that may affect pole strength and integrity. Additional consideration shall be made for potential ground line decay, pole top degradation or shrinkage that may result in loosening of hardware. Sub-grade inspection shall be done on older poles or poles in high stress environments using techniques and at intervals determined by a qualified person.

D.4. Guy Systems

D.4.1. Strength: Guy system(s) ~~cables~~ ~~(excluding ground anchors or footings)~~ shall have the same safety factor as the lifeline(s) or element components and systems that they support and be based on the expected load in those systems. ~~the~~ ~~guy cable.~~

D.4.2. Design Considerations: Guy systems shall be designed by a qualified person. The designer shall consider the relative support provided by the structure, individual guys, and the interaction between them.

Explanatory Note to D.4.2. *This standard does not mandate the use of a guy system. Self-supporting or freestanding structures may also be acceptable.*

D.4.2.1. Elements in trees: The designer shall specify the need for guys based on the size and type of tree, the nature of the soil, and the structural requirements of the element.

Explanatory Note to D.4.2.1. *For example, if a zip line support tree flexes excessively, the zip line cable tension may be compromised, rendering the zip*

line operationally unacceptable.

~~**D.4.3 Material Requirements:** When designing guy systems, the designer shall consider the following: environmental conditions, location, anticipated life span, and compatibility of materials.~~

D.4.3. Determination: A qualified person shall determine if guy components and systems are to be considered critical. The rationale used to delineate critical from non-critical guys and guy systems shall be part of commissioning documents supplied to the owner.

Explanatory Note to D.4.3.

- *In general, guys opposing a horizontal lifeline on a conventional high element of relatively short span are not considered critical. The consequence of guy failure is not likely to break the pole and even with the increased sag the climbers or riders will not be at risk of death or serious injury.*
- *Certain elements with long spans, high tensions, or where riders come near the ground without the ability to stop, such as zip lines and high swing elements, are sensitive to lifeline tension and their guys are most likely to be considered critical.*
- *Foot cables of low elements may require guys to resist the horizontal component of the load generated by individuals standing on them. These guys are necessary from an operational standpoint (standing on a cable that is touching the ground is not remotely challenging) but are generally not considered critical since the height of the fall in the event of guy anchor failure is not likely to cause death or serious injury.*

~~**D.4.4. Ground Anchors:** The head of the ground anchor or connecting link shall extend above the ground. The anchor shall be installed per manufacturer's specifications and recommendations. Variations from the installation specifications for any reason shall be considered by a qualified person when specifying the anchor. Accepted engineering practice shall be followed in the verification of the anchor's holding capacity.~~

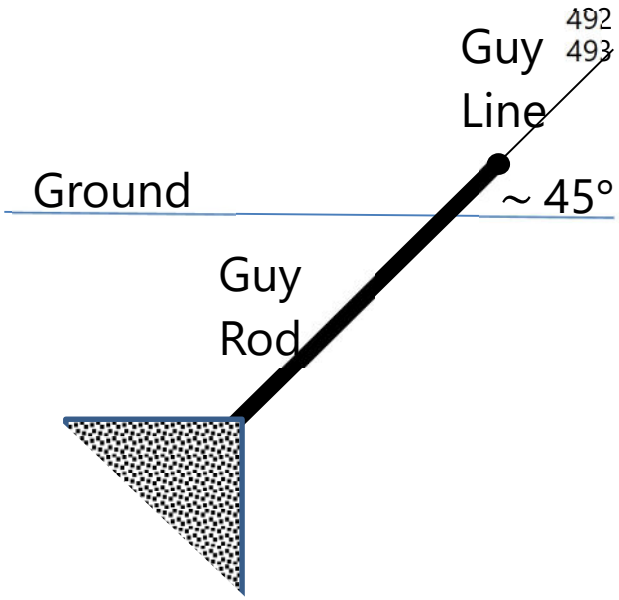
~~***Explanatory Note to D.4.4.*** *Anchor heads installed above the ground minimize corrosion and facilitate inspection of cable terminations. Ideally, anchor rods are aligned with the load so as not to adversely affect the operation of the element or compromise anchor integrity due to concentrated bending, particularly for critical guy anchors. It is understood that it may not be possible to achieve exact or even approximate alignment due to installation machinery limitations.~~

D.4.4. Performance: Critical guy systems shall meet all applicable requirements of DPI Standard Section A.3.2.1. A critical guy system consists of one or more of the following: upper anchorage, anchorage connectors, tension adjustment devices, the guy rope or member, lower termination and ground anchor.

Explanatory Note to D.4.4. *Redundancy in anchors is not an option to bypass critical guy anchor requirements. Anchor testing is required for installed anchors and documentation verifying holding capacity is required for built anchors.*

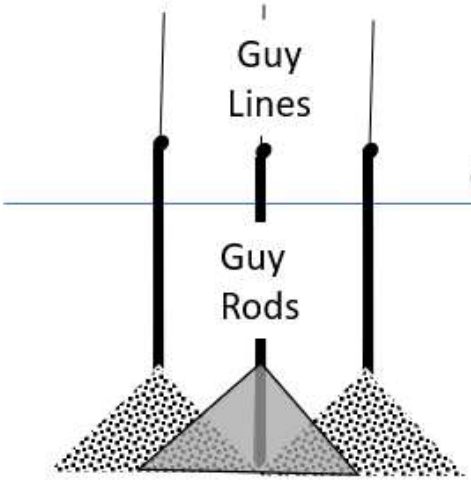
D.4.5. Material Requirements: When designing guy systems, the designer shall consider the following: environmental conditions, location, anticipated life span, compatibility of

materials, and potential for soil cone overlap.



A soil cone is the triangle-shaped area of disturbance created when an anchor is installed.

Figure 1. Geometry of anchor cone – side view



Soil cone overlap may occur when anchors are placed close to one another. When cones overlap, the holding ability of individual anchors may be reduced.

Figure 2. Interaction of cones for overall stability analysis – top view

D.5. ~~Critical Guy Systems~~ Ground Anchors

~~**D.5.1 Determination:** A qualified person shall determine if guy components and systems are to be considered critical.~~

D.5.1. General Considerations: Most challenge course designs employ vertical or

downward inclined ground anchors to resist horizontal loading in pole structures and trees and shall be designed for the combined effects of shear and tension from the horizontal, overturning, and uplift loads.

D.5.1.1. Failure mechanisms: Critical ground anchors shall be designed to resist the following events including and not limited to change in soil conditions, corrosion of the buried component, creep due to constant tension, failure in shear along the grout/rock-soil interface, inadvertent disconnection of the guy system, and tampering.

Explanatory Note 5.1.1. *Frost, rise in ground water table, extreme weather event (drought, 100-year rain), and flooding are examples of events than may cause changes in soil conditions.*

D.5.1.2. Verification of holding capacity: Installed critical anchors shall be proof tested and built critical anchors shall have their holding capacity verified and documented. Trees used as critical ground anchors shall be evaluated according to D.2.3. Non-critical anchors do not require proof testing.

D.5.1.3. Proof tests shall be performed and documented by a competent person. Test documentation shall be part of commissioning documents supplied to the owner.

~~**D.5.2. Performance:** Critical guy systems shall meet all applicable requirements of the critical life safety systems standard (DPI Standard Section AE).~~

D.5.2. Types: Guy anchors for permanent element support structures shall be classified as installed or built. For temporary or portable installations, the anchoring system may consist of a permanent ballast device or a staking system designed by a qualified person.

Explanatory note to D.5.2. *Installed anchors include and are not limited to grouted soil or rock anchors, screw anchors (and similar inserted devices such as helical piles), rock bolts, or trees. Built anchors include and are not limited to connections to existing structures or buildings and those that generally involve excavation, reinforcing steel, concrete and embedded connections or bolted knife plate connections. A concrete block, stone-filled basket, or other ballast device is also considered a built system. A common term for a built system anchor is a "deadman".*

~~**D.5.3. Testing Requirements for Critical Ground Anchors:** With the exception of engineered footings or structures (e.g., formed concrete), a qualified person shall proof test newly installed critical guy ground anchors to a minimum of two times the expected load following accepted engineering practice for testing.~~

D.5.3. Soils Exploration: A qualified person shall gather adequate geotechnical information to determine the design of the anchor system based on the soil or rock conditions. Anchor design shall be based on the maximum load under the worst-case condition (i.e. frozen or saturated ground), protection against corrosion, and a suitable safety factor.

~~**D.5.3.1.** Proof tests shall be applied in the direction of the expected load and follow manufacturer's recommended procedures. A soils investigation is required when the anchor's capacity relies on soil conditions.~~

~~**D.5.3.2.** Proof tests shall be performed and documented by a competent person.~~

~~Test documentation shall be part of commissioning documents supplied to the owner.~~

~~**D.5.4. Inspection and Evaluation:** Guy system and ground anchor inspection shall include evaluation of design, operational load in the guy(s), anchorages and connectors, ground anchor placement, all constituent components, and an assessment of any material defect, stress deformity, corrosion, pitting, erosion, ground movement, ground uplift, etc.~~

D.5.4. Design: The designer shall specify the tolerance to which anchors shall be built or installed including and not limited to the position, angle from horizontal, and angle from vertical. The head of the ground anchor or connecting link shall extend above the ground. The design shall also include means or method of monitoring settlement or pull out.

Explanatory Note to D.5.4. *Anchor heads installed above the ground minimize corrosion of the guy cable or rope and facilitate inspection of cable terminations.*

~~**D.5.4.1. Verification:** In the absence of supporting information, the inspector may require proof testing of existing ground anchors to properly assess their strength and suitability. Proof tests on existing ground anchors shall be done according to DPI Standard D.5.3. The inspector may, at his or her discretion, alternatively recommend the installation of a redundant system that shall be installed according to DPI Standard D.4. and tested according to DPI Standard D.5.3.~~

D.5.5. Installed Ground Anchors

D.5.5.1. Strength: Installed anchors shall be designed with a minimum safety factor of 3.0 applied to the expected load.

Explanatory Note D.5.5.1. *This standard applies to both installed critical anchors or installed non-critical anchors.*

D.5.5.2. Installation Specifications: The design of an installed anchor may follow generally recognized geotechnical engineering practice or the recommendations of the anchor manufacturer. Variations from the installation specifications for any reason shall be considered by a qualified person when specifying the anchor.

D.5.5.3. Alignment: An installed anchor shall be aligned with the guy(s) to which it is attached. For anchors that are attached to multiple guys, the anchor shall be installed in line with the resultant force vector of the guys. Maximum allowable alignment variation shall be specified by the designer.

Explanatory note to D.5.5.3. *Ideally, anchor rods are aligned with the load so as not to adversely affect the operation of the element or compromise anchor integrity due to concentrated bending, particularly for critical guy anchors. It is understood that it may not be possible to achieve exact or even approximate alignment due to installation machinery limitations. See D.5.4.*

D.5.5.4. Testing Requirements for Critical Installed Ground Anchors: Newly installed critical guy ground anchors shall be tested to a proof load ~~to~~ a minimum of two times the expected load in accordance with the following conditions:

- The proof load shall be applied colinear with the resultant force vector of the guy system
- The proof load shall be applied in increments of 25%, 50%, 75%, and 100%
- Sufficient hold time shall be specified by the designer for a period at least equal to the time a rescue operation would require but not less than 10 minutes
- The test procedure or test equipment arrangement shall not influence the capacity of the anchor
- An anchor shall be judged acceptable and qualified for use if the proof load is held for the required time period without exceeding the permissible movement specified by the designer. The permissible movement shall be, at a minimum, the distance required to develop the required soil resistance.
- Grouted rock or soil anchors shall be tested and measured for allowable movement in accordance with the latest edition of the Post-Tensioning Institute (PTI) "Recommendations for Pre-Stressed Rock and Soil Anchors". The proof load for a grouted anchor shall be established in accordance with the PTI standard.
- Anchors that fail the proof test shall be reinstalled in a new location or advanced further into the ground or bedrock and subsequently retested.

Explanatory Note to D.5.5.4. *Load tests are required for critical installed ground anchors because there are numerous factors beyond soil type that influence an anchor's holding ability including and not limited to construction method.*

D.5.6. Built Ground Anchors

D.5.6.1. Strength: Built ground anchors shall be designed in accordance with the local building code and generally recognized geotechnical engineering practice, conforming to the following minimum safety factors:

- Sliding 1.5
- Overturning 1.5
- Uplift 2.0
- Bearing 3.0

Explanatory Note to D.5.6.1. *Refer to "Foundations and Earth Structures Design Manual 7.2, NAVFAC DM- 7.2 May 1982. The safety factors are associated with Allowable Stress Design", there are no companion values from LRFD.*

D.5.6.2. Verification of holding capacity for built anchors: A built anchor shall be judged acceptable and qualified for use, without a load test, based on construction inspection which includes but not limited to the following:

- Soil bearing conditions are found to be as identified by the geotechnical exploration and design
- All materials of construction are found to be the correct type, location, placement, geometry and dimensions as shown on the design drawings
- Concrete compressive strength testing
- Soil backfill material and density testing conform to the design drawings and specifications
- A report of construction inspection and certification performed by a party acceptable to the design engineer or qualified person

D.5.6.3. Anchoring to Pre-existing Buildings or Structures: Built critical anchors

connected to pre-existing buildings or structures shall be evaluated by a professional engineer.

D.5.6.4. Inspection and Evaluation: Guy system and ground anchor inspection shall include evaluation of design, operational load in the guy(s), anchorages and connectors, ground anchor placement, all constituent components, and an assessment of any material defect, stress deformity, corrosion, pitting, erosion, ground movement, ground uplift, etc.

D.5.6.5. Verification: In the absence of supporting information, the inspector may require proof testing of existing installed critical ground anchors to properly assess their strength and suitability. Proof tests on existing ground anchors shall be done according to DPI Standard D.5.5.4. The inspector may, at their discretion, alternatively recommend the installation of a redundant system that shall be installed according to DPI Standard D.4. and D.5. and its holding capacity verified as required in DPI Standard D.5.1.2.

D.6. Existing Buildings and Structures

D.6.1. Structural Suitability: Assessment of the suitability of existing buildings or structures for element support shall be performed by a qualified person.

D.6.2 Inspection and Evaluation: Inspection and evaluation of elements on existing buildings and structures shall be performed by a qualified person and shall include investigation of structural integrity, element location, expected loads, and an assessment of any deflection and/or deformation and/or cracking in any structural member supporting an element. If any cracks or deformation are found, remedial action is required.

Explanatory Note to D.6.2. *Assessment of an existing element or course in a building or structure is a specialized skill that may warrant consultation with a structural engineer or other qualified person. Assessment may include hands-on inspection and/or an "as built" construction plan review.*

E. ~~LIFE SAFETY SYSTEMS~~ OPERATING SYSTEMS

E.1. General Requirements

E.1.1. ~~**User Load: Life Safety System Design/Installation:** Life safety systems shall be engineered systems or be designed by a qualified person and be manufactured and/or installed by a competent person.~~

Selection Criteria: Operating Systems differ for low elements, spotted activities and high elements. Each operating system and its constituent life safety equipment, if any, shall be specified and implemented with the appropriate level of design, manufacture, information, training, and participant supervision as outlined in the Operations Standards.

> ***Explanatory Note to E.1.1.*** *~~When creating a rope system,~~ The expected load at different points in the ~~rope~~ load path and any strength-reducing factors such as terminations, connectors, etc. are important for the designer to take into account when specifying components and equipment in an Operating System.*

E.1.2. **Maximum Allowable ~~Impact~~ Force on the body:** The Operating System ~~Belay system and rope rigging system components~~ shall be designed ~~selected~~ to minimize the arrest force on the climber. ~~and prevent unintended contact with the ground or other hazards.~~

> ***Explanatory Note to E.1.2.:*** *The impact force generated by a fall depends not only on the length of fall and the amount of rope in service but also on the characteristics of the connecting elements and especially their ability to absorb energy. This includes the ability of trees or poles to shift under load.*

E.1.3. **Maximum allowable free fall distance:** The elements and their associated life safety systems shall be installed at a height that the maximum allowable free fall distance allows the operating system to function effectively and prevent unintended contact with the ground and other hazards.

> ***Explanatory Note to E.3.1.*** *The designer of belay systems and tensioned rope systems should consider rope elongation and length of rope in service when determining impact forces and the likelihood of the climber hitting the ground or other part of the element. In some circumstances spotting may be required while climbing up or down, as the 'stretch' in the belay system means it can only function as intended once the climber reaches a certain distance from the ground.*

E.1.4. **Compatibility:** Individual components within an operating ~~personal safety~~ system shall be functionally and operationally compatible with all other components in the ~~of the personal safety~~ system. Compatibility shall be determined by a qualified person and may require manufacturer guidance.

~~i. **System Integrity:** Life safety systems shall be installed according to the designer or manufacturer instructions and integrity shall be assured in one or more of the following ways:~~

~~• **Proof Testing:** A non-destructive static test load equivalent to two times the expected load shall be applied simulating operational conditions of the system. The system is deemed to comply if no permanent deformation or displacement in anchorage or components results from the application of~~

~~this load.~~

- ~~**Specification Verification:** The components that make up the system are manufactured using an accepted, applicable and verifiable quality assurance process.~~
- ~~**Redundancy:** A backup (redundant component or system) is implemented that has the same safety factor as that of the primary system.~~

~~***Explanatory Note to E.1.2.*** *The proof testing requirement states: "a non-destructive test load shall be applied…if no permanent deformation or displacement in anchorage or components results from the application of the proof load". Proof tests performed on anchorage placed in soft materials, such as softwood trees, may display some displacement or settling without permanent deformation or other detrimental effect to the anchorage, fastener, or material substrate. It should be verified following proof tests in these conditions that no permanent deformation has occurred.*~~

~~*A verifiable Life Safety System Standard describes an established standard of a kindred association which provides an equivalent level of safety. Examples may include belay anchors that meet climbing wall industry standards (CWA design and engineering standard or EN 1257.*~~

E.2. Categories of Operating Systems: The operating systems used by challenge course participants are:

E.2.1. Automated Systems: Automated systems connect the climber or rider to a life safety system.

Explanatory Note to E.2.1.: *Automated systems include and not limited to auto-belays, zip line braking systems, free fall devices, etc. They may use electrical, hydraulic, pneumatic, magnetic and other sources of power.*

E.2.1.1. Maximum Allowable Free Fall Distance: The manufacturer of the automated system shall determine the maximum allowable free fall distance.

E.2.1.2. Maximum Allowable Force on the Body: The manufacturer of the automated system shall determine maximum allowable on the body of the climber or rider.

E.2.2. Belay Systems: Belay systems connect the climber to a life safety system.

Explanatory Note to E.2.2.: *Belay systems include and are not limited to systems using one top anchor set-up (whether belayed by a belayer with a belay device or a belay team using a participatory method) and team belays that employ multiple anchor points such as a Pecos River style M-Belay, Single N team belay, or Traversing Double N team belay.*

E.2.2.1. Maximum Allowable Free Fall Distance: A top rope or team belay system shall limit the climber's fall to a distance equal to the length of the rope in service (Fall Factor 1)

Explanatory Note to E.2.2.1: *This distance accounts for elements that use ropes meeting EN 1891 or EN 892.*

E.2.2.2. Maximum Allowable Force on the Body: A top rope or team belay system shall limit the force on the climber to 6 kN (1,350 lbf).

E.2.3. Collective Safety Systems: Collective Safety Systems do not connect the climber to a life safety system. There are both preventive and soft fall collective safety systems. Collective safety systems are considered critical.

***Explanatory Note to E.2.3.**: Preventative collective safety systems include and are not limited to barriers such as guard rails, balustrades, net and fences that prevent falls. Soft -fall collective safety systems include and are not limited to crash mats, safety netting, pools of water that absorb a climber's fall.*

E.2.3.1. Maximum Allowable Free Fall Distance: The manufacturer of the soft-fall collective safety system shall determine the maximum allowable free fall distance of the climber. There is no maximum allowable free fall distance for preventative collective safety systems as these systems prevent falls from occurring.

E.2.3.2. Maximum Allowable Force on the Body: The manufacturer of the soft-fall collective system shall determine maximum allowable on the body of the climber. There is no maximum allowable force on the climber's body for preventative collective safety systems as these systems prevent falls from occurring.

E.2.3.3. Prevention Barriers: Any item including and not limited to barriers, fences, railings, banisters, containment nets used to prevent a fall from height shall conform to relevant building codes in the jurisdiction of use.

***Explanatory Note to E.2.3.3.** ASTM F2375 may be an appropriate standard for barrier nets, nets used as or in fencing, no-hold netting, and debris nets.*

E.2.3.4. Catch (aka Soft-fall) Systems: Catch systems for protection due to falls from height shall cover the entire surface area that may be hit by a falling climber. The falling space and landing area shall be free of any hazards other than the parts of the element.

***Explanatory note to E.2.3.4**. It may be sensible to pad items such as edges of platforms and support structures (i.e. trees and poles) that are in close proximity to an element.*

E.2.3.4.1. Safety Nets: Nets that protect climbers due to falls from height must conform to relevant standards and/or regulations in the jurisdiction of use.

***Explanatory note to E.2.3.4.1.** ANSI/ASSE A10.11 is used in the United States of America and EN 1263-1, EN 1263-2 is used in the European Union.*

E.2.3.4.2. Water: Any body of water used to protect the climber due to falls from height or as a brake system for the rider shall conform with any required 'swimming water safety' standards and/or regulations in the jurisdiction of use including but not limited to:

- Water quality that is suitable for swimming (pool, pond, lake, ocean, etc.)
- Controlled access to prevent accidental drowning

- Qualifications of staff including ability to perform a water rescue of an unconscious person

E.2.3.4.2.1. Depth: The depth of water used to protect the climber or rider due to falls from height shall be of sufficient to prevent injury.

E.2.3.4.2.2. The designer shall provide a daily procedure for verifying the sufficiency of water depth.

E.2.3.4.2.3. The pool of water shall provide suitable ground-level entry and exit.

E.2.3.4.2.4. Inspection: The inspection of the challenge course elements shall be separate from the assessment of water quality. Assessment of water quality shall be performed by a person authorized to perform this task by the Authority Having Jurisdiction.

E.2.4. Limited Fall System: Limited fall systems connect the climber to a life safety system.

Explanatory Note to E.2.4. *A limited fall system was called a Personal Safety System in ANSI/ACCT 03-2019. Historically it has also been referred to as a self-belay or static belay system. Sub-categories of lanyards in this system include: manual locking lanyards, auto locking lanyards, interlocking lanyards, integrated lanyards, and continuous lanyards. Some regulatory bodies refer to this system as fall restrict.*

E.2.4.1. Maximum Allowable Free Fall Distance: A limited fall system shall limit the climber's fall to a distance of 2 ft (610 mm) or less.

E.2.2.2. Maximum Allowable Force on the Body: A limited fall system shall limit the top force on the climber to 4 kN (900 lbf).

E.2.5. Positioning System: Positioning systems connect the climber to a life safety system or shall be used with a separate operating system that connects to a life safety system (such as PFAS, belay, etc.)

Explanatory Note to E.2.5. *Positioning systems limit a climber's movement. In some jurisdictions positioning is considered a form of travel restraint.*

E.2.5.1.Maximum Allowable Free Fall Distance: The authority having jurisdiction shall determine the climber's maximum allowable free fall distance when using a positioning system.

E.2.5.2. Maximum Allowable Force on the Body: The authority having jurisdiction shall determine the maximum allowable force on the climber's body when using a positioning system.

E.2.6. Spotting: Spotting does not connect the climber to a life safety system.

Explanatory Note to E.2.6. *Spotting is used with low elements and may be used in conjunction with belay systems when the climber is near the ground.*

E.2.6.1. Maximum Allowable Free Fall Distance: The authority having jurisdiction shall determine the climber's maximum allowable free fall distance when spotting is the only operating system.

E.2.6.2. Maximum Allowable Force on the Body: The authority having jurisdiction shall determine the maximum allowable force on the climber's body when spotting is the only operating system.

E.2.7. Tensioned Rope Systems: Tensioned Rope Systems connect the climber to a life safety system.

Explanatory Note to E.2.7. *A Tensioned Rope System was called a Rope Rigging System in ANSI/ACCT 03-2019. Tensioned Rope Systems include and are not limited to ascending lines (whether they use prusik-type knots or mechanical ascenders such as Jumars), haul systems such as those used for Flying Squirrel and Giant Swing elements, rappelling (abseiling), and Zip Lines.*

E.2.7.1. Maximum Allowable Free Fall Distance: A tensioned rope system shall limit the climber's fall to a distance equal to the length of the rope in service (Fall Factor 1)

Explanatory Note to E.2.7.1.*: This distance accounts for elements that use ropes meeting EN 1891 or EN 892.*

E.2.7.2. Maximum Allowable Force on the Body: A tensioned rope system shall limit the force on the climber to 6 kN (1,350 lbf).

Explanatory Note to E.2.7.2.: *Nearly all rope in use is subject to dynamic loading to some degree. Whenever a load is lifted, stopped, moved, or swung there is an increased force due to the dynamics of the movement. The force generated by a dynamic event is greater when the action is rapid or sudden, the rope is made of a low stretch material, the rope is short / there is less material available to absorb the energy (i.e. dissipate the impact force) generated by a fall.*

E.2.8. Travel Restraint Systems: Travel restraint systems connect the climber to a life safety system.

Explanatory Note to E.2.8. *Travel restraint systems may include either frontal (waist-level) connections or rear (waist-level) connections. In some jurisdictions positioning is considered a form of travel restraint.*

E.2.8.1. Maximum Allowable Free Fall Distance: There is no maximum allowable free fall distance for travel restraint systems as this operating system prevents falls from occurring.

E.2.8.2. Maximum Allowable Force on the Body: There is no maximum allowable force on the climber's body for travel restraint systems as this operating system prevents falls from occurring.

E.2.9. Personal Fall Arrest Systems: A Personal Fall Arrest System is not suitable for use by challenge course participants.

Explanatory Note to E.2.9. *Information about Personal Fall Arrest Systems where the individual is attached via the dorsal connection point of a full body harness is included for completeness. The maximum allowable free fall distance is determined by the jurisdiction's regulatory authority and may be up to 6 ft. The maximum allowable force on the body is determined by the jurisdiction's regulatory authority and may be up to 1 800 lbf (8 kN).*

F Life Safety Systems

F.1. General Requirements

F.1.1 Life Safety Systems Design/Installation: Life safety systems shall be engineered systems or be designed by a qualified person and be manufactured and/or installed by a competent person.

F.1.2. System Integrity: Life safety systems shall meet all applicable requirements of the critical ~~life safety~~ systems standards (DPI Standards Section A.3.2.1).

~~**E.1.2. System Integrity:** Life safety systems shall be installed according to the designer or manufacturer instructions and integrity shall be assured in one or more of the following ways:~~

- ~~**Proof Testing:** A non-destructive static test load equivalent to two times the expected load shall be applied simulating operational conditions of the system. The system is deemed to comply if no permanent deformation or displacement in anchorage or components results from the application of this load.~~
- ~~**Specification Verification:** The components that make up the system are manufactured using an accepted, applicable and verifiable quality assurance process.~~
- ~~**Redundancy:** A backup (redundant component or system) is implemented that has the same safety factor as that of the primary system.~~

> ~~***Explanatory Note to E.1.2.*** *The proof testing requirement states: "a non-destructive test load shall be applied…if no permanent deformation or displacement in anchorage or components results from the application of the proof load". Proof tests performed on anchorage placed in soft materials, such as softwood trees, may display some displacement or settling without permanent deformation or other detrimental effect to the anchorage, fastener, or material substrate. It should be verified following proof tests in these conditions that no permanent deformation has occurred.*~~

~~*A verifiable Life Safety System Standard describes an established standard of a kindred association which provides an equivalent level of safety. Examples may include belay anchors that meet climbing wall industry standards (CWA design and engineering standard or EN 12572).*~~

F.1.3. Design Considerations: When the operation uses limited fall systems with manual locking, auto-locking, or interlocking connections, participants shall be able to clearly distinguish life safety connection points from parts of the facility that are not suitable connection points including and not limited to guys, element support systems, and access components.

> ***Explanatory Note to F.1.3.*** *Locating items out of reach, signage, markings, and barriers may be strategies for designating suitable and unsuitable connection points*.

F1.4. Providing Stable Footing for Climbers: The location of connection points for Limited Fall Systems shall allow climbers to maintain handsfree balance when transferring lanyards from one connection point to another. A platform shall be provided when a Limited Fall System uses manual locking lanyards.

F.2. ~~Lifeline~~ Critical Rope Systems

F.2.1. Performance Criteria: ~~Lifeline~~ Critical rope systems that are not

engineered systems shall comply with all of the following:

- Be designed and specified by a qualified person.
- Be appropriately flexible for the application
- Be resistant to wear, fatigue, and environmental degradation
- ~~Be designed and installed in a manner that allows for inspection along the entire length of the lifeline system~~
- Be accompanied documentation for all materials used in the load path of the system, including ~~by the lifeline rope material~~ manufacturer~~'s inspection and test certification or documentation~~ information and data for components, performance test certification for the system. Alternatively, the system shall be test-verified from an appropriate quality control program specific to the application
- Be terminated using a method specified or approved by the rope manufacturer
- Be accompanied by the designer~~'s~~, manufacturer~~'s~~, and/or inspector~~'s~~ criteria for proper use, future routine maintenance, inspection, testing, lifespan and ~~replacement~~ retirement
- ~~For synthetic fiber rope and webbing, meet the requirements of the DPI Equipment Standard I.3.11.1 (Rope and Webbing)~~
- Be assembled using components that have functional and operational compatibility with one another and the anchorage

Explanatory Note to F.2.1.

This standard also applies to synthetic fiber rope and webbing used in lifeline and other critical rope systems.

Lifelines experience a range in the amount of flexing during operation based upon line diameter, tension, and the type of equipment used in operation (e.g. pulleys, trolleys, brake systems). "Flexible" or "Extra Flexible" wire rope is generally recommended for ~~wire rope~~ lifelines because of its longstanding record of reliability and durability. ~~This standard also applies to synthetic fiber rope and webbing used in lifeline systems.~~

The designer/engineer must have specific information and documentation to satisfy the requirements above before sign-off. If the required information on materials is not available and proper testing not performed, the materials are not appropriate for use in a critical rope system.

The compatibility of components in a critical rope system is essential to ensure that a system works as intended. Examples of compatibility include the use of ~~proper diameter ropes in belay devices as~~ connectors between terminations and anchorages that may be prescribed by a manufacturer of one or all of the components.

F.2.2. **Proof Testing:** When proof testing is used to meet the system integrity standard, a non-destructive static test load equivalent to two times the expected load on the rope shall be applied to simulate the operational conditions of the lifeline system. The rope system is deemed to comply if no permanent deformation or displacement in anchorage or components results from the application of this load. The expected load shall be determined by a qualified person.

Explanatory Note to F.2.2. *Proof tests performed on anchorage placed in soft materials, such as softwood trees, may display some displacement or settling*

without permanent deformation or other detrimental effect to the anchorage, fastener, or material substrate. It should be verified following proof tests in these conditions that no permanent deformation has occurred.

F.2.3. Vertical Lifeline Strength: Vertical lifeline systems including terminations, anchorage(s), anchorage connectors, and backups shall be capable of supporting a minimum load of 5,000 lbf (22.2 kN) without failure or shall be designed to a minimum lifeline system breaking strength of two times the expected load as determined by a qualified person. One ~~participant~~ climber is permitted at any one time on each vertical lifeline during normal operations.

Explanatory Note to F.2.3 *The structure that supports an anchorage is not considered part of the rope system.*

F.2.4. Horizontal Lifeline Strength: Horizontal lifeline systems including terminations, anchorage(s), anchorage connectors, and backups shall be designed to a minimum rated breaking strength of five times the expected load (safety factor of 5:1) as determined by a qualified person.

Explanatory Note to F.2.4.: *The structure that supports anchorages is not considered part of the rope system.*

F.2.4.1. ~~A~~ For wire rope horizontal lifelines safety factor of not less than 3:1 shall be allowable ~~for wire rope lifelines of~~ when the nominal diameter is greater than ½" (12.7 mm) or 12 mm on die-compressed (swaged) wire rope, only if the design has been reviewed and stamped by a licensed professional engineer.

F.2.5. Inspection and Evaluation: Inspection of both metallic and non-metallic rope used in lifelines shall include an assessment of the entire load path ~~span~~, including non-visible components, ~~termination points,~~ operational wear and fatigue points, terminations, anchorage connectors and anchorages. The required component manufacturer information is important in assessing critical rope systems, as it may contain essential information on service life, effects of age, application, environmental degradation, compatibility of materials as well as other retirement criteria. The designer, manufacturer, and/or inspector shall determine if and when additional non-destructive test methods are required ~~in order~~ to assess the integrity of the ~~wire~~ rope.

Explanatory Note to F.2.5. *Operational wear and fatigue points include intermediate anchorage or connectors, zip line loading and unloading areas, brake system contact areas, and areas where wire rope passes around or through another object. Self-retracting lifelines are part of an engineered system and shall be inspected according to the system manufacturer's inspection and replacement ~~policies~~ requirements.*

F.2.5.1. A critical wire rope ~~lifeline~~ shall be retired from service when any one of the following occurs:

- The reduction in nominal diameter due to tension, wire breaks, surface wear, metal loss, or corrosion amounts to 5% or more from the diameter measured under tension at commissioning
- The crown (surface) wires are worn by approximately 1/3 or more of their diameter
- There are 6 or more broken wires in one lay

- There are 3 or more broken wires in one strand in one lay
- There are 1 or more broken wires within one wire rope diameter of an attached fitting due to fatigue

F.2.5.2. ~~Lifeline~~ Critical rope system integrity shall be assessed based on the appropriateness of the termination (application) and anchorage connectors, negative effects from overloading, loss of wire/fiber rope cross-sectional area, corrosion, wear, ~~UV~~ ultraviolet light exposure, kinks, core exposure, broken wires or fibers, electrical damage, vibratory fatigue damage, terminations that are cracked, worn, or deformed, etc., as specified in F.2.1. (Performance Criteria).

F.2.6. Intermediate Anchorages or Connectors: An intermediate anchorage or connector used on a lifeline shall meet the strength requirement of the applicable standard and be designed to mitigate the potential of fatigue or other damage to the lifeline.

F.2.7. Terminations

F.2.7.1 Materials and Processes: Termination materials and techniques are permitted only when it can be demonstrated by testing or documentation that all requirements of the ~~life safety system standard~~ performance criteria for critical rope systems are met and, additionally, that the durability, reliability, and other properties pertinent to the intended use(s) have been evaluated and determined suitable by a qualified person.

Explanatory Note to F.2.7.1.

Many different termination materials and installation techniques are employed on ~~lifelines~~ critical ropes including poured zinc and resin, mechanical socket fittings, clamp plates, wire rope clips, ferrules/oval sleeves, automatic deadends, knots, stitching, splices, etc. ~~Three common wire rope termination fittings are listed below because of specific material requirements for each.~~

Certain methods have been used successfully for many years and reliability is a known quantity when proper materials and installation techniques have been used, whereas some are entirely novel and require more thorough evaluation before being employed.

Acceptable termination methods in non-metallic rope and webbing include stitching, splices, knots, bends, and hitches.

~~**F.2.6.1.1 Wire Rope Clips**~~

~~**F.2.6.1.1.1. Material:** Wire rope clips shall conform to US Federal Specification number FF-C-450 or equivalent standard in the jurisdiction of use.~~

~~**F.2.6.1.1.2. Inspection and Evaluation:** Wire rope clip terminations shall be inspected for appropriateness of the termination (application) and negative effects from broken wires at the turn of the eye (if no thimble is present), corrosion, deformities, poor thread condition, nicking damage, etc.~~

~~**F.2.6.1.2. Swaged Fittings**~~

~~**F.2.6.1.2.1. Material:** Swaged fittings used to fabricate eyes or splices in wire rope shall be created using ferrules(oval sleeves) that conform to US Military Standard MS51844E or equivalent standard in the jurisdiction of use and shall be from a material that is compatible with that of the wire rope.~~

~~**F.2.6.1.2.2. Inspection and Evaluation:** Swaged fittings shall be inspected for appropriateness of the termination (application), the number of ferrules employed and negative effects from broken wires at the turn of the eye (if no thimble is present), corrosion, deformities such as cracks and splits, quality of crimps, amount of compression, and material compatibility.~~

~~**F.2.6.1.3. Automatic Deadends**~~

~~**F.2.6.1.3.1. Automatic deadends** shall be fitted with a redundant system equal in strength to the expected load of the cable system plus applicable safety factor for the cable system and configured to prevent connection failure resulting from release (slippage) of wire rope through the device and/or resulting from bail failure on automatic deadends.~~

~~**F.2.6.1.3.2. Inspection and Evaluation:** Automatic deadends shall be inspected for appropriateness of the termination (application), defects, signs of wire rope release or slippage, appropriate size and type, defects and deformities in the connector, and strength of the backup.~~

~~**F.2.6.2 Terminations in non-metallic Rope and Webbing**~~

~~**F.2.6.2.1. Allowable Techniques:** Lifeline terminations in non-metallic rope and webbing shall be specified by a qualified person and created by a competent person. Acceptable termination methods include stitching, splices, knots, bends, and hitches.~~

F.2.7.2. Inspection and Evaluation: ~~Non-metallic rope and webbing~~ Terminations shall be assessed for integrity based on the appropriateness of the termination (application), proper installation according to rope and termination manufacturer's instructions and negative effects from wear, abrasion, deformities, kinks, cuts, broken fibers, corrosion, discoloration, the effect of ~~UV~~ ultraviolet light exposure, age, ~~and~~ chemical contamination, etc.

F.2.8. Backup Loops: Any backup loops around trees shall be sufficiently loose to prevent damage to the tree surface. All backup loops shall be ~~and~~ sufficiently taut to minimize ~~participant~~ climber fall distance should the primary connection fail.

F.3. Belay Beams

F.3.1. General Requirements

F.3.1.1 Belay Beams shall:

- Be designed and specified for the intended use by a qualified person and have appropriate levels of rigidity, resistance to wear, fatigue, and environmental degradation
- Be accompanied by manufacturer's criteria for maintenance, inspection, testing, and replacement

- Be designed and configured to prevent excessive belay rope wear

F.3.2. Strength: A qualified person shall specify belay beams based on the expected load(s) plus safety factor required by accepted engineering practice for the material and installation techniques used.

F.3.2.1. Minimum beam strength supporting multiple belay loads shall be calculated with one person load equal to 2,250 lbf (10.0 kN) and each additional person load equal to 675 lbf (3.0 kN). The formula for computing the minimum overall capacity of a beam in pounds is {(n–1) 675 + 2,250} where n equals the maximum number of person loads.

F.3.2.2. For unfixed anchorages along the beam (such as on belay pipes), the above loads shall be assumed to be 5 feet (1520 mm) apart and as close to mid-span as possible. The resultant of the belay load(s) shall take into account the resolved angle possibilities as illustrated in Diagrams F.3.2.2.a and F.3.2.2.b.

Explanatory Note to F.3.2.2. *Design considerations include belay stations or floor anchorage positioning that affects the resolved angle of belay load(s) as referenced above. A moving anchorage belay (see Diagram F.3.2.2.a) is a special case that will have a variable and possibly severe resolved angle.*

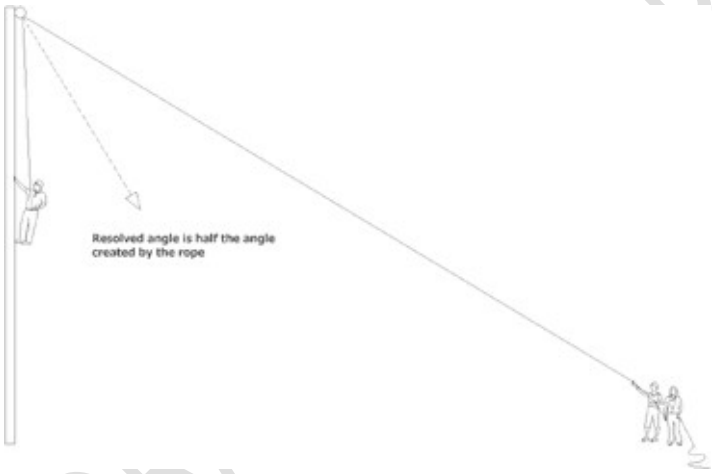


Diagram F.3.2.2.a

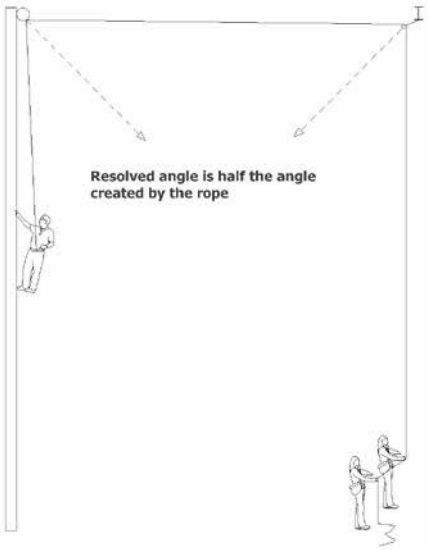


Diagram F.3.2.2.b

F.3.3. Inspection and Evaluation: The inspector shall assess belay beam integrity by taking into consideration deflection or yielding and shall also include scrutiny of welds, connecting hardware, suspension components, damage or defects resulting from wear, abrasion, surface corrosion (rust, pitting, etc.), and corrosion of metal components.

F.4. Anchorages

F.4.1 Strength: Installed anchorages shall be capable of supporting a load of at least 5,000 lbf (22.2 kN) per climber attached without failure or two times the expected

load on the anchorage without causing permanent displacement in the anchorage or its components. The expected load shall be determined by a qualified person. This standard does not apply when anchorages are components of an assembly in an engineered system.

Explanatory Note to F.4.1. *Examples of installed anchorages are eye bolts, bolt hangers, beam clamps, and slings made from cordage, cable, or chain. Examples of specification verification may include and are not limited to belay anchors that meet climbing wall industry standards (Climbing Wall Association (CWA) design and engineering standard or EN12572).*

F.4.2. Inspection and Evaluation

F.4.2.1. Engineered Anchorages: Inspectors shall follow the manufacturer's inspection and replacement policies regarding application and retirement.

F.4.2.2. Bolt, Beam Clamp, and Bracket Anchorages: Inspection shall include an assessment for integrity based on the appropriateness of the termination (application), proper installation, fastener torque, negative effects from deflection, distortion, wear in the clamp or bolt or its connecting components, rust, corrosion, pitting that may affect the ability of the clamp or bolt to support the expected load, quality of welds, and misalignment with the expected load.

F.4.2.3. Concrete or Rock Anchorages: Inspection shall include an assessment of the anchorage, the embedment material and the substratum. As many components of expansion or chemical anchorages cannot be visually inspected, the inspector shall rely on external signs of deterioration and one of the methods outlined in the system integrity standard (DPI Standard A.3.2.1.). The inspector shall assess anchor system integrity based on negative effects from corrosion, wear, yielding, cracking, fracturing or crumbling of embedment material, looseness of any anchorage component that cannot be corrected, pullout or movement of anchorage components, and age of anchorage components (relating to possible deterioration of internal components).

F.4.2.4. Screw Anchorages in Wood Products: Inspection shall rely on external signs of deterioration and one of the methods outlined in the system integrity standard (DPI Standard ~~E.1.2~~A.3.2.1.). The inspector shall assess anchor system integrity based on the negative effects from damage due to cracks or decay in the wood around the screw, severe nicks, gouges, excessive wear or abrasion, pitting or corrosion, and tree growth that interferes with the operation of the anchor system. Conditions warranting increased scrutiny include visible yielding of the screw or anchorage, looseness of the screw in the wood, or evidence of heat damage and/or discoloration (potential causes include lightning strikes or fire).

F.4.2.5. Rope and Webbing Slings: Inspection shall include assessment of the anchor system integrity based on the negative effects from wear, improper terminations, improper positioning or movement of the sling under load, flattening, stiffening, distortion of wires or strands, stitching integrity, signs of overloading or excessive load, and distortion or wear on structural components supporting the sling.

F.5. Ground Belay Anchor Systems

F.5.1 Primary

F.5.1.1. Strength: Ground anchor systems used as anchorage for a primary belay system shall be capable of supporting two times the expected load as determined by a qualified person.

Explanatory Note to E.5.1.1. *Primary ground belay anchor systems are those that support the belay device and the full load transmitted from a falling person. Some examples are belay posts (e.g., Just-Rite Descenders), utility ground anchors, foundations, floor anchorages, horizontal lifelines, and belay benches. These anchor systems are defined as "primary" because they directly connect the belay device to the load from the falling ~~person~~ climber and are critical.*

F.5.1.2. Inspection and Evaluation: Embedded logs or posts used as primary ground belay anchors shall be categorized and inspected as critical anchorages. When used as the belay device (e.g. a belay post), they shall also be inspected for proper belay function. The inspector shall assess anchor system integrity based on the negative effects from looseness of the post or of anchorages or anchorage connectors, rot or decay, material defects or damage and surface conditions that may cause damage to rope or other belay system components.

F.5.2. Secondary

F.5.2.1. Strength: Ground anchor systems used for maintaining belayer position or providing additional support to the belayer when belaying from a harness shall be capable of supporting the expected load as determined by a qualified person.

Explanatory Note to E.5.2.1. *Examples of secondary ground belay anchor systems are those used for maintaining position or offering additional belayer support while belaying from a harness. An example includes using group members as anchors.*

F.5.2.2. Inspection and Evaluation: The inspector shall verify that the belay anchor is appropriately configured and of sufficient mass or strength to perform as intended and shall assess anchor system integrity based on the negative effects from damage or defect to any component.

G. ELEMENT SUPPORT SYSTEMS

G.1 General Requirements

G.1.1 Strength: Element support systems shall be capable of supporting two times the expected load without causing permanent displacement in the system. The expected load shall be determined by a qualified person.

G.1.1.1. Critical element support cables systems shall be designed to a minimum rated breaking strength of five times the expected load (safety

factor of 5:1) as determined by a qualified person.

G.1.2. Material Requirements: When specifying structural components, including all installation hardware and lumber products, the designer shall consider environmental conditions, location, anticipated life span, and compatibility of materials.

Explanatory Note to G.1.2. *Environmental factors include prevailing weather conditions (such as heat/cold, wet/ dry cycles, etc.), proximity to salt spray or other corrosive atmospheric conditions, ground contact, etc. Commercial wood preservatives and coatings applied by hand at manufacturer's recommended intervals may be suitable treatments for untreated wood products.*

G1.3. Performance Criteria: The quality and reliability of materials shall be consistent with application and performance expectations. Critical element support systems shall meet all the applicable requirements of DPI Standard Section A.3.2.1 (System Integrity).

Explanatory Note to G.1.3. *For example, wire rope clips that conform to US Federal Specification number FF-C-450 (or equivalent) and proof tested rapid links of known quality are chosen for use on critical systems, whereas non-critical systems may use alternative components.*

G.1.4. Inspection and Evaluation: The inspector shall apply the same criteria as those found in Section ~~E~~ A.3.2.1 (~~Life Safety~~ Systems~~s~~ Integrity) for assessing and evaluating the specific materials used in element support systems.

H. PLATFORMS

H.1. General Requirements

H.1.1. Strength: The strength of platforms and associated components shall be determined by a qualified person applying accepted engineering practice for appropriate resistance to live and dead loads and consideration to the required capacity of the platform.

H.1.2. Design Considerations: Guardrails and handrails shall not be required when individuals are required to be connected to a life safety system.

> ***Explanatory Note to H.1.2.*** *Factors such as variation in platform height, terrain features, and dynamics associated with incoming zip line riders may contribute to the underestimation of the consequences of falls from platforms. An adequate fall restraint or fall protection system needs to be available on platforms and employees trained in its proper use whenever the potential of a fall exists. More information is available in the ACCT Technical Advisory on Zip Line Landing Area Platforms issued August 2015 and available on the ACCT website. Additional information may also be found in OSHA publication OSHA3845.*

H.1.2.1. When platforms~~,~~ with ~~including~~ guardrails and handrails, are classified by a qualified person to be ~~life safety~~ critical systems, the criteria found in DPI Standard Section A.3.2.1. ~~E~~ (~~Life Safety~~ Critical Systems Integrity) in specifying materials, components, and systems shall be applied. ~~This classification may be either direct or indirect through a connection to another life safety system (e.g. on the primary load path).~~

H.1.3. Inspection and Evaluation: The inspector shall visually assess the supports, frame, joists, decking, and fasteners used in platform construction and assess platform integrity based on the negative effects from rot and wood degradation, component defects and deformities, and overgrowth. The inspector shall additionally assess platform size and strength, construction materials and preservatives, and any other potential hazard or environmental impact.

I. ZIP LINE BRAKE SYSTEMS

I.1. ~~Brake System~~ Scope: ~~All zip lines shall be designed and installed with an integrated brake system~~.

I.1.1 Types of Zip Lines: This standard establishes brake requirements for zip lines within the scope of DPI standard A.1.

Explanatory Note to I.1.1. *Other types of structures where the individual is suspended off the ground while riding down an inclined line including and not limited to backyard zip lines (whether ~~or not~~ installed using a commercially purchased kits or not), zip lines that do not solely use gravity for propulsion, zip lines that employ a mechanized return system, and playground track rides fall outside the scope of this standard.*

I.1.2. Rope Systems: This standard applies to zip lines where the rider is wearing a harness and suspended by a flexible rope including and not limited to those systems using wire or synthetic fiber rope.

Explanatory Note to H.1.2*. Activities where the rider merely hangs on to a handle or is suspended from a rigid rail are outside the scope of this standard.*

I.1.3. Additional Criteria: The performance of the brake system is just one of the requirements that determine the readiness of a zip line for use. Designers and Inspectors shall refer to standards found throughout the Design, Performance, and Inspection; Operations; and Training chapters of this document when evaluating zip lines.

I.2. General Principles:

I.2.1. Complexity: Zip line brake systems vary widely in design and performance from simple gravity brakes where the sag in the lifeline is used to both accelerate and decelerate the rider, to complex systems that require calculating the interactions among multiple variables. The designer shall consider that zip lines exceeding a particular speed, tension, length, rope diameter, etc. may require engineering analysis since these variables often serve as proxies for the complexity of a particular zip line.

I.2.2. Preventing Collisions / Braking is often limited to the brake zone: A rider who has departed the launch platform often has no practical means of braking independently to prevent a collision. The designer shall specify appropriate means to prevent riders from launching before the zip line and corridor are clear.

Explanatory Note to I.2.2*: Collisions may include and are not limited to rider-to-rider on the same zip line, rider-to-rider on adjacent zip lines, and rider-to-mobile-obstacle (such as a person, ladder, vehicle, horse).*

I.2.2.1. The designer shall include an additional departure control system if any part of the zip line or the zip line landing area is not visible from the starting point. This requirement applies to intermittent visibility that may occur with nighttime operations, bright sunlight, or fog.

Explanatory Note to I.2.2.1*. Examples of additional departure control systems include and are not limited to radio communication between staff on the sending and receiving platforms, a live video of the landing area, bright*

warning lights visible in the worst weather conditions, and an electronic/mechanical interlock system between the zip line and zip trolley/lanyards.

I.2.2.2. Zip lines designed to use a self-guided delivery approach shall include instructional signage, including pictograms where possible, at the start of each zip line advising participants of actions required to avoid collisions.

I.2.3. Braking is Critical: Zip Line Brake Systems shall meet all applicable requirements of the system integrity standard (DPI Standard Section A.3.2.1.). Test documentation is required.

I.2.3.1. Brake systems when properly operated shall not cause significant/serious injury to the rider or operator. This includes and is not limited to injuries that may result from pendulum swing, or entrapment of hair or body parts in the trolley or brake system.

Explanatory Note to I.2.3.1.: *Strategies to reduce injury should be employed.*

I.2.4. Tensioned Rope System: Maximum allowable force on the rider's body during launch, ride, and braking processes shall comply with E.2.1.

Explanatory Note to I.2.4*.: No more than a factor 1 fall is permitted at launch or take-off. A factor 1 fall describes a situation where the length of the zip lanyard is equal to the height of free fall experienced when stepping off the deck. It typically occurs when the zip line cable is approximately at the rider's waist and the rider is attached to the zip lanyard at the harness waist connection.*

~~***Explanatory Note to H.1.*** *Brake systems may arrest a participant in many ways, ranging from the use of gravity alone to sophisticated mechanical systems. Brakes are divided into two types, primary brakes and emergency brakes. Primary brakes may be either active or passive in nature whereas emergency brakes engage without input from the zip line participant.~~

~~**H.1.1 General Requirements**~~

~~**H.1.1.1. The Brake System shall:**~~

~~a. Limit the deceleration of the participant so as to prevent a hazard to the participant~~

~~b. Be capable of repeated operation without permanent deformation, undue wear, or failure of any associated components or equipment~~

~~c. Arrest the motion of the participant regardless of participant orientation~~

~~d. Not inhibit the participant retrieval procedure in the event that arrest occurs before the zip line landing area is reached~~

~~***Explanatory Note to H.1.1.1.*** *This standard takes into account brake systems that induce pendulum swing to the participant as well as those that do not.~~

~~**H.1.2. Design Considerations:** Brake Systems shall be designed by a qualified person. The design shall~~

address the following:

- Arrest as a critical function
- Static, dynamic, and impact loads in worst-case situations
- Resistance to wear and fatigue with consideration given to the anticipated use
- Environmental factors such as extreme temperatures, wind, and weather conditions
- The level of risk to the participant posed by the failure of the brake system or any of its components, including potential for pinching, binding, entanglement, etc.

H.1.3 Emergency Brake Requirements: An emergency brake shall require no action by the participant and shall either be completely separate from the primary brake or an integrated backup feature of the primary brake. An emergency brake shall be required if, upon failure of the primary brake, both of the following may occur:

- The participant arrives at the zip line landing area at a speed in excess of 6 mph (10 kph)
- The participant experiences unintended and/or harmful contact with terrain, objects or people in the zip line landing area

H.1.4. Test Requirements: A qualified person shall design the methods, oversee the performance, and assess the results of operational tests.

H.1.4.1 The following circumstances require testing of the brake systems by a competent person to determine proper system operation:

- Prior to commissioning of the zip line
- Whenever a brake system or component is disassembled and reassembled, changed, added, or replaced.

H.1.4.2. All tests shall provide proof of the following:

- Brake system operational characteristics at the extremes of the design continuum for participant weight and arrival speed
- Confirmation that the brake system performs reliably and as designed

H.1.5. Inspection and Evaluation: Zip line brake systems shall be evaluated according to the manufacturer's specifications as included in the documentation provided at the time of installation.

Explanatory Note to H.1.5. *A brake system inspection may require a comparison of current performance for compliance with the manufacturer's specification. Measurements of wear in brake system components may also be necessary.*

I.3. Zip Line Landing Areas ~~shall~~: The designer shall ensure that zip line landing areas:

- Provide sufficient space for brake system operation and dismount procedures
- Prevent potentially harmful contact with zip lines, people, and other components with consideration given to rider ~~participant~~ orientation
- Be free from hazards that require rider ~~participant~~ action to avoid. The ground and/or objects in the brake zone or the zip line landing area that have the potential to harm ~~participants~~ riders shall be covered with shock absorbing material adequate for the anticipated impact

Explanatory Note to I.3. *Hazards may include platform components, participants, staff, fixed or heavy steps, etc. Other hazards are discussed in the August 2015 ACCT Advisory Notice for Zip Line Landing Area Platforms. See also Standard H.1.2.1.*

I.3.1. Platform Edges Padding shall be required on the edge of a zip line landing platform if a rider has potential to make contact.

Explanatory Note to I.3.1. *Designers should consider that the height of riders may vary considerably and that tall riders with long legs may be able to contact an edge that is not reachable by most individuals.*

I.4. Brake Systems: All zip lines shall be designed and installed with ~~an integrated~~ brake system that consists of a combination of primary and emergency brakes.

Explanatory Note to I.4. *Brake systems may arrest the motion of a ~~participant~~ rider in many ways, ranging from the use of gravity alone to ~~sophisticated mechanical~~ automatic systems. ~~Brakes are divided into two types, primary brakes and emergency brakes.~~ Primary brakes may be either active or passive ~~in nature~~ and may require an active re-set or re-set automatically ~~whereas emergency brakes engage without input from the zip line participant~~. The following table locates common braking systems within this matrix.*

Zip Line Brakes by Brake and Re-set Category

		RE-SET	
		Active	***Passive (Automatic)***
BRA	***Active***	*Active Brake with Active Re-set* • *Travelling Shuttle* • *Closed Rope Loop* • *Sliding Prusik*	*Active Brake with Automatic Re-set* • *Not common but possible*

K E	***Passive***	*Passive Brake with Active Re-set* • *AUTOPRUSIK – Hackwell Innovations* • *ZIPKEA – Hackwell Innovations* • *EAD System – Bonsai Design* • *Spring Stack with restraint or locking system*	*Passive Brake with Passive Re-set* • *Gravity* • *Bungee Brake* • *Counterweight* • *Water Impact* • *Spring Stack (unrestrained)* • *zipSTOP – Headrush Technologies* • *Zip E-Brake with counterweight return – Bonsai Design* • *Auto-Braking Trolley*

I.4.1. Primary Brake: Depending on predicted rider speed, the primary brake may be passive, automated, or entirely actively operated by a trained staff member.

Explanatory Note to I.4.1. *A trained staff member may be assigned manual and visual tasks including and not limited to re-setting a brake system that would be inappropriate to expect of a participant. It is illogical and inconsistent to expect a trained staff member to be able to perform a zip line rescue or mid-line trolley swap yet be excluded from actively operating any aspect of a zip line brake system. More information about guide operated systems is provided in I.4.1.3.*

I.4.1.1. Gravity Brake: When the zip line is designed to use gravity alone the rider simply rolls back and forth in the belly of the zip line until coming to a stop. In this case, gravity is the only component of the primary brake, and if no possibility exists of striking anything during normal operations, the zip line shall not require an emergency brake.

Explanatory Note to I.4.1.1. *Gravity brake zip lines are distinct from other types of zip lines in that they are mechanically very simple. The only moving component of a gravity brake zip line is the trolley from which the rider is suspended. The possibility for gravity to fail is zero.*

I.4.1.2. Active Braking by Participants: Due to the inability of staff to physically intervene with participant actions when a participant is on a zip line, zip line brake systems shall not depend on participant actions to provide the primary brake.

Explanatory Note to I.4.1.2. *Active braking is permitted by guides. Unlike participants, guides are trained individuals for whom zip line riding and the operation of zip line brakes is a regular part of their job. Zip line braking, while critical, is functionally equivalent to belaying or driving a vehicle – tasks requiring the ability to judge speed and react appropriately, and which fit and healthy individuals perform on a routine basis.*

I.4.1.3. Guide Operated Systems: The designer shall specify the training and skills verification required for trained staff members who operate brake systems. The designer shall provide this information in the documents provided to the owner at the time of commissioning. The design considerations for guide operated systems shall also include and not be not limited to:

- Physical capabilities of staff members

- Force generated by participants with maximum mass arriving at maximum speed

Explanatory Note to I.4.1.3. *Staff members should not need to possess extraordinary strength to effectively perform this aspect of their job. The ability of the guide or staff member to maintain control throughout the braking process should be considered as it relates to closed rope loop systems.*

I.4.1.4. Water Impact Braking: When the rider's body decelerates and stops through contact with water the designer shall specify

- minimum and maximum water depths required to decelerate and stop riders and allow them to exit the water without encountering an obstruction,
- the exit path so that riders do not cross the landing zone of this zip line or others
- the procedure for determining water depth, and
- the clearance of the rider's head above the water

Explanatory Note to I.4.1.4.: *The designer should consider that additional mass that may be added at dismount or during zip line rescue and that the rider may take deliberate action to avoid being submerged in the water (for example, attempting barefoot water skiing).*

I.4.2. Participant Interaction: At predicted rider speeds below 15 mph (24 km/h) the designer may include approaches that enable participants to interact with the zip line or surrounding environment ~~in order~~ to decrease speed as a supplement to the primary brake. Approaches include and are not limited to hand braking, Striding Foot Arrest, and Participant Trolley Braking. Participant interaction shall not be permitted on high-speed zip lines.

I.4.3. Emergency Brake Requirements: An emergency brake shall be required if, upon failure of the primary brake, both of the following may occur:

- The ~~participant~~ rider arrives at the ~~zip line landing area~~ brake zone with a predicted rider ~~at a~~ speed in excess of 6 mph (10 km/h)
- The ~~participant~~ rider experiences ~~unintended and/or~~ harmful contact with terrain, objects or people in the zip line landing area

Explanatory Note to I.4.3.: *A primary brake may have enough reliability to also serve as an emergency brake – designated as fail-safe. Examples include and are not limited to a water impact brake (water resistance is guaranteed), gravity (the force of gravity is guaranteed), spring stacks only (where there are enough springs that the failure of one is not critical). The qualified designer should determine failure modes ~~in order~~ to justify that a single point of failure will not be critical. The qualified designer should provide this analysis in commissioning documents provided to the owner.*

I.4.3.1. Passive Brake is Mandatory: An emergency brake shall require no action by any person

Explanatory Note to H.4.3.1.: *Active re-set is permissible*

I.4.3.2. Padding used in an Emergency Brake System. When the emergency brake system creates the potential for a rider to make harmful contact with the structure, lifeline, or other objects, adequate padding shall be employed.

Padding shall meet performance, construction, and requirements of ASTM 2440, UIAA 106, EN 12572, or other applicable sport impact standards or be approved for use by the qualified designer. The qualified designer shall provide the selected padding requirements in the commissioning documents provided to the owner.

I.5. Criteria for Brake Systems:

I.5.1. Selection Criteria: Rider speed on entry to the brake zone shall determine the brake system(s) required. The predicted rider speed for each individual medium or high speed line shall be at least 10% greater than the established test speed.

I.5.1.1. Gravity Brake Zip Line:

I.5.1.1.2. Predicted Rider Speed on Entry to Brake Zone: The designer of a gravity brake zip line calculates that riders will stop, roll back past the landing area, and finally come to stop a safe distance away from the end of the zip line. In practical terms, a rider on a gravity brake zip line has an entry speed of 0 mph (0 km/h)

I.5.1.1.3. Established Test Speed: There is no established test speed required on a gravity brake zip line.

I.5.1.1.4. Primary Brake: No primary brake is required on a gravity brake zip line.

I.5.1.1.5. Emergency Brake: No emergency brake is required on a gravity brake zip line.

I.5.1.2. Low Speed Zip Line:

I.5.1.2.2. Predicted Rider Speed on Entry to Brake Zone: The designer of a low speed zip line calculates that riders will arrive at the brake zone travelling less than or equal to 6 mph (10 km/h).

I.5.1.2.3. Established Test Speed: During testing the maximum speed shall be less than or equal to 6 mph (10 km/h).

Explanatory Note to I.5.1.2.3. *The low-speed category is meant to reflect an easy to achieve landing, roughly equivalent to jogging speed. A reduced established test speed has NOT been provided as it is difficult to obtain accurate speed readings at low speeds and a definitive speed is not practically useful. What is important is to determine that it is easy for participants to manage their arrival.*

I.5.1.2.4. Primary Brake: No primary brake is required on a low speed zip line.

Explanatory Note to I.5.1.2.4. *Loss of momentum from naturally occurring circumstances (wind resistance, friction, etc.) typically serves as the primary brake system on a low speed zip line.*

I.5.1.2.5. Emergency Brake: No emergency brake is required on a low speed zip line.

I.5.1.3. Medium Speed Zip Line

I.5.1.3.2. Predicted Rider Speed on Entry to Brake Zone: The designer of a medium speed zip line calculates that riders will arrive at the brake zone travelling between 6 mph (10 km/h) and 15 mph (24 km/h).

I.5.1.3.3. Established Test Speed: During testing the maximum speed on a medium speed zip line shall be between 5.4 mph (9 km/h) and 13.5 mph (21.6 km/h)

Explanatory Note to I.5.1.3.3. *The medium-speed category is meant to reflect an arrival where even failure of all brake systems is likely to result in a survivable collision for the rider and operator. These speeds provide adequate reaction time and brake distance to come to a controlled stop. This range corresponds with the speed limit in most parking lots and the typical speeds of bicycles on shared use paths.*

I.5.1.3.4. Primary Brake: A medium speed zip line requires a primary brake. The primary brake may be guide-operated.

I.5.1.3.5. Emergency Brake: A medium speed zip line requires an emergency brake as specified in I.4.3.

I.5.4.1. High Speed Zip Line:

I.5.1.4.2. Predicted Rider Speed on Entry to Brake Zone: The designer of a high speed zip line calculates that riders will arrive at the brake zone travelling faster than 15 mph (24 km/h).

I.5.1.4.3. Established Test Speed: During testing the maximum speed on a high speed zip line is greater than 13.5 mph (21.6 km/h).

Explanatory Note to I.5.1.4.3*. The high-speed category reflects speeds where failure of the brake system is likely to be catastrophic for the rider and any individuals in the strike zone.*

I.5.1.4.4. Primary Brake: A high speed zip line requires a primary brake. The primary brake shall be passive.

I.5.1.4.5. Emergency Brake: A high speed zip line requires an emergency brake as specified in I.4.3.

I.5.2. **Performance:** The brake system shall:

- ~~Limit the deceleration of the participant so as to prevent a hazard to the participant~~
- Be capable of repeated operation without permanent deformation, undue wear, or failure of any associated components or equipment
- Arrest the motion of the rider ~~participant~~ regardless of their ~~participant~~ orientation
- Not inhibit ~~the participant~~ retrieval ~~procedure in the event~~ if arrest occurs before the rider reaches the zip line landing area ~~is reached~~ or when the emergency brake is activated.

I.5.3. Design Considerations: Brake Systems shall be designed by a qualified person. The design shall address the following:

- ~~Arrest as a critical function~~
- Static, dynamic, and impact loads in worst-case situations
- Compatibility of zip line and brake system including resistance to wear and fatigue with consideration given to the anticipated use
- Environmental factors such as extreme temperatures, wind, and weather conditions
- ~~The level of risk to the participant posed by the failure of the brake system or any of its components, including potential for pinching, binding, entanglement, etc.~~

I.6. Test Requirements:

I.6.1. A qualified person shall design the methods, oversee the performance, and assess the results of operational tests. Standard A.3.2.1. Test Documentation shall exist for every zip line at a facility.

I.6.2. The following circumstances require testing of ~~A competent person shall test~~ the brake systems ~~by a competent person~~ to determine proper system operation:

- As part of the ~~Prior to~~ commissioning of the zip line
- Whenever a brake system or component is disassembled and reassembled, changed, added, or replaced

Explanatory Note to I.6.2.: *The designer may specify an alternate test procedure that may be used when the replacement is like-for-like.*

I.6.3. Participant Action: The designer shall exclude from testing procedures any reduction in speed that may occur as a result of participant interaction.

I.6.4. Testing for Guide Active Systems: A trained and skilled individual who is experienced with the specific brake system and the predicted rider speed shall be the initial tester. The brake system for each zip line shall be re-tested using a range of guides ending with the smallest guide.

Explanatory note to I.6.4. *In addition to establishing test speed, the intent of initial testing of guide active systems is to ascertain that guide strength and reaction time are appropriate. Also refer to standard I.4.1.3. and its explanatory note.*

I.6.4.1. Persons in the Strike Zone: No person, including the tester of guide active systems, shall be in the strike zone during the time of impact of the mass to the brake system.

I.6.5. Emergency Brake: The effectiveness of the emergency brake shall be determined by testing as part of the commissioning process. The primary brake shall be disabled during the testing process. The stopping location, swing, and any contact shall be recorded on a test sheet and this documentation shall be provided to the owner.

Explanatory Note to I.6.5.: *The intent is to verify the compatibility of the emergency brake with the zip line and selected trolley. The test results should be recorded on video that allows for stop action analysis. The criteria for passing an emergency brake should include the rider not hitting the support structure (tree, pole, etc.) or any object and upswing limited to 70 degrees.*

I.6.6. Test masses required: The designer shall specify the minimum and maximum rider masses to be used in the testing procedures and the form (block, mannikin, etc.) that is required.

Explanatory Note to I.6.6.: *As much as is practical, the test should replicate typical zip line operations. For example, use the same style and length lanyard during testing as will be used during operations.*

I.6.7. Number of Trials: The number of test runs on each line with each test mass shall be sufficient to achieve performance stability. Consistent results are obtained when trials are repeated.

Explanatory Note to I.6.7.: *Variability is intrinsic to zip lines. A speed established using too few trials may result in an inaccurate value. Increasing the number of trials in a variety of environmental conditions improves reliability at the detriment of time, cost, and tester fatigue. The number of trials required depends both on the degree of accuracy needed and the variability of initial measurements. More accuracy is required when near the upper limit of a brake system. One must be certain that speed will not exceed capacity if more trials are run. Trials that are tightly clustered, have a normal statistical distribution, and yield a small standard deviation are easy to analyze and require fewer additional trials to establish certainty. Data that are not normally distributed (very remote outliers, clumps away from the mean, skew - more high or low data points) require more trials to achieve performance stability. As a general guideline for each set of variables on each line, three trials is a minimum, five trials is common, and more is better.*

I.6.8. Test results: The speed of each zip line shall be determined by testing as part of the commissioning process. The speed shall be recorded on a test sheet and this documentation shall be provided to the owner.

Explanatory note to I.6.8.: *The intent is to verify compatibility of the zip line with the maximum allowable speed of the selected trolley and brake system. The intent is also to establish a baseline against which speeds observed during operations and periodic monitoring may be compared. The primary brake should be tested (and pass the test) before conducting any additional tests.*

I.6.8.1. Established Test Speed: The established test speed shall be determined by the results of several identical trials yielding performance stability and shall be at least 10% less than the maximum predicted rider speed for that line to ensure that the maximum speed when entering the brake zone does not exceed limits of any components.

Explanatory Note to I.6.8.1.: *The intent is to verify that a buffer exists that accounts for variables that may be present during operation but were not present at the time of testing the line including and not limited to rider position, wind speed, extreme temperatures, and other weather conditions.*

I.6.9. All tests shall provide proof of the following:

- Brake system operational characteristics at the extremes of the design continuum for ~~participant~~ rider weight and arrival speed
- Confirmation that the brake system performs reliably and as designed

Explanatory Note to I.6.9.: *Test documentation provided to the operator should include*

- *Name of the zip line and its location*
- *Type of the brake system being tested and any set-up parameters including and not limited to the location of brake blocks*
- *Test date and time*
- *Names of testing personnel*
- *Record of relevant environmental conditions including and not limited to temperature, humidity, wind speed and direction*
- *Instrumentation used including and not limited to manufacturer, model, and most recent calibration date*
- *Operating parameter being tested including and not limited to mass of the test load used for the trial*
- *Number of trials performed and the result for each trial*

I.7. Inspection and Evaluation: Zip line brake systems shall be evaluated according to the manufacturer's specifications as included in the documentation provided at the time of ~~installation~~ commissioning.

Explanatory Note to I.7. *A brake system inspection may require a comparison of current performance for compliance with the manufacturer's specification. Measurements of wear in brake system components may also be necessary.*

I.7.1. Ongoing Evaluation: The designer shall specify the pre-use check, periodic monitoring, and documentation required of the operator to detect changes in the performance of a zip line brake system. The designer shall specify the condition(s) at which the operator shall inform the designer or manufacturer of the issue and cease operation until the issue is resolved.

Explanatory Note to I.7.1.: *Over time the size of the zip line corridor, the speed of riders, position of padding, performance of the padding, and tension of the lifeline may change. These changes, alone or in combination with one another, could alter the performance of a zip line brake system in ways that may or may not be critical. Regular monitoring procedures including and not limited to use of a GPS speedometer app, assessing cable tension, and measuring cable height enable the operation to detect early changes.*

I.7.2. Professional Inspection: The inspector shall review operator provided data from pre-use checks and periodic monitoring to determine whether zip line braking system continues to function within the predicted rider speed.

Explanatory Note to I.7.2.: *Where the operator is unable to supply the professional inspector with data from previous evaluation procedures, the operator should provide the professional inspector with this data within 30 days. The intent is to ensure that the operation has procedures for detecting possible changes in zip line performance before the situation becomes critical – not to re-create historic data.*

J. EQUIPMENT

J.1. Scope: This standard establishes requirements for life safety ~~system~~ equipment (hereinafter referred to as 'equipment') used as part of the operation of a course by participants.

J.2 General Principles

J.2.1. Understanding and Interpreting the Standard (Systems Approach): Courses may use equipment assembled into systems of components (hereinafter referred to as 'system') to achieve a variety of purposes. ~~As such, systems may include belay systems, rope rigging systems, personal safety systems, and fall arrest systems.~~ Unless specific editions of other standards are referenced, the current edition shall be used.

J.2.2. System Integrity: Life Safety Equipment Systems shall meet all applicable requirements of the critical systems standard (DPI Standard Section A).

J.3. Application

J.3.1. Selection Criteria for Equipment

J.3.1.1. Design Considerations: When creating equipment systems, the qualified person shall consider the actual loads at various locations in these systems as well as conditions that may reduce the strength of components or adversely impact their performance.

Explanatory Note to J.3.1.1. *An example of a condition that reduces the strength of a component is the loss of strength in a rope due to knots.*

J.3.1.2. Compatibility: Individual pieces of equipment within a given system shall be compatible with other pieces of equipment in the system and shall not adversely affect the performance of the system.

Explanatory Note to J.3.1.2. *The compatibility of components in an equipment system is essential to ensure that a system works as intended. Examples of compatibility include the use of proper diameter ropes in belay devices as prescribed by the manufacturer. Compatibility is also meant to address material interactions, such as the use of an appropriate pulley sheave on a zip line cable. Compatibility requirements are not intended to limit the use of products from a variety of manufacturers in a particular system.*

J.3.1.3. Limitations: Strength and performance requirements of this standard are limited to equipment that is being used to support or arrest the fall of a single ~~person~~ climber. Higher breaking strengths or different performance criteria shall be specified by a qualified person when designing systems for multi-participant or rescue-level loads.

J.3.1.4. Guidelines for Use of Equipment: A qualified person shall specify equipment components and systems and shall document limitations of use if different from original equipment manufacturer guidelines.

Explanatory Note to I.3.1.4. *When variant use for equipment is prescribed, it may result in the "manufacturer" becoming the person or entity who prescribes the variant use of the equipment, with all the legal implications that this change entails.*
Although the accurate conversion of 5,000 lbf to the SI system is 22.2 kN, it is important to acknowledge that manufacturers of many pieces of equipment publish a rounded-off strength rating of 22 kN when the strength is actually 5,000 lbf or the equipment was originally designed under the SI system (where 22 kN may have been the specified strength). In any case, ACCT considers a published rating of 22 kN to be equivalent to and complying with the 5,000 lbf strength standard.

J.3.2. Inspection and Evaluation - General

J.3.2.1. Inspection: Equipment shall be inspected at intervals specified by the manufacturer or qualified person for correct operation and function. Supporting information may include date of purchase, use logs, and other records as applicable.

J.3.2.2. Retirement: Retirement of equipment shall be determined by a qualified person in accordance with DPI Standard J.3.1.

J.3.2.2.1. Metallic Materials: In the absence of manufacturer's guidance, retirement shall be based solely on an evaluation of wear, deformation, cracking, weld anomalies and assessment of its general condition.

J.3.2.2.2. Synthetic Materials: Manufacturer's instructions and equipment implementation shall be referenced in determining synthetic material retirement. It is the inspector's responsibility to gather information regarding equipment purchase and/or implementation dates.

Explanatory Note to J.3.2.2.2. *Synthetic materials such as polyamide (e.g., nylon, Kevlar, Technora) and polyester degrade with time and use, presenting additional challenges in determining retirement criteria for equipment. Factors such as environmental exposure, stress cycling, solvent damage, and abrasion should be factors considered, amongst others, when determining the retirement of synthetic equipment. Manufacturer's instructions along with usage history will provide a baseline for assessment of such equipment.*

J.3.2.3. If the inspector is unfamiliar with a piece of equipment or its manufacturer, ~~he/ she~~ they may choose to disclaim responsibility for that item of equipment and refer the client to the equipment supplier or manufacturer. In the instance of the inspector disclaiming responsibility for the item of equipment, the inspector shall issue a disclaimer statement to the owner.

J.3.3. ~~Personal Safety Systems~~ (reserved for future use)

~~**I.3.1.1. Strength:** A personal safety system shall be designed with a minimum rated breaking strength of 3,375 lbf (15.0 kN).~~

~~**I.3.1.2. Freefall Limitation:** The potential free-fall shall be limited to no more~~

~~than 2′- 0″ (610 mm).~~

~~***Explanatory Note to I.3.3.2.*** *This limitation is often determined by the authority having jurisdiction (for example, state regulators). See definition for personal safety system.*~~

~~**I.3.1.3. Compatibility:** Individual components within a personal safety system shall be functionally and operationally compatible with all other components of the personal safety system. Compatibility shall be determined by a qualified person and may require manufacturer guidance.~~

~~***Explanatory Note to I.3.3.3.*** *Other compatibility issues are discussed in the August 2015 ACCT Advisory for Dual Leg Lanyards.*~~

J.3.4. ~~Belay Systems and Rope Rigging Systems~~ (reserved for future use)

~~**I.3.1.4. Strength:** Belay systems and rope rigging systems shall be designed so that the minimum breaking strength of the system is five times the expected load (safety factor of 5:1). The expected load shall be determined by a qualified person.~~

~~***Explanatory Note to I.3.4.1.*** *When creating a rope system, the designer should take into account the expected load at different points in the rope load path and strength loss due to knots or other contributing factors.*~~

~~**I.3.1.5. Impact Force:** Belay system and rope rigging system components shall be selected to minimize the arrest force on the participant and prevent unintended contact with the ground or other hazards.~~

~~***Explanatory Note to I.3.4.2.*** *The designer of belay systems and rope rigging systems should consider rope elongation and length of rope in service when determining impact forces and the likelihood of the participant hitting the ground or other part of the element.*~~

~~**I.3.1.6. Compatibility:** Individual components within a belay or rope rigging system shall be functionally and operationally compatible with all other components in the system. Compatibility shall be determined by a qualified person and may require manufacturer guidance.~~

~~***Explanatory Note to I.3.4.3.*** *The compatibility of components in a system is essential to ensure that a system works as intended. Examples of compatibility include the use of proper diameter ropes in belay devices as prescribed by the manufacturer. Compatibility is also meant to address material interactions, such as the use of an appropriate pulley sheave on a zip line cable. Compatibility requirements are not intended to limit the use of products from a variety of manufacturers in a particular system.*~~

J.3.5. Connectors on Equipment Systems

J.3.5.1 Design Requirements: Carabiners, snap hooks, and rapid links shall have a minimum rated breaking strength of 5,000 lbf (22.2 kN).

J.3.5.2. Material Requirements: Connectors that traverse (slide) on uncoated wire rope under load shall have wear resistant (toughness) characteristics equivalent to that of the steel on the contact surface.

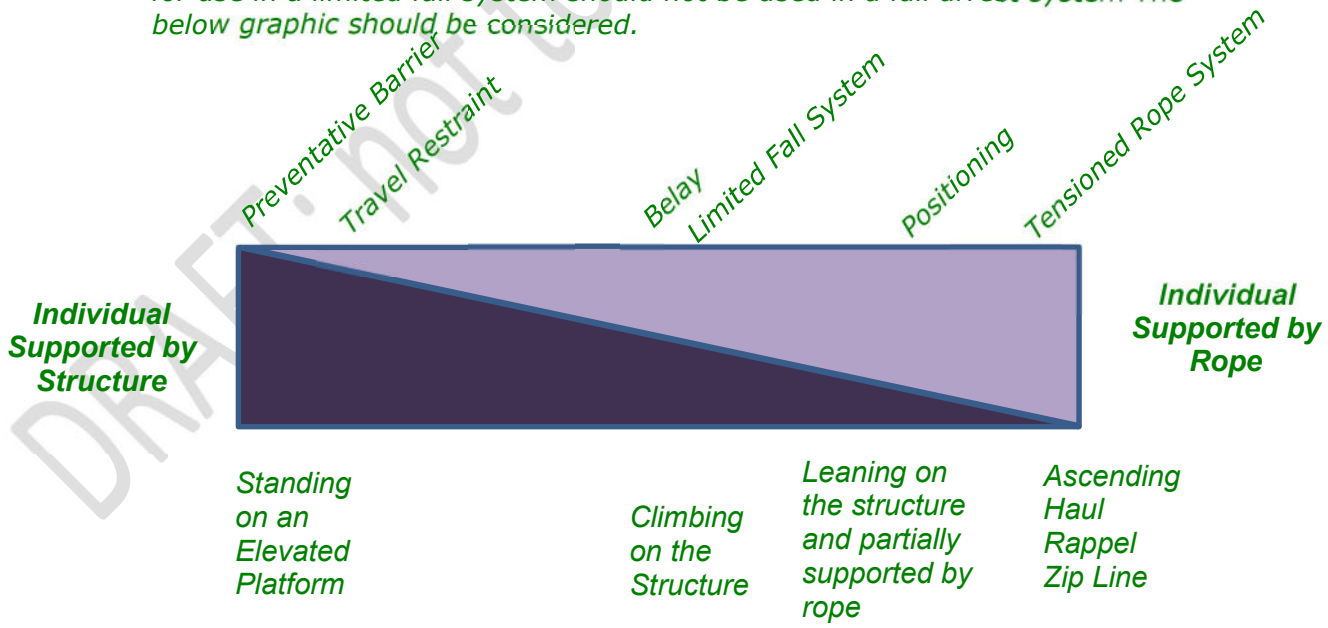
J.3.5.3. Quality Assurance: Connectors shall meet the requirements of and be compliant with any one of the following: ANSI Z359, CSA Z259, EN 12275, EN 362, NFPA 1983, or UIAA 121. When used as part of a personal fall arrest system or other automated safety system, the connector shall meet the requirements of one of the following standards: ANSI Z359, ANSI A14.3, CSA Z259, EN 12275, EN 362, or other applicable standard in the jurisdiction of use.

J.3.5.4. Inspection and Evaluation: The inspector shall assess the severity of any degradation on the integrity of the connector. The inspector shall assess connector integrity with consideration given to scoring, cracking, corrosion, area reduction, material incompatibility, defect in gate operation, hinge, locking mechanism, and deformation.

J.3.6. Lanyards

J.3.6.1. Type: Lanyards as part of limited fall systems, belay systems, and tensioned rope systems are acceptable for use by participants on courses. Lanyards may be tied or sold as a manufacturer-assembled system.

Explanatory Note to J.3.6.1: *Lanyards may be suitable for use in more than one operating system. For example, some lanyards designed for use in a fall arrest system may be used in a tensioned rope system, a belay system or a limited fall system. However, the converse is not true: equipment specifically for use in a limited fall system should not be used in a fall arrest system The below graphic should be considered.*



J.3.6.1.1 Tied Lanyards: ~~**Strength:** Lanyards shall have a minimum rated breaking strength of 5,000 lbf (22.2 kN) for fall arrest systems and 3,375 lbf (15.0 kN) for personal safety systems.~~ Knots are allowable so long as the strength

requirement is met and they are tied by a competent person.

Explanatory Note to J.3.6.1.1. *Tying knots in ropes and clipping carabiners into the created loops is considered rope rigging and not manufacturing. However, spliced terminations are considered to be manufactured due to their intended permanent nature.*

J.3.6.1.1.1. Tied Lanyard Material: Material used for tied lanyards shall be of type specifically designated for life safety use and comply with the requirements of DPI standard J.3.11.1.

J.3.6.1.2. Manufactured (Manufacturer Assembled) Lanyards: Lanyards sold as a manufacturer-assembled system shall be tested as a complete product using a recognized and named quality assurance system that complies with the requirements of DPI standard J.3.6.3.

Explanatory Note to J.3.4.1.2.: *When the lanyards are not intended to be disassembled by the climber in order for the components to be used separately, the manufacturer shall provide certified test results of the unit as a whole – the testing requirement is not met by using individually tested components.*

~~**I.3.1.7. Quality Assurance:** Material used for lanyards in life safety systems shall comply with the requirements of DPI Standard I.3.11.1.~~

J.3.6.2. Selection: Lanyards shall be selected by a qualified person to be appropriate for the intended use and compatible with the design of the facility and other system components. Lanyards shall be correctly sized for the height and weight of the climber.

Explanatory Note to J.3.4.2. *Other selection ~~compatibility~~ issues are discussed in the August 2015 ACCT Advisory for Dual Leg Lanyards.*

J.3.6.3. Performance Requirements: Lanyards shall be of a type specifically designed for life safety use and meet the strength requirement for the operating system(s) where they are used.

J.3.6.3.1. Belay Systems: Lanyards used in belay systems shall have a minimum rated breaking strength of 5,000 lbf (22.2 kN). Lanyards used in belay systems shall meet the requirements of and be compliant with any one of the following: EN 566, UIAA 104, UIAA 109, or NFPA 1983 – T (end-to-end) straps.

Explanatory Note to J.3.6.3.1. *Typically the lanyard(s) used in belay systems are part of a Pecos River Style M-Belay.*

J.3.6.3.2. Limited Fall Systems: Lanyards in limited fall systems shall have a minimum rated breaking strength of 3,375 lbf (15.0 kN). Lanyards used in limited fall systems shall meet the requirements of and be compliant with any one of the following: EN 354, EN 566, UIAA 104, UIAA 109, or NFPA 1983 – T (end-to-end) straps.

Explanatory Note to J.3.6.3.2. *Typically the lanyard(s) used in limited fall*

systems are issued to climbers on elements where the fall distance is 2 ft (60 cm) or less and there is a high likelihood of the climber will be able to recover from a fall.

J.3.6.3.3. Tensioned Rope Systems: Lanyards used in tensioned rope systems shall have a minimum rated breaking strength of 3,375 lbf (15.0 kN). Lanyards used in Tensioned Rope Systems shall meet the requirements of and be compliant with any one of the following: EN 355, EN 566, UIAA 104, UIAA 109, or NFPA 1983 – T (end-to-end) straps.

Explanatory Note to J.3.6.3.3. *Typically the lanyard(s) used in tensioned rope systems are part of the rider attachment system for zip lines, Giant Swings, and 4:1 pulley systems. The Tensioned Rope Systems category does not include requirements for lanyards used in Travel Restraint, Positioning or Personal Fall Arrest Systems.*

J.3.6.4. Inspection and Evaluation: Inspection of lanyards shall include an assessment of knots, splicing, swaging, and stitching; strength reduction from the termination; condition of the energy (shock) absorber, lanyard material, and metallic components (including built in connectors or buckles); age; and use.

Explanatory Note to J.3.6.4. *Lanyards that incorporate automated systems (i.e. interlocking, integrated, self-retracting) shall be inspected according to the manufacturer's inspection and replacement specifications including the use of manufacturer-recognized technicians where specified.*

~~***Explanatory Note to J.3.6.4.*** *Self-retracting lanyards are part of an engineered system and shall be inspected according to the manufacturer's inspection and replacement specifications. Anchorages for self-retracting lanyards should be inspected according to Standard E.4*~~

J.3.7. Pulleys

J.3.7.1 Strength in a Belay System: Pulleys used as part of a belay system for an individual ~~participant~~ climber shall have a minimum rated breaking strength of 5,000 lbf (22.2 kN) or five times the expected load as determined by a qualified person.

J.3.7.2. Strength when part of a Limited Fall ~~Personal Safety~~ System: Pulleys used as part of a limited fall ~~personal safety~~ system for an individual ~~participant~~ climber shall have a minimum rated breaking strength of 3,375 lbf (15.0 kN) or five times the expected load as determined by a qualified person.

~~**Explanatory Note to J.3.7.2.:** *Zip line pulleys (trolleys) may be considered part of a tensioned rope system.*~~

J.3.7.3. Strength when part of a Tensioned Rope ~~Rigging~~ System: Pulleys used as part of a tensioned rope ~~rigging~~ system to support individual ~~participants~~ climbers or riders shall have a minimum rated breaking strength of 3,375 lbf (15.0 kN) or two times the expected load as determined by a qualified person.

Explanatory Note to J.3.7.3. *Pulleys that may be used as part of an activity and will only be subjected to static loads use the same strength criteria as element support systems (DPI Standard G.1.1.). An example of pulleys in a tensioned rope ~~rigging~~ system are pulleys in a 4:1 haul system. Pulleys that are part of the belay system may be subject to greater impact forces and therefore have a higher strength requirement. An example of this application is a cable pulley that supports a shear reduction device. Zip line pulleys (trolleys) may be considered part of a tensioned rope system.*

J.3.7.4. Material Requirements: Pulley sheaves shall be compatible with the other components with which they are used.

J.3.7.5. Quality Assurance: Pulleys used on elements shall meet the requirements of either the UIAA 127, EN 12278 or NFPA 1983 standard or be approved for use by a qualified person.

J.3.7.6 Inspection and Evaluation: Inspection shall include an assessment of the following: operation of moving parts; defects or damage to metallic components including scoring or grooving; loose or damaged bearings or bushings; damage to the axle or fasteners; and corrosion. The inspector shall assess the pulley's integrity and suitability for use.

J.3.8. Belay Devices and Descent Control Devices

J.3.8.1. Performance Requirements: Belay devices and descent control devices shall meet the requirements of NFPA 1983, UIAA 129, ISO 22159, EN 15151-1 or EN 341.

J.3.8.2. Inspection and Evaluation: Inspection shall include an assessment of the following: presence of significant scoring, grooving, wear, or sharp edges; damage or defects; and improper operation of moving parts. The inspector shall assess the impact on the performance of the device from any problems found.

J.3.9. Shear Reduction Devices

J.3.9.1 Application: A shear reduction device should be used for dynamically belayed diving/leaping elements or other activities with similar dynamic features.

J.3.9.2. Strength: Shear reduction devices shall have a minimum rated breaking strength of 5,000 lbf (22.2 kN).

J.3.9.3. Inspection and Evaluation: Inspection shall include an assessment of the following: presence of significant scoring, grooving, wear, or sharp edges that may damage the belay line; damage or defects; proper operation of moving parts; and corrosion. The inspector shall assess the shear reduction device's integrity and suitability for use.

J.3.10. Vertical Fall Arresters (Rope/Cable Grabs)

J.3.10.1. Selection: Vertical fall arresters shall be selected by a qualified person and be compatible with the host lifeline. When selecting a vertical fall

arrester, consideration shall be given to its ability to effectively arrest a fall when used in combination with other system components (e.g. harness type and attachment location, shock absorber, etc.).

J.3.10.2. Performance Requirements: Vertical fall arresters shall be of a type that prevents accidental detachment from the rope. Vertical fall arresters shall meet the requirements of one of the following standards: ANSI Z359, ANSI A14.3, CSA Z259, EN 353, or other equivalent standard in the jurisdiction of use.

Explanatory Note to J.3.10.2. *When using cable grabs, the occurrence of a phenomenon called delayed lock-on is possible and remedial action may be required. Information about delayed lock-on and its risks is found in the ACCT Safety Awareness Bulletin dated January 2009.*

J.3.10.3. Inspection and Evaluation: Inspection shall include an assessment of the following on the performance of the device: damage and defects; grooving and wear; and improper operation of hinge/locking mechanisms.

J.3.11. Rope and Webbing

J.3.11.1. Performance Requirements: Rope and webbing used as part of a life safety system shall be of a type specifically designed for life safety use.

J.3.11.1.1. Dynamic Rope shall meet UIAA 101 or EN 892 or be approved by the manufacturer for belaying a single person.

J.3.11.1.2. Low Stretch Rope and Static Rope shall meet one or more of the following standards: UIAA 107, NFPA 1983, EN1891 (Type A), CI 1801, or CI 1805 or be approved by the manufacturer for ~~belaying a single participant~~ life safety use.

J.3.11.1.3. Webbing (tape) shall have a minimum rated breaking strength of five times the expected load as determined by a qualified person.

Explanatory Note to J.3.11.1.3. *References: PIA (Parachute Industry Association) standard for webbing (PIA-W-5625), EN 565 or UIAA 103.*

J.3.11.1.4. Accessory Cord for use in an equipment system shall meet either UIAA 102, EN 564, or CI 1803, and be compatible with other system components, AND shall meet the system performance requirements in which it is employed.

J.3.11.2. Inspection and Evaluation: Inspection shall include assessment of rope or cordage integrity with consideration given to wear, cuts, discoloration, or glazing; stiffness, softness, or inconsistency; change in diameter or bend radius; unknown or suspect history; age; and use.

J.3.12. Harnesses

J.3.12.1. Type: Manufactured sit, sit/chest, full body, or tied harnesses are acceptable for use by participants on courses. Harnesses shall be selected by a qualified person to be appropriate for the activity and intended use.

J.3.12.2. Fit: Harnesses shall be correctly sized and fitted based on the age, size, and body type of the individual.

J.3.12.3. Strength: Harnesses used as part of belay, tensioned rope ~~rigging~~, or limited fall ~~personal safety~~ systems shall have a minimum breaking strength of 3,375 lbf (15.0 kN) when oriented as designed. Harnesses used as part of personal fall arrest system shall have a minimum breaking strength of 5,000 lbf (22.2 kN) when oriented as designed.

J.3.12.4. Quality Assurance: Harnesses shall meet performance, construction and testing requirements of: UIAA 105, EN12277, ANSI Z359, ASTM 1772, NFPA 1983 or other applicable standards or be approved for use by a qualified person.

J.3.12.5. Inspection and Evaluation: Inspection shall include an assessment of webbing and stitching, belay/rappel loops, and any metallic components including built in D-rings or buckles. The inspector shall assess harness integrity with consideration given to damage to the webbing material or stitching; discoloration or deformity of the webbing material; defective or deformed metallic components; age; and use.

J.3.13. Helmets

J.3.13.1. Selection: A qualified person shall determine whether a helmet is required and the standard the helmet shall meet. Relevant Standards may include UIAA 106, EN 12492, ANSI Z89.1 or CSA Z94.1.

J.3.13.2. Inspection and Evaluation: Inspection shall include assessment of the shell, absorption material, suspension system and fasteners, and buckles. The inspector shall assess helmet integrity with consideration given to fractures or other damage to the shell; damaged or defective absorption material including mold and mildew; defective suspension system; corrosion on metallic fasteners; broken or defective buckles; strap material condition; age; and use.

CHAPTER 2

OPERATION STANDARDS

A. GENERAL REQUIREMENTS

A.1. Scope: The ANSI/ACCT 03-2019 Standards: Operation Standards (hereinafter referred to as "Operation Standard") establish minimum operational procedures and staff competencies for Challenge Courses, Aerial Adventure/Trekking Parks, Canopy Tours and Zip Line Tours (hereinafter referred to as "courses").

A.2. Purpose: The purpose of this section is to establish a set of standards that:

- Define the critical skills and knowledge necessary for management, programmatic, and technical operation of a course
- Designate core, technical, and interpersonal/program management staff competencies for a course
- Elevate the level of quality and enhance professional practices in all course programming
- Promote better risk management practices associated with operating a course
- Represent a consensus of leading practitioners, managers, vendors, or any person with a direct and material interest in the field
- Allow for creativity in design and implementation of programs while ensuring effective operations
- Apply to all facilities and operations using the DPI Standard for the construction, maintenance, and inspection of the facility

A.3. General Principles

A.3.1. The Operation Standard is organized into two sections:

- **Operations Management:** Philosophy & Ethics, Administration, and Human Resource Management.
- **Staff Competencies:** Core, Technical, and Interpersonal/Program Management Competencies are general headings with applicable sub-sections organized by Delivery Approach ~~as shown in the table below:~~

A.3.1.1. Facilitated Delivery Approach: In a facilitated challenge course program participants engage in an adventure-based learning experience designed to lead toward particular outcomes. Trained staff are responsible for safety and the group's learning process.

Explanatory Note to A.3.1.1. *The facilitated delivery approach includes and is not limited to conventional challenge course programming. Typical operating systems include spotting, top rope belay (including team belays), limited fall systems, and tensioned rope systems such as those used for Flying Squirrel, Giant Swing by Choice, rappelling (abseiling), and zip lines.*

A.3.1.2. Guided Delivery Approach: Under the guided approach, Participants engage in a set tour escorted by trained personnel who directly supervise (i.e. close enough to physically intervene) participant actions. Trained staff are responsible for safety and may provide educational programming.

Explanatory Note to A.3.1.2. *The guided delivery approach includes*

and is not limited to zip line and canopy tours. Typical operating systems include collective safety systems (preventative), limited fall systems, and tensioned rope systems such as those used for zip lines, and rappelling (abseiling).

A.3.1.3. Self-Guided Delivery Approach: At operations using a self-guided delivery approach, participants engage in an adventure-based experience & are able to select their own route or elements. Trained staff monitor safety and do not directly supervise (i.e. are not close enough to physically intervene) participant actions.

Explanatory Note to A.3.1.3. *The self-guided delivery approach includes and is not limited to aerial adventure parks and aerial trekking parks. Typical operating systems include collective safety systems (both preventative and soft-fall), automated systems, limited fall systems, and tensioned rope systems such as those used for zip lines.*

A.4. Application

A.4.1. The Operation Standard should be taken as a whole. However, some standards may not apply to specific programs or practitioners, depending upon such variables as: type of program, client profile, type of course, course operating systems, or other site-specific conditions.

A.4.2. The competencies outlined in these standards do not necessarily need to be held by every individual staff member. The intent is that these competencies are present in the staff body as a whole during all programming. These competencies may be possessed by an individual or a team of individuals and are expressed in three forms:

- Knowledge of a topic: familiarity, awareness, or understanding gained through experience or study.
- Demonstrated ability: the act of showing or performing a particular skill at a particular time.
- Mastery of skills and knowledge: possession of full and current command of particular skills and/or area of knowledge.

B. OPERATIONS MANAGEMENT

B.1. Philosophy and Ethics

B.1.1 This item is intentionally left blank.

B.1.2. The organization shall represent itself, and market its products and services, accurately to the public.

B.1.3. The organization shall meet mandated codes of conduct with respect to employee's and client's rights and confidentiality.

B.1.4. The organization and its staff shall operate within the bounds of their organizational and individual competencies.

B.1.5. The organization shall follow applicable laws and regulations.

B.1.6. The organization shall have knowledge of and conduct operations in accordance with applicable local, regional, and national environmental guidelines.

Explanatory Note to B.1.6. *It is recommended that the organization take adequate steps to mitigate the environmental impact of programming in areas or on courses where they conduct activities. Examples include, ~~but~~ and are not limited to, care of the natural environment; proper waste disposal; respect for wildlife; and minimized impact from fire, erosion, and soil compaction.*

B.2. Administration

B.2.1. The organization shall have a risk management system in place that addresses the identification, mitigation, and ongoing monitoring of reasonably foreseeable risks to the organization, its staff, and its participants.

Explanatory Note to B.2.1. *A functioning risk management system has components or features in place allowing an organization to comprehensively identify risks to itself, staff, and its clients. Risk management may include such mitigation strategies as eliminating, minimizing, transferring, or accepting certain risks. A risk management system also includes components that allow an organization to monitor risks on an ongoing basis, resulting in intervention and adaption of operations or programming as prudence dictates. Appropriate signage may be an important component of the risk management system as follows:*

- *List of facility rules and essential operational guidelines (e.g. restrictions for minimum height, weight limits, minimum age, etc.)*
- *Guidance to and along designated trails*
- *Warning signs for restricted areas or hazards*

B.2.2. The organization shall maintain written records for a period of time which takes into account statutes of limitations pertaining to claims under pertinent laws.

B.2.3. The organization shall maintain professional inspection reports for at least the life of each specific element.

Explanatory Note to B.2.3. *Manufacturer instructions, recall notices, and advisories pertaining to the element should also be retained.*

B.2.4. The organization shall have adequate written policies, procedures, and/or practices that establish minimum acceptable criteria for all course operations.

Explanatory Note to B.2.4. *Document(s) that define adequate policies, procedures, and/or practices include, and are not limited to: a discussion of adequate preparation and planning for activities; conduct of specific activities or types of activities; appropriate curriculum; competent instruction; sufficient participant supervision; appropriate safety procedures; care and use of equipment; and emergency response.*

B.2.5. The organization shall have a written plan in place for the reasonable management of emergencies.

Explanatory Note to B.2.5. *A reasonable emergency response plan may include, and is not limited to: prevention strategies; emergency preparedness; administrative response to emergencies; field response to medical emergencies; field response to incidents/accidents and fatalities; technical rescues; activating the emergency medical system; evacuations; addressing severe weather, natural disasters, terrorism, violent crime, missing persons, and notification of next of kin; media relations; or response to any reasonably foreseeable emergency situation. Periodic training and practicing of emergency action plan should occur.*

B.2.5.1. The organization shall have onsite, when participants are present, a person trained in basic first aid and CPR.

B.2.6. The organization should maintain appropriate types and amounts of insurance coverage for each location in which they operate.

Explanatory Note to B.2.6. *Insurance coverage may include general liability and other coverage required by law, such as workers compensation.*

B.2.7. The organization shall engage in a review of its practices by an external qualified person(s), at least once every five (5) years.

Explanatory Note to B.2.7. *The organization engages person(s) outside the organization to review risk management and program quality. This could include a comprehensive review of documentation (pre-use checks and periodic ~~self-inspections~~ monitoring, ~~annual~~ professional inspections, near miss logs, training documents, participant screening and informed consent procedures, etc.), interacting with and shadowing staff to determine culture and common practices, reviewing equipment storage, etc.*

B.2.8. The organization shall ensure a qualified person is responsible for administrative and operational decisions.

B.2.9. The organization shall maintain written documentation of an acceptance inspection for all new installations and major modifications.

B.2.10. The organization shall have its course(s) inspected by a qualified inspector annually or more frequently as specified by the designer, manufacturer or other qualified person.

Explanatory Note to B.2.10. *Significant environmental impacts such as ice storms, hurricanes, tornadoes, or earthquakes, lightning strike, or other events that may affect the structural integrity of components on the course may trigger the need for an inspection. See Section B of the DPI Standard (Inspection Requirements) for detail on the information required in the report.*

B.2.11. The organization shall take appropriate actions based on the results and recommendations of an inspection report provided by a qualified inspector.

Explanatory Note to B.2.11. *Appropriate actions may include and are not limited to: making recommended repairs to or replacement of course elements or equipment; and/or alterations or maintenance of the environment. This may include suspending operations of all or specific elements, activities, or areas until repairs or other actions have been completed.*

B.2.12. The organization shall conduct and document periodic internal monitoring of its course and equipment as designed by the manufacturer or a qualified person.

Explanatory Note to B.2.12. *Internal monitoring assesses the condition of the following: course environment/ area; and all constructed course elements and equipment. The frequency of internal monitoring is contingent upon course location, frequency of use, and course design.*

B.2.13 The organization shall ensure a pre-use check is conducted for each course element and related equipment according to a written checklist. The pre-use check shall be developed by the designer, manufacturer, installer, or qualified person and the check shall be documented prior to participant use.

Explanatory Note to B.2.13. *The pre-use check may be a routine visual examination. Checks may be ongoing throughout the use of an element or event to monitor changes in element conditions, weather, or other related factors.*

B.2.13.1. For zip lines, the pre-use check shall include one full cycle, or as recommended by the original equipment manufacturer, by staff prior to operations with participants to assess sufficiently the condition and functionality of the activities and the zip line(s).

Explanatory Note to B.2.13.1. *It is strongly recommended that staff visually examine all terminations and cables from the ground before completing one full cycle on the tour.*

B.2.14. Critical maintenance items discovered during ~~in-house~~ periodic internal monitoring and pre-use checks which pose an immediate risk to participants or staff shall be documented.

B.2.15. Critical maintenance items documented during ~~in-house~~ periodic internal monitoring and pre-use checks shall be addressed.

B.2.16. Remediation of critical maintenance items shall be documented.

B.2.17. The organization shall have a policy for assessing and confirming that activity corridors are clear of obstructions and hazards before each and every participant starts the activity.

Explanatory Note to B.2.17. *This includes assessing and confirming that zip lines, giant swings, etc. are clear of obstacles such as ladders, trees and branches, people, vehicles; and dismounting devices.*

B.2.18. The organization shall have an appropriate participant screening process.

Explanatory Note to B.2.18. *An appropriate participant screening process varies according to specific circumstances including ~~but~~ and not limited to: types of activities offered; course operating system(s); activity difficulty levels; and type of environment. The organization solicits sufficient information from the client or participant to facilitate screening, which may include collecting pertinent medical or other information to achieve maximum participant inclusion.*

B.2.19. Prior to participation, the organization shall inform participants of the existence of inherent and other risks of course activities, describing a sampling of risks.

B.2.20. The organization shall have a written participant supervisory plan.

Explanatory Note to B.2.20. *A supervisory plan may include participant appropriate measures, such as adequate ratios of practitioners to participants, taken during both structured and unstructured program time.*

B.2.21. The organization shall have written, site-specific procedures for all activities or types of activities.

B.2.22 The organization shall have a system in place for incident documentation.

B.2.23. The organization shall perform an annual analysis of all incident documentation. Findings shall be documented in writing, including any remedial measures or changes implemented.

Explanatory Note to B.2.23. *The incident data is analyzed at least annually to identify trends, evaluate performance, and inform prudent corrective action.*

B.2.24. The organization should take appropriate measures to provide access to basic amenities for staff and participants.

Explanatory Note to B.2.24. *Basic amenities include, ~~but~~ and are not limited to, adequate nourishment and water, access to appropriate bathroom facilities, provision for hand washing, and provision of clean equipment.*

B.2.25. The organization shall operate each course element according to the original equipment manufacturer and/or qualified person's recommended procedures regarding and not limited to capacities, weights, and number of participants.

B.2.26. Where courses are used in dark or low light environments the organization shall:

- Provide appropriate lighting of all takeoff and landing areas
- Provide personal light or reflective material on each participant
- Provide lighting at all exit and entry areas or any other areas necessary for operations
- Provide sufficient emergency lighting to facilitate evacuation in the event of an emergency or a power failure

B.3. Human Resource Management

B.3.1 The organization shall have employment policies in place.

B.3.2. The organization shall have a means of communicating employment policies to staff.

B.3.3. The organization shall define adequate, minimum qualifications for all staff.

Explanatory Note to B.3.3. *The minimum qualifications may address*

age, educational requirements, prior experience, necessary skills or competencies, specific job responsibilities and duties, and essential functions.

B.3.4. The organization shall have an appropriate screening process in place for staff.

Explanatory Note to B.3.4. *Screening procedures may include ~~but~~ and are not limited to: having candidates complete a written application; face-to-face or telephone interviews; reference check; medical examinations; review of driving record; and criminal background check.*

B.3.5. The organization shall maintain a current personnel file for each staff member.

Explanatory Note to B.3.5. *The personnel file may include and is not limited to: an application form, résumé or curriculum vitae, letter of application, written references, certifications, records of training completed, proof of identity, proof of citizenship, job description, compensation agreement, or other documents.*

B.3.6. The organization shall have a system in place for training staff and volunteers in necessary skills and competencies, beyond those skills of initial employment, and all training shall be documented.

B.3.7. The organization shall conduct annual or more frequent staff assessments on core, technical, and interpersonal/program management competencies necessary to conduct course operations.

B.3.8. This item is intentionally left blank

B.3.9. The organization shall have a system in place for supervising and monitoring the performance of all staff.

B.3.10. The organization shall maintain documentation of agreements with independent contractors and staff.

C. STAFF COMPETENCIES

C.1. **Core Competencies** are fundamental to operations and possessed by each staff member.

C.1.1. This item is intentionally left blank.

C.1.2. Staff shall operate within the limits of their technical and interpersonal/program management skill level.

C.1.3. Staff shall know and understand ACCT Operation Standards applicable to their job assignment.

C.1.4. Staff shall have knowledge of venue and specific activities appropriate to their job duties.

C.1.5. Staff shall know duty relevant participant information.

C.1.6. Staff shall understand and maintain client confidentiality.

C.1.7. Staff shall follow original equipment manufacturer's recommendations and/or local operating procedures to determine appropriate staff-to-participant ratios for activities.

C.1.8. Staff shall be capable of initiating and implementing the organization's emergency action plan.

C.1.9 Staff shall follow organizational policies and procedures for restrictions, limitations and participant screening. This should include and is not limited to:

- Weight, age, height, and/or medical conditions
- Intoxication
- Dress and footwear requirements
- Physical limitations
- Element capacity
- Weather and environmental conditions

C.1.10. Staff shall know and implement site-specific first aid procedures.

C.1.11. Staff shall know and communicate activity associated inherent risks to participants.

C.1.12. Staff shall follow the original manufacturer and/or vendor recommended course use procedures regarding capacities, weights, and maximum simultaneous participants.

C.2. **Technical Competencies** refer to management of physical safety and may not necessarily be possessed by all staff or at the same level of expertise.

C.2.1. **General** (applicable to all operating systems)

C.2.1.1. Staff shall recognize risks which are inherent in each activity.

C.2.1.2. This item is intentionally left blank.

C.2.1.3. Staff shall conduct activities according to the organization's guiding policies, procedures, and practices.

C.2.1.4. Staff shall conduct and document a reasonably thorough, ~~in-house~~ periodic monitoring of its own course and equipment including and not limited to life safety systems, activity support structures and life safety equipment. This monitoring may be completed by a qualified third party.

C.2.1.5. Staff shall conduct a pre-use check for each course element and related equipment according to a written checklist.

Explanatory Note to C.2.1.5. *These checks should include pre-use checks ~~inspection~~ of ~~Personal Safety System~~ life safety equipment used during normal course operations and equipment used for participant*

assistance and/or rescue.

C.2.1.6. Staff shall document maintenance issues discovered during periodic monitoring and pre-use ~~inspections~~ checks that pose a risk to participants or staff.

C.2.1.7. Staff shall document remediation of critical maintenance issues.

C.2.1.8. Staff shall properly fit and use equipment in accordance with manufacturer and/or qualified person's recommended procedures.

C.2.1.9. Staff shall set up, operate, and take down equipment used for course operation.

C.2.1.10. Staff shall be able to evaluate proper equipment setup.

C.2.1.11. This item is intentionally left blank.

C.2.1.12. Staff shall communicate to participants necessary safety information prior to the use of any activity or element.

C.2.1.13. Staff shall assess and confirm that activity corridors are clear of obstructions and hazards.

C.2.1.14. Staff shall teach and manage movements and/or transfers from one life safety system to another if applicable.

Explanatory Note to C.2.1.14. *This may include:*

- *Proficiency in use of ~~Personal Safety~~ Limited Fall System equipment*
- *Proficiency in identification and use of appropriate anchor points on all elements*
- *Ability to apply communication protocol*

C.2.1.15. Staff shall identify and assess hazardous conditions that might require course operations to cease, and implement appropriate site-specific emergency procedures, including but not limited to:

- Interruption of critical communications
- Severe weather
- Environmental hazards
- Catastrophic event

Explanatory Note to C. 2.1.15. *For example, operating staff may cease operations because communication was interrupted, or a course manager may determine to cease operations while monitoring lightning activity, etc.*

C.2.1.16 Staff shall perform appropriate interventions and/or technical rescues.

C.2.2. Facilitated Challenge Course: Spotted Activities

C.2.2.1. Staff shall assess when spotting is necessary for an activity based on the element design, population, terrain and the original manufacturer or current vendor documented practices.

C.2.2.2. Staff shall provide for effective spotting on relevant activities.

C.2.2.3. Staff shall determine which spotting techniques are appropriate for relevant activities.

C.2.2.4. Staff shall assess when an individual or group is ready to implement the technique of spotting.

C.2.2.5. Staff shall teach relevant spotting techniques so participants have the ability to help manage risks.

C.2.2.6. Staff shall supervise and manage an individual or group's effective use of various spotting techniques.

C.2.2.7. Staff shall incorporate a clear and consistent communication system between spotter(s) and participant(s).

C.3. Facilitated Challenge Course: Activities Using Life Safety Systems

C.2.3.1 Staff shall be able to assess when a life safety system is required for appropriate participant protection.

C.2.3.2. Staff shall select the appropriate ~~personal safety system, belay system, or rope rigging tensioned rope system, limited fall system~~ operating system from ~~methods~~ those established by original equipment manufacturer and/or local operating procedures.

C.2.3.3. Staff shall be able to tie and evaluate appropriate knots ~~for life safety~~ used as part of operating systems.

C.2.3.4. This item is intentionally left blank.

C.2.3.5. This item is intentionally left blank.

C.2.3.6. Staff shall effectively implement applicable top rope belay systems. Implementation includes and is not limited to:

- Proper physical positioning of a belayer in relation to a participant
- Controlling the belay rope and maintaining proper tension/slack at all times
- Incorporating backup, if necessary
- Incorporating a ground belay anchor system when needed
- Utilizing a communication system that is clear and consistent
- Having the participant attached to the belay system at all times
- Setting up an application-appropriate belay system including: an appropriate shear reduction device, selection of a proper belay device, number and type of ropes, appropriate harness, and clip-in location
- Communicating element specific safety requirements to participants

C.2.3.7. Staff shall effectively supervise and monitor a participant belayer or group belay, taking reasonable steps to determine that the person or group is:

- Properly performing appropriate method and technique
- In proper physical position in relation to the participant
- In control of the belay rope and maintaining proper tension/slack at all times during the belay

- Incorporating backup, if necessary
- Incorporating a belayer anchor system when needed
- Utilizing a clear and consistent communication system

C.2.3.8. Staff shall assess the need for, and incorporate when necessary, spotting during belayed activities.

C.2.3.9. Staff shall effectively implement ~~applicable personal safety~~ limited fall systems and other applicable operating system(s). Implementation includes and is not limited to:

- Proper method and technique
- Proper physical positioning of a participant
- Utilizing a communication system that is clear and consistent
- Having the participant protected from a fall from height at all times.

C.2.3.10. This item is intentionally left blank.

C.2.3.11. This item is intentionally left blank.

C.2.3.12. This item is intentionally left blank.

C.2.3.13. This item is intentionally left blank.

C.2.3.14. This item is intentionally left blank.

C.2.3.15. This item is intentionally left blank.

C.2.3.16. Staff shall use established methods to access high elements and elevated structures.

Explanatory Note to C.2.3.16. *Established methods for accessing and working on high elements and elevated structures are based on analysis of potential hazards and specify the type and application of ~~personal protective~~ life safety equipment. When hazard analysis determines that a person may be pulled off a launch or landing area/platform to a position where there is risk of a fall, that person shall use ~~fall prevention/protection methods~~ operating systems that have been established for working on high elements and elevated structures.*

C.2.3.17. Staff shall use established procedures to perform applicable equipment retrievals from lifelines.

C.2.3.18. This item is intentionally left blank.

C.2.3.19. Staff shall appropriately use ladders or other apparatus incorporated in any high element access or egress.

C.2.3.20. Staff shall use established methods to appropriately descend from a high element.

C.2.3.21. Staff shall properly set up, teach, and manage participant rappel stations if applicable. Skills include and are not limited to:

- Identifying and using acceptable anchor points

- Setting up a proper system to allow timely lowering of a participant if the rappel device becomes jammed (e.g. releasable rappel line)
- Properly attaching rappel rope to anchors
- Properly setting up a separate belay or backup system
- Instructing participants in rappel method and technique including:
  - Proper brake hand position
  - Proper body position
  - Equipment use
- Properly manage any backup system incorporated
- Implementing proper communication techniques

C.2.4. Guided Courses: Zip Line Tours and Canopy Tours

C.2.4.1. Staff shall understand and manage zip line participant take off, travel and dismount as well as instruct and manage other relevant zip line procedures and techniques which may include and are not limited to:

- Body positioning
- Body orientation and control
- Speed control
- Signals and commands
- Braking
- Landing
- Retrieval protocol
- Hand placement
- Contingency response procedures

Explanatory Note to C. 2.4.1. *The dynamics of each zip line are unique. Staff need to understand and be able to communicate to participants the actions required to manage those differences.*

C.2.4.2. Staff shall have a full understanding of and proficiency in the setup, operation and ongoing monitoring requirements of the braking system in effect, when operating zip line(s).

Explanatory Note to C.2.4.2. *This may include:*

- *Proficiency to check and set braking system on all elements*
- *Ability to determine a fault in a braking system*
- *Knowledge of communication protocol for braking system operation*
- *Proficiency in the use of all braking systems on all elements*

C.2.4.3. Staff shall use established methods to properly connect and disconnect a zip line pulley and other ~~personal safety system~~ life safety equipment.

C.2.4.4. If applicable, staff shall have full understanding of and proficiency in the set-up, operation, and ongoing monitoring of equipment and procedures used for tandem or multi-person riding.

C.2.4.5. If applicable, staff shall have proficiency in belaying techniques on vertical elements, proper use of belay equipment, and knowledge of communication protocol for belaying.

C.2.5. Self-Guided Courses: Aerial Adventure/Trekking Parks

C.2.5.1. Staff shall climb and work throughout the course area using appropriate staff ~~Personal Safety~~ operating systems.

C.2.5.2. Staff shall monitor and/or supervise use of appropriate belay systems.

C.2.5.3. Staff shall monitor and assess participants as needed.

C.2.5.4. Staff shall respond to participants needing assistance.

C.2.5.5. Staff shall provide monitoring and/or supervision that are appropriate for the category of ~~Personal Safety System(s)~~ Operating System (s) employed and participant requirements as defined by the original equipment manufacturer or qualified person.

Explanatory Note to C.2.5.5. ~~Personal Safety~~ Limited Fall System Sub-Categories are defined as follows:

- ***~~Non Auto~~ Manual-Locking Lanyard Connections:*** *The connectors are self-closing but not auto-locking ~~connections~~ (e.g. non-locking or screw-locking carabiners). This system is not suitable for use in ~~commercial~~ self-guided operations.*
- ***Auto-Locking Lanyard Connections:*** *Self-closing and auto-locking connections. (e.g. twist-locking carabiners, snaps).*
- ***Interlocking Lanyard Connections:*** *Interconnected to reduce the likelihood of unintentional detachment from the ~~lifeline or anchorage~~ life safety system.*
- ***~~External Keyed Locking~~ Integrated Lanyard Connections:*** *Lanyard attachment is combined with a life safety system detector to prevent unintentional detachment in the air. Includes and is not limited to external keyed locking systems and systems incorporating lifeline sensors. ~~Interconnected to prevent unintentional detachment from the lifeline or anchorage using an external keyed locking system.~~*
- ***~~Consistent~~ Continuous Lanyard Connections:*** *Remains attached to the Life Safety System without the need for the ~~participant~~ climber to transfer connectors between elements (i.e. continuous lifeline system).*
- ~~***Collective Safety System:*** *Permanent and/or temporary systems that allow free movement on an elevated work surface while reducing the risk of injury from falls. Examples include and are not limited to guard rails, balustrade, fences, stairs, and safety nets.~~

Supervision Strategies are defined as follows:

- ***Strategy A:*** *The monitor can physically intervene with a participant to ensure proper use of the ~~Personal Safety System (PSS).~~Limited Fall System*
- ***Strategy B:*** *The monitor is able to see to confirm that the participant is clipped to a life ~~line~~ safety system during connector transfers and able to communicate verbally.*
- ***Strategy C:*** *The monitor is able to see and communicate verbally with the participant.*
- ***Strategy D:*** *The monitor is able to hear and promptly respond to a participant's call for assistance and provide that assistance.*

Note: *Strategies A, B and C supervision are proactive in nature and Level 4 supervision is primarily reactive in nature.*

Minimum supervision strategies are defined as follows:

~~Safety~~ Operating System Sub-Category	*Age 6 and under*	*Age 7 to 9*	*Age 10 and over*
~~Non-~~Auto Manual-Locking	*Not Suitable*	*Not Suitable*	*Not Suitable*
Auto-Locking	*A*	*A*	*B*
Interlocking ~~connected~~	*B or C**	*C*	*C*
~~External Keyed~~ Integrated	*B or D**	*D*	*D*
*~~Consistent~~** Continuous*	*D*	*D*	*D*
*Collective****	*D*	*D*	*D*

** Accompanied by an adult with supervision strategy A capability who provides strategy D response*

*** There must be a system, human or mechanical or combination, in a place that ensures that participants are correctly secured to the lifeline before beginning the circuit.*

**** If participants can escape ~~from~~ the collective system, for example a soft-fall system that uses water, strategy C supervision is needed.*

C.3. Interpersonal/Program Management Competencies

C.3.1. Communication

C.3.1.1. Staff shall be able to clearly and concisely communicate in a manner appropriate to the participants and applicable to the course.

Explanatory Note to C.3.1.1. *Age of participants, number of participants, participant expectations and course types are some of the considerations when determining what to say to participants and when to say it.*

C.3.1.2. Staff shall provide opportunities for participant questions.

C.3.2. Facilitated Courses: Program Design

C.3.2.1. Staff shall conduct an appropriate needs assessment prior to program implementation.

Explanatory Note to C.3.2.1. *The organization solicits relevant information about the group prior to programming that may include and is not limited to: the number of participants; ages; identified group goals and objectives; and any needs related to accessibility, nutrition, or medical conditions.*

C.3.2.2. Staff shall design and provide programming that addresses the needs of the client.

Explanatory Note to C.3.2.2. *Appropriate client programming includes and is not limited to: the type of activities selected, the length of program and the presentation of activities. Activities selected should reflect the expressed goals, needs and abilities of each group. Activities are appropriately sequenced,*

monitored, and adjusted as needed.

C.3.2.3. This item is intentionally left blank.

C.3.3. Facilitated Courses: Assessment

C.3.3.1. Staff shall conduct a group and individual participant assessment of physical abilities, readiness, affect, and behavior prior to activity engagement.

C.3.3.2. Staff shall conduct a performance ability self-assessment for tasks required to effectively facilitate and manage program risks prior to participant engagement.

Explanatory Note to C.3.3.2. *A self-assessment may include and is not limited to: the type of activities selected, the length of program and the presentation of activities. Activities selected should reflect the expressed goals, needs and abilities of each group. Activities are appropriately sequenced, monitored, and adjusted as needed.*

C.3.3.3. Staff shall continually assess participants and staff throughout all aspects of their time on the course.

C.3.3.4. This item is intentionally left blank.

C.3.4. Facilitated Courses: Program Implementation

C.3.4.1. Staff shall communicate relevant program information to participants, including: the nature of the program as voluntary; an explanation of the course activities and/or elements; inherent risks; behavioral norms or expectations; and specific program objectives.

Explanatory Note to C.3.4.1. *Specific information may include: a program format overview, planned activity types, physical exertion levels required, a "level of choice" participation philosophy, and a group agreement/ contract facilitation or presentation.*

C.3.4.2. Staff shall assess group skills, abilities, goals, program objectives, developmental stages, and social/ cultural needs.

C.3.4.3. Staff shall sequence activities that they determine to be appropriate or suitable for the group based on an assessment of group skills, abilities, stages of development, goals, program objectives, and social/ cultural needs.

C.3.4.4. This item is intentionally left blank.

C.3.4.5. Staff shall adapt challenge levels appropriate to group abilities, goals and program objectives.

C.3.4.6. Staff shall provide opportunities for discovery and reflection appropriate for the experience.

Explanatory Note to C.3.4.6. *Staff provides participants opportunities to reflect and express thoughts and ideas related to their experience. These may include*

discussion, writing, art, journaling, or other methods; identifying any generalizations or learning applications to other environments; or other techniques as applicable. This dedicated time may integrate experiential learning cycles or other appropriate reflection and learning models and may vary widely from one program design to another.

C.3.4.7. Staff shall facilitate experiences in a manner that does not unreasonably enlarge the risk for emotional, physical, or social harm.

Explanatory Note to C.3.4.7. *Staff have knowledge of and the skills necessary to promote and monitor safety in physical, emotional, and social domains. Minimizing potential harm may incorporate a group agreement or contract.*

C.3.4.8. Staff shall operate with an appropriate understanding/ knowledge of group-practitioner relationship roles.

C.3.4.9. Staff shall understand and recognize common group behaviors and be able to respond accordingly.

Explanatory Note to C.3.4.9. *Common group behaviors include: resistance, avoidance, transference, counter transference, sabotaging, and discounting. The "How and When" to deal with such behaviors is directly relevant to the program type provided.*

C.3.4.10. Staff shall manage conflicts or other difficulties arising with individuals or groups during the program.

Explanatory Note to C.3.4.10. *As an extension of monitoring and managing the group, a primary function of staff is aiding and assisting group difficulties. This may include: verbal redirection to a group having difficulty performing tasks; group intervention for behaviors that increase risks or potentially cause harm; or facilitating a discussion to resolve a group dispute or conflict. Some situations may require separation or removal of disruptive participants.*

C.3.4.11. Staff shall understand that group member interactions may reflect behaviors in extended work or social contexts.

C.3.4.12. Staff shall recognize that course activities may elicit powerful and intense reactions or emotions.

Explanatory Note to C.3.4.12. *A diversity of responses to course experiences may arise in individual participants resulting from past experiences or memories. Negative or positive course activities may elicit strong recall of emotionally intense past experiences. Staff shall respect and assist any participant experiencing this during programming, while also assisting the group as a whole to achieve its purpose. Staff may suggest professional assistance to an individual.*

C.3.4.13. This item is intentionally left blank.

CHAPTER 3

TRAINING STANDARDS

A. GENERAL REQUIREMENTS

A.1. Scope: The ANSI/ACCT 03-2019 Standards: Training Standards (hereinafter referred to as "Training Standard") establish requirements intended to enable course owner/operators to design and deliver, or purchase training curricula that meet the minimum industry standards and provide necessary content for staff.

A.2. Purpose: These training standards are intended for all trainings from in-house job specific training to those trainings intended to develop a broader set of skills leading to practitioner certification.

A.3. General Principles: Successful training provides opportunities for practitioners to develop knowledge, skills, and understanding ~~in order to~~ deliver effective and consistent course experiences to participants.

B. TRAINING

B.1. Training Delivery Requisites

B.1.1. Scope: Training shall include the specific skills required to operate a course including and not limited to: operations management, core, technical, and interpersonal/program management competencies.

Explanatory Note to B.1.1. *Any individual training event may address some or all aspects of program operation.*

B.1.2. Frequency: Training shall occur annually, or more frequently, contingent upon staff turnover, seasonal fluctuations, operational changes, or as a response to incident/accident analysis.

B.1.3. Trainer Qualifications: Training shall be delivered by a qualified person.

B.1.4. Delivery: Training shall provide staff with opportunity to obtain knowledge, skills, and understanding including hands-on, deliberate practice.

B.1.4.1. Trainee Safety: The trainer shall manage risk to allow trainee error, while reducing the likelihood of serious injury or death.

Explanatory Note to B.1.4.1. *For example, when learning to access an element using a personal ~~safety~~ fall arrest system, the trainee may also be on a separate belay.*

B.1.5. Operational Standard: Training shall be conducted in a manner consistent with ACCT Operation Standard Section B.

B.1.6. Disability: Reasonable accommodations shall be made for persons with disabilities. Accommodations shall take into account the essential functions of each position.

B.1.7. Location: Training shall take place at a course inspected and maintained to the current DPI Standard Section A through J.

B.2. Training Documentation Requisites

B.2.1. Training Records: Training shall be documented to include and not be limited to: trainees who were present, date, time, trainer, location, content, training objectives, and completion.

B.2.2. Training Syllabi: Training agenda shall be accurate to the training delivered and made available to each trainee.

> ***Explanatory Note to B.2.2.*** *This could be an accurate and current operations manual, a basic list of learning objectives, or a training skills assessment record.*

B.3. Training Content Requisites

B.3.1. Technical Content: The training shall reinforce or increase staff competencies in the knowledge, skills, and understanding required to operate the course effectively.

B.3.2. Facilitation Content: Training shall reinforce or increase staff competencies with the knowledge, skills, and understanding required to operate an organization's course effectively.

B.3.3. Emergency Procedures Content: Training shall reinforce or increase staff competencies to respond to foreseeable emergencies.