	Elevating and Amusement Devices Safety Division	Ref. No.: 530/09	Rev. No.:
	Amusement Devices Code Adoption Document - Amendment	Date: March 1, 2009	Date:

IN THE MATTER OF:

THE *TECHNICAL STANDARDS AND SAFETY ACT* 2000,
S.O. 2000, c. 16

- and -

ONTARIO REGULATION 221/01 (Amusement Devices)
made under the
***Technical Standards and Safety Act* 2000**

Subject: Amusement Devices Code Adoption Document Amendment
Sent to: All Zip Line Licensees, Designers, Builders, Mechanics & Consultants

1.0 **Effective immediately,** the Director of Ontario Regulation 221/01 (Amusement Devices), pursuant to section 4 of Ontario Regulation 223/01 (Codes and Standards Adopted by Reference), hereby provides notice that the Amusement Devices Code Adoption Document dated June 1, 2001 (CAD), as amended, published by the Technical Standards & Safety Authority is further amended by adding the following:

PART VII

26. ZIP LINES

(1) Every newly installed or altered zip line shall conform to the requirements of Part I "General" and Part II "General Technical Requirements" of the Code Adoption Document, and the following:

(2) For the purpose of Part VII:

"active braking system" means a brake or braking system that is initiated and/or sustained because of an action of an attendant, facilitator or the participant.

"arborist" means a competent person who has had relevant formal education and who is certified by a third party to undertake arboreal assessments.

"Association for Challenge Course Technology (ACCT)" means a trade organization that publishes standards for challenge course installation, operation and inspection.

"PVM Professional Vendor Member" means a company which successfully completes the Professional Vendor Member accreditation process through ACCT.

"attendant" means a person who is trained to operate an engineered or stand-alone zip line that is not part of an elevated challenge or walking course.

Note: Attendants do not require the same level of mountaineering experience as course facilitators because climbing is not a part of their job description. Zip line attendants' duties may include controlling queues, set up

and inspection of zip line rigging equipment, training of zip line riders on riding techniques, and continued communication with the launch or load platform and other attendants.

"change over," means a manual transfer of carabiners or snap hooks from one activity or anchor point to the subsequent activity or anchor point by a facilitator, attendant or participant; common in challenge courses or zip line/canopy tours.

"**connect/disconnect component**" means a component of a zip line or personal rigging system that is manipulated by the facilitator, attendant or the user during the action of preparing for, and completion of riding. Connect/Disconnect components are intended for "quick" release and/or regular opening/closing, latching/unlatching and/or connection/disconnection.

"**critical component**" means a piece of equipment, structure or device that forms part of a zip line where the failure of the component would likely result in a serious injury as a result of a fall or impact.

"direct supervision" means supervision where the facilitator is within close physical proximity of the patron such that they could directly intervene if necessary, can inspect equipment visually as well as manually inspect locking mechanisms and rigging equipment set up.

"gravity brake" means a passive braking system where the zip line rider is brought to a stop by gravity. The patron's momentum carries them to the end of the zip line. Gravity brings the patron back towards the launch platform and they eventually come to a stop at the lowest point in the wire rope. Patrons are generally removed from the zip line via a ladder or scissor lift.

"hand brake" means an active breaking system whereby a participant controls their rate of deceleration by adjusting the amount of hand pressure applied to the wire rope. The participant wears a heavy glove or other type of protection to prevent friction burns/injury.

"facilitator" means an employee who is trained to guide, supervise and assist patrons through tree or pole-based canopy walks or challenge courses or other similar climbing type activities. Facilitators are equipped with mountaineering personal equipment and climbing is a routine aspect of their workday.

"factor of safety" means the ratio of the ultimate stress of the material over the maximum possible stress imposed on a component in the intended application.

"indirect supervision" occurs when a facilitator supervises from a distance (from the ground or another location). Instruction, inspection and/or intervention are limited to verbal instructions and visual inspection from a distance.

"loading or unloading area" means the space, platform or structure within immediate proximity to the zip line where patrons are either attached to or are unattached from the zip line pulley or trolley.

"passive braking system" means any system that results in a deceleration and occurs without any action of the facilitator or the participant.

"personal rigging equipment" means the combination of harness, lanyards, carabiners, snap hooks, rapid links that are used to support a zip line rider's body while suspended from the pulley or trolley.

"Professional Ropes Course Association (PRCA)" is the non-profit association comprised of a board of directors, peer-reviewed vendors, organizational members, and individual members, created by ropes challenge course professionals for ropes challenge course professionals.

"PRCA Peer-Reviewed Organizations (PRO)" These vendors have undergone a voluntary peer review and have successfully completed a rigorous peer review process and critical assessment of their ropes course construction, inspection, training and business practices.

"safety line" means the flexible or rigid, horizontal, vertical or sloping, continuous or discontinuous device used as a protection against falling from a height.

"Safe Working Load (SWL)" means the maximum rated load as determined by the designer and verified by a professional engineer which can be safely handled under specified conditions.

"sling" means a single or double looped construction of tubular webbing or tape, designed for attachments

"static component" means a piece of equipment, structure or device, that is not adjusted or manipulated by the attendant or facilitator or the user during the course of approaching to, riding or detaching from the zip line. A static component is not intended for quick release or routine opening/closing, latching/unlatching, connection/disconnection and generally requires the use of a tool to remove.

"static sag" means the maximum vertical distance between a) the imaginary straight line between the anchor points of the safety line and b) the middle of the safety line when the traffic load is applied.

27. GENERAL DESIGN REQUIREMENTS

(1) Where this Standard requires action by a designer or manufacturer who is no longer in business, that action shall be performed by an engineer.[i]

(2) Every person who operates a zip line shall assemble and maintain updated documents that shall include the following:

a) all instructions, bulletins or other information issued by manufacturers, designers, the designated administrative authority and other safety or regulatory authorities that are applicable to the zip line, and

b) all additional instructions based on requirements in the Regulation that are related to installation, operation, inspections, testing, maintenance and repairs of the zip line.

(3) The quality and testing of materials, quality of work, and level of inspection of manufactured components shall be appropriate to the level of risk to passenger safety posed by the failure of such components.[i]

(4) The design of components for zip lines shall include, but not be limited to, consideration of the following:

a) static and dynamic loads,
b) possible impact loads,
c) static properties,
d) fatigue endurance at a number of load cycles appropriate for the component and the installation,
e) resistance to brittle fracture, and
f) protection against corrosion.[i]

(5) For each item specified in subsection 27.(4) above, the design shall be based on the most adverse temperature condition appropriate for the installation.[i]

(6) Components that are subjected to repeated loadings shall be verified against the possibility of fatigue failure. Verification shall be in the form of calculations and/or testing.[i]

(7) The engineer or designer shall define the acceptable limits to angle of inclination, tension, zip line speed, and braking deceleration, as well as any additional critical design parameters.

(8) The engineer or designer shall specify the operational and design restrictions with respect to: user height, weight, age, ability, or any other restrictions as applicable.

(9) The tension on the zip line shall be calculated under the most adverse conditions. Allowance shall be included for the following:

a) rope weight,
b) weight of rider,
c) weight of rescue personnel and equipment,
d) environmental conditions such as ice, wind, temperature,
e) static and dynamic loads, and
f) rope pre-tensioning.

(10) For the purposes of design, the zip line rider or patron shall be considered to have a mass of not less than 77 kg (170 lb).

(11) An acceptance test procedure (ATP) shall be provided as part of the submission by the designer or engineer. The ATP shall be completed and certified by the submitting engineer prior to use of the zip line by the public.

(12) Safety lines and anchor points shall have a safety factor against failure of not less than six (6). The calculation shall consider the type of connection or termination, traffic load, and dynamic loads.

(13) Despite Part II "General Technical Requirements", subsection 8.(1), the safety factor of the zip line system shall not be less than six (6). Static loads, dynamic loads, rope termination efficiency, rescue methods etc. shall be considered.

(14) All critical components must be accessible for inspection. Where special lifting equipment is required for inspections, this equipment shall be available at the time of initial, follow-up or periodic inspections, as requested by the inspector or submitting engineer.

28. SITE SELECTION

(1) When selecting the location and alignment of an installation, consideration shall be given to factors that are known to affect the operational requirements of the installation. The following shall also be considered when applicable:

a) electric power lines and their supports,
b) railways,
c) highways,
d) structures,
e) rock and earth slides, erosion, washouts, etc.,
f) snow creep and avalanches,
g) wind,
h) icing,
i) ski slopes and trails,
j) rivers and gullies,
k) buried installations, including pipelines,
l) crossing of or close proximity to other zip lines or passenger ropeways and passenger conveyors,
m) control of air space below, above, and adjacent to the installation,

n) zip line patron height above the ground or other surface,
o) ambient temperatures,
p) evacuation, and
q) fire hazards from buildings and vegetation.[i]

29. CLEARANCE ENVELOPE

(1) Zip lines in proximity to overhead electric supply and communication utility systems must meet the clearance requirements of CSA Standard CAN/CSA-C22.3 No. 1. "Overhead Systems".

(2) A safety clearance envelope shall be maintained above, to the sides of and underneath the zip line under the most adverse loading conditions. The clearance envelope shall be specified by the designer or submitting engineer.

(3) Despite subsection 29.(2) above, the minimum vertical clearance between any part of the zip line and any part of an overhead system shall not be less than the following:

a) If the zip line crosses above a road or parking lot or any area with vehicular traffic, the lowest point of the zip line patron, under the most adverse loading conditions shall be not less than 5.0 metres above the road.

b) If the zip line crosses above a passenger ropeway, under the most adverse loading conditions including wire rope sag, stretch, and a deropement of the passenger ropeway, the lowest point of the zip line patron will not pass closer than 2.4 metres from the highest point on the ropeway.

c) If the zip line crosses underneath a passenger ropeway, the designer shall consider a complete deropement between the towers: no part of the ropeway shall come in contact with the zip line or zip line rider under the most adverse loading conditions.

d) A clearance envelope of at least 1.5 metres shall be maintained to each side of a zip line patron, under the most adverse loading conditions and rope deflection. The measurement shall be taken from the centre of the patron's torso.

e) Where a zip line crosses over a hiking trail, walkway or ski slope, a vertical clearance of 2.4 metres shall be maintained from the lowest point of the zip line patron under the most adverse loading conditions to the ground or snow level.

(4) Preparation of a zip line right-of-way shall include the following:
a) interference by vegetation shall be prevented,
b) washouts shall be prevented, and
c) potentially dangerous trees shall be removed.[i]

30. TOWERS, PLATFORMS AND STRUCTURES

(1) Steelwork shall be designed taking into consideration the effects of corrosion. Corrosion protection shall be provided where necessary.[i]

(2) Localized corrosion, which can occur because of entrapped water, excessive condensation, or other factors, shall be minimized by suitable design and detailing. Positive means of drainage shall be provided where necessary. [i]

(3) Foundations shall be designed in accordance with the Ontario Building Code to carry all of the combinations of dead load, live load, and wind, together with ice, earthquake, impact, and vibration. [i]

(4) Each foundation shall be designed to resist overturning or sliding with a factor of safety of 2 with respect to the combination of deadload and live load, and 1.5 with respect to these loadings and wind acting simultaneously. [i]

(5) Foundations located in snow creep and/or avalanche areas shall be designed for such conditions and loads or shall be protected. [i]

(6) The bottoms of foundations shall be below the normal frost line unless they rest on solid rock. [i]

(7) The top of concrete shall be not less than 150 mm above finished grade unless instructions for the protection of the structural steel below grade are provided by the designer. [i]

(8) All parts of anchorage connections below ground shall be protected. [i]

(9) Structures bolted to foundations shall be secured with double nuts, locknuts, or equivalent means. [i]

(10) The designer shall provide specifications for excavation, backfill, concrete, formwork, reinforcing steel, rock anchors, anchor bolts, grout, and placement tolerances. [i]

(11) Concrete test cylinders shall be made, cured, and tested in accordance with CAN/CSA-A23.2 “Methods of Test and Standard Practices for Concrete”. [i]

(12) The zip line designer shall specify the percentage of rock anchors at each location to be given a pull test and the force to be applied. The test shall be carried out on 10% of rock anchors but at least one rock anchor per location. Test reports from a recognized certification agency shall be provided prior to the acceptance tests. [i]

(13) Towers, railings, fences, and other structures shall be designed and constructed to prevent persons or equipment from becoming entangled with such structures. [i]

(14) Handrails, safety nets, or ramps shall be provided where necessary for the protection of passengers and operating personnel. [i]

(15) Platforms, decks, staircases or any structure that forms part of a zip line launch or landing platform must comply with the Ontario Building Code.

(16) Wood structures, in addition to subsection 30.(15) above shall be designed to CAN/CSA-O86-01 “Engineering Design in Wood”.

(17) Despite subsections 30.(15) and 30.(16), small platforms (capacity less than or equal to four persons) that form part of a challenge course or zip line tour shall be one of the following:

a) certified by a professional engineer to be capable of supporting three times the rated capacity, of sound construction and free of sharp edges or gaps that could pose a trip hazard. The participant must be attached to a safety line that is in compliance with subsection 27.(11), at all times, or

b) designed and constructed in compliance with subsections 30.(15) and 30.(16).

(18) Platforms that form part of challenge courses or similar (low capacity, no guardrails) must have suitable tie-offs or safety lines. The tie-offs shall be designed and placed to facilitate the movement of personnel while performing their required tasks and consideration shall be given to rescue situations. The number of anchor points, cables or rails shall be the same as the maximum number of people permitted on the platform or shall be a single device capable of supporting the total load.

(19) Platforms, decks, staircases or any structure that forms part of a zip line launch or landing platform shall be designed to prevent water accumulation.

(20) Platforms, decks, or any structure that forms part of a zip line launch or landing platform shall have a conspicuously posted sign indicating Safe Working Load (capacity) in kg and number of persons.

(21) Wood structures shall be treated with a decay-resistant material if necessary.

(22) Landing platforms of the ramp style shall have a maximum gradient of 1:8.

(23) Landing platforms shall be designed to provide maximum clearance and minimal risk to the zip line rider in the event of an improper landing due to various events such as a brake failure, incorrect riding position, rider disorientation or loss of consciousness. Padding shall be provided where possible impact areas exist.

(24) Where the zip line is designed such that a patron could begin to roll back in the direction of the start platform, a method to assist in landing, such as a grab 'rope' or an alternative device shall be in place. Consideration shall be given to possible choke or entrapment hazards created by the choice of device.

(25) Methods to deter unauthorized access and use during off hours shall be in place. The level of warning and security measures shall be appropriate for the level of danger presented by improper use and/or unauthorized access.

(26) Prevention of unauthorized access to ladders may be achieved only by methods which do not compromise the safety or structural integrity of the ladder.

(27) Ladders must be designed, constructed, installed and maintained so as not to endanger a patron, and must be capable of withstanding all loads to which they may be subjected. Surfaces of fixed ladder installations must be free of sharp edges, burrs, or any aspect that may be hazardous to the person using the ladder.

(28) Fixed ladders that provide access to a building, tower, platform, or structure must conform to the Ontario Building Code.

(29) Despite subsection 30.(28), wood ladders that are part of challenge courses (or similar) in which a patron is attached to a safety line do not have to comply with the building code, but the design shall be certified by an engineer as part of the submission.

(30) Where the zip line or supporting elements are dependent on living trees, subsections 30.(31) to 30.(32) apply:

(31) An arboricultural assessment shall be performed by a certified arborist, as part of the design process. With a frequency of not less than once per year, an arborist shall determine the physiological, mechanical and general condition of trees used as element supports and reassess their ability to meet the loads placed upon them. These records shall form part of the log book.

(32) The systems used to fix zip lines, platforms or any other supporting elements shall be designed to minimize damage to the trees. Measures should be taken to protect the root system, particularly against compaction.

(33) Where the zip line is constructed upon utility poles, subsections 30.(33) to 30.(36) apply:

(34) A professional engineer or a professional utility pole installer shall conduct a foundation assessment to determine ground soil characteristics for actual pole placement, method, and/or depth.

(35) A professional engineer shall provide specifications for excavation, backfill, concrete, formwork, reinforcing steel, ground anchors, grout and placement tolerances.

(36) Utility poles used for zip lines shall be a class H1 or greater. Longer spans may require H2 or H3 poles based on the anticipated loads. The classification is based on ANSI O5.1-2002 "American National Standard for Wood Products – Specifications and Dimensions".

(37) Ground decay of wooden poles shall be considered.

31. WIRE ROPE

(1) Only flexible steel wire rope may be used as a zip line.

(2) Wire rope used for zip lines or guy wires shall have a Wire Rope Test Certificate in accordance with CSA G4-00 "Steel Wire Rope for General Purpose and for Mine Hoisting and Mine Haulage".

(3) Wire ropes used for zip lines or guy wires shall have inspection criteria, non-destructive testing requirements, and replacement criteria/intervals specified by the designer or engineer.

(4) The entire length of the wire rope and all wire rope terminations must be visible for inspection.

(5) Zip lines, or any critical life safety lines shall be one continuous un-cut length of wire rope. i.e. no splices**.**

32. GUY WIRES

(1) Anchoring for guy wires shall be rated with a pull-out strength as designated by an engineer. Soil conditions shall be considered.

(2) Trip hazards created by guy wires shall be prevented as much as possible; trip prevention shall be utilized where the guy wire is in an area that people are able to access.

(3) Preventative measures shall be in place where a guy wire could be used, whether accidental, or deliberate, as a descent line.

(4) Each guy wire rope system, including terminations, must be designed so that the applied load does not exceed one fifth ($1/5^{th}$) of the breaking strength of any component in the guy wire system.

(5) The head of the anchor or connecting link must extend above the ground to facilitate inspection of the wire rope termination.

33. END TERMINATIONS

(1) End terminations of the zip wire rope shall be designed to maintain the full strength of the rope to which they are attached.

(2) Despite subsection 33.(1), in applications such as the wrap method for tree-based zip lines utilizing u-clips, end terminations of supporting ropes shall have an efficiency of eighty percent (80%) or greater, based on the nominal strength of the rope. This reduction in ultimate strength must be incorporated into the safety factor calculation.

(3) Where the wrap method is used, the dead end of a zip line shall not be loaded or used as a safety line.

(4) In addition to the requirements of Part II, General Technical Requirements, subsection 8.(2), u-bolt or fist grip clips shall be drop forged, galvanized steel or equivalent, and installed to manufacturer's specifications. Torque values and retightening procedures and schedules shall conform to the clip manufacturer's instructions.

(5) Through bolted terminations of zip lines must be backed up with a system rated to eighty percent (80%) of the primary wire rope strength, and configured to protect against bolt and termination failure, not wire rope failure.

(6) Turnbuckles, when used as part of the rigging of the zip line shall have a redundant back up in the case of turnbuckle failure. The back-up system shall be rated to eighty percent (80%) of the strength of the primary system.

34. BOLLARDS AND SOCKETS

(1) A lined rope bollard (anchor) shall have a diameter of not less than 65 times the rope diameter or 600 times the largest diameter or height of the outer wires. For an unlined bollard or wheel, the diameter shall be increased by 25%. [i]

(2) One end of a rope shall be anchored by wrapping it around a bollard a minimum of two wraps. The residual tension shall be secured by no fewer than two identical clamps, one carrying the load and another acting as a check against slippage. The number of turns and number of clamps shall be specified by the manufacturer or designer**.** [i]

(3) At the time of installation, the length of the rope shall allow for slipping a minimum of three times. The allowance for each slip shall be not less than the length of the longest saddle or roller chain, plus 5 m. [i]

(4) A rope bollard and stored rope shall be covered for protection from the weather. [i]

(5) A rope socket shall be designed so that it will not be stressed beyond the yield point of the material used when the rope it anchors and connects is under tension equal to its nominal breaking strength. [i]

(6) The method of socketing shall be one currently in practice or established by tests, and shall develop the nominal breaking strength of the rope. [i]

(7) Socketing shall be performed by a qualified person. [i]

(8) A sleeve socket and cone shall be secured against turning. [i]

(9) A report shall be provided by the person performing the socketing procedure. At a minimum, the following shall be included in the report: chemical analysis of material used; temperatures of pouring material and preheated socket body (zinc sockets); details of cleaning process (resin sockets); type of rope lubricant applied after socketing; and name and signature of person pouring the socket. [i]

(10) The whole length of each rope (including tensioning ropes and guys) and all connections shall be visually examined at established intervals not exceeding one year or 2000 h of operation, whichever comes first, and immediately after any incident that can affect the condition of the rope. [i]

(11) A sleeve and socket that is to be used or reused shall be non-destructively tested to establish its usability. This testing shall be documented. [i]

(12) The socket replacement interval shall be specified by the manufacturer or an engineer. [i]

35. BRAKES

(1) A zip line that requires mechanical brakes shall have a minimum of one independent back up brake that will safely stop a rider from full speed. The failure of one brake will not impair the functioning of the other.

(2) Where the speed of the rider upon the approach to the unload platform is greater than 10 km/hr, the system shall utilize a passive brake as the primary brake. In addition, an emergency brake is required that will function in the event of primary brake failure, user error, operator error, injury or rider loss of consciousness.

(3) Where the speed of the rider at approach to the unload platform is less than 10 km/hr, the primary brake may be an active brake. It is recommended that a passive emergency brake be in place in the event of failure of the active braking system, user error, operator error, rider injury or rider loss of consciousness.

(4) Engineered drawings shall be provided for all mechanical braking systems. The drawings shall provide detail of the components including dimensions, material, set up, testing and fabrication.

(5) Block brakes that utilize bungee cords shall be designed such that a bungee cord failure will not result in a whipping or snapping motion that could injure the rider, or anyone in the vicinity.

(6) Customized brakes or unique designs shall be engineered components of known design limits, and shall have a data tag which states the following:

a) manufacturer's name, identification or designation,
b) model, style, lot, or serial number,
c) rope sizes permitted,
d) speed limitations, and
e) any additional safety requirements.

36. PERSONAL RIGGING EQUIPMENT

(1) All components that form part of a safety line such as pulleys, lanyards, harnesses or carabiners shall be permanently labeled by the manufacturer, such that the source of the equipment is traceable.

(2) Commercially manufactured products used in personal rigging equipment application which bears the label of a different certifying body to another standard will be considered in lieu of those specifically stated below provided the strength, quality and testing requirements meet or exceed those defined. A

statement of equivalency shall be provided by the submitting engineer along with details of the test procedure and the certifying body.

37. HARNESSES

(1) Harnesses shall be commercial grade, designed and manufactured for zip lines, paragliding, or mountaineering and shall bear the label of one of the following:

a) EN 12277: 2007 "Mountaineering equipment – Harnesses – Safety requirements and test methods",
b) EN 1651: 1999 "Paragliding equipment – Harnesses – Safety requirements and strength tests", or
c) UIAA 105 "Mountaineering and Climbing Equipment Harnesses".

(2) Where sit harnesses or similar are used, a certified chest harness shall also be utilized. The chest and seat harness shall be used in such a manner so as to prevent inversion, whether deliberate, accidental or in the event of loss of consciousness.

(3) Harnesses shall be available to fit the range of participant sizes permitted on the zip line.

(4) Harness selection shall consider the time required for evacuation.

(5) Harness construction, design and fit must be adequate to keep the participant attached at all times and in the proper orientation.

38. HARDWARE

(1) The following requirements apply to all equipment used in a safety application such as connectors, pulleys, and shackles:

a) equipment shall have a product label stamped, engraved, or otherwise permanently marked with the product label information,

b) load-bearing hardware shall display the mark or logo of the certification organization, and manufacturer's name or identifying mark, and

c) load-bearing hardware shall display the minimum rated breaking strength.

(2) Connect/Disconnect components in critical component applications should be avoided whenever possible. Where necessary, as part of the rigging connection in challenge course applications, the connect/disconnect component shall be backed up with a redundant system that is equal to or greater than the strength of the primary.

(3) In challenge course applications, where patrons conduct repeated change-overs, auto-locking carabiners or snap hooks shall be used. Single action carabiners are not permitted. Double action locking snap hooks that allow relatively quick release with the use of one hand are a preferred option.

(4) Connect/Disconnect components in critical component applications shall be commercial grade, and shall comply with subsection 38.(4)(a) or 38.(4)(b):

a) A carabiner with self-closing gate and gate-locking device shall bear the label of one of the following:
    i. UIAA 121 "Mountaineering and Climbing Equipment Connectors", or

ii. EN 12275:1998 “Mountaineering equipment – Connectors – Safety requirements and test methods”, or

b) A two-stage automatic locking termination connector (class T) or anchor connector (class A) that bears the label of EN362: 2004 “Personal protective equipment against falls from a height – Connectors”.

(5) Screwlink (class Q) connectors and Quicklink (type Q) connectors in critical component systems shall bear the label of one of the following:

a) UIAA 121 “Mountaineering and Climbing Equipment Connectors,
b) EN 12275:1998 “Mountaineering equipment – Connectors – Safety requirements and test methods”, or
c) EN 362:2004 “Personal protective equipment against falls from a height – Connectors”.

(6) Load-bearing locking carabiners, locking snap hooks or rapid links shall be made of steel where direct contact with the wire rope occurs during zip line riding.

(7) Carabiners shall be of a size suitable for the equipment used.

39. LANYARDS AND SLINGS

(1) Lanyards and slings in critical component applications shall be commercial grade, and shall bear the label of one of the following:

a) Union International Alpinism Association (UIAA) 104 “Mountaineering and Climbing Equipment Slings”,
b) EN 566:1997 “Mountaineering Equipment – Slings – Safety requirements and test methods”, or
c) EN 354:2002 “Personal protective equipment against falls from a height – Lanyards”.

(2) Load-bearing textile materials shall have strength, aging, ultraviolet resistance, abrasion resistance, and heat and cold resistance characteristics equivalent or superior to polyamides.

(3) Lanyards made of spliced rope are not permitted.

(4) Where one or more parallel slings or lanyards are under tension, their lengths shall be varied or another method employed to minimize the risk of entrapment or strangulation.

40. PULLEYS AND ZIP TROLLEYS

(1) Mountaineering pulleys used with zip lines are considered dynamic critical components and shall be commercial grade, and shall bear the label of one of the following:

a) Union International Alpinism Association (UIAA) Standard 127 “Mountaineering and Climbing Equipment Pulleys”, or
b) EN 12278:2007 “Mountaineering equipment – Pulleys – Safety requirements and test methods”.

(2) Despite subsection 40.(1), custom zip pulleys and trolleys shall be engineered components of known and tested design limits, and the shall be labeled with the following:

a) manufacturer’s name, identification or designation,
b) model, style, lot, or serial number,

c) rope sizes permitted,
d) speed limitations, and
e) any additional safety requirements

(3) Pulleys/Trolleys in accordance with subsection 40.(2) shall also be supplied with engineered drawings, and replacement, testing, and inspection criteria and intervals.

(4) Pulleys and trolleys or other dynamic critical components must be backed up in case of failure with a redundant connection between the person and the zip line, where the safety factor of the pulley or trolley is less than twelve (12)**.** The redundant system shall be at least eighty percent (80%) of the strength of the trolley or pulley.

(5) Redundant lines for pulleys or trolleys, where required, shall attach to the zip line in parallel with the pulley. It may go through a part of the pulley but the steel of the connector must be over the wire rope such that it would maintain suspension even in the event of a catastrophic failure of the pulley.

(6) Despite subsection 40.(4), where the pulley is placed on the rope by the patron or the attendant, (in applications such as challenge courses that utilize small lightweight pulleys), a redundant back up to the pulley is required regardless of the pulley safety factor.

(7) Pulleys or trolleys shall be suitable as specified by their manufacturer for the size of wire rope being used, the maximum speed of travel, and of at least dual sheave construction

(8) Pulley sheaves made of soft material such as certain types of plastic or aluminum are inappropriate for use on wire rope.

(9) Shackles classified as critical components shall be commercial grade, and shall have a minimum breaking strength of not less than an equivalent factor of safety of six (6), and shall be suitable as specified by the manufacturer for the size of rope or wire rope being used.

41. HELMETS

(1) Helmets must be worn by zip line participants.

(2) Helmets shall be commercial grade and bear the mark of one of the following:

a) EN 12492:2000 “Mountaineering Equipment – Helmets for mountaineers – Safety requirements and test methods”, or
b) UIAA Standard 106 “Mountaineering and Climbing Equipment Helmets”.

42. OPERATIONAL REQUIREMENTS

(1) The owner/operator shall post signs, when necessary, at entrances to machinery rooms and restricted areas, to warn unauthorized persons not to enter.[i]

(2) Safety rules must be posted and explained to the participants prior to riding.

(3) Challenge course or other zip lines where participants are more actively involved in their own connection/disconnection shall have a training area where a sample of a zip line is installed close to the ground. All patrons shall be given an orientation prior to proceeding on to the challenge course or zip line. This training area will be used by facilitators and attendants to assess the patron’s ability and allow them to practice using the equipment, while allowing facilitators to assess their ability to proceed.

(4) Measures, whether equipment-related, procedural or both, shall be implemented to ensure that entanglements with hair, body parts, clothing or jewelry does not occur between the pulley or any other piece of equipment.

(5) In challenge course applications, at any point along a zip line, where a change over occurs, participants must be directly supervised.

(6) Means shall be in place to physically prevent participants from launching before they are properly attached to the pulley system and/or before the zip line path is clear of obstructions.

(7) The launch platform and unloading area of each zip line shall have one designated attendant or facilitator at each location.

(8) Every zip line shall have a dedicated two-way voice communication system between launch and unloading areas. Operation shall cease if communication is not possible.

(9) Zip lines that require a solid object such as a scissor lift or rolling staircase to be moved into the path of the zip line at any point during normal operation shall meet one of the following conditions:

a) The launch facilitator or attendant shall have clear view of the zip line including the landing area. A procedure shall be in place to ensure that participants cannot be released before the zip line pathway is free of obstructions, or

b) Where the launch facilitator or attendant cannot see the landing area, where night operation is permitted, or where the span is such that visibility may be impeded by bad weather, direct sunlight or poor vision, another level of prevention shall be in place.

Note: Examples include a live video monitor of the unload area, bright warning lights visible in the worst weather conditions, an electronic/mechanical interlock that prevents the rider from launching when the object is out of the home or parked position or a combination thereof.

(10) Attendants who operate scissor lifts or any other similar devices shall have documented formal training in compliance with the Occupational Health and Safety Act.

(11) Zip lines that require a scissor lift or a similar mechanical lifting device as part of normal operation, such as loading or unloading shall have a solid flat surface that has been engineered for the loads placed upon it.

(12) The zip line shall not be operated during icing and freezing rain conditions.

(13) Where zip lines are used during hours of darkness, adequate lighting shall be provided to ensure safe operation.

(14) If the site has night operation, emergency lighting shall be provided to permit evacuation and assist emergency personnel in the event of a power failure.

(15) Before a zip line is placed in service, an operations manual shall be supplied for use with the installation, including but not limited to the following:

a) pre-opening inspections,
b) daily inspections and person responsible,
c) launching and unloading procedures,

d) emergency procedures for all anticipated situations,
e) incident reporting,
f) evacuation procedures, including those for night operation,
g) staffing requirements,
h) contact information of all site supervisors and emergency personnel ,
i) emergency phone numbers,
j) procedure for pre-zip briefings and/or patron training,
k) job descriptions of all supervisory, attendant & facilitator positions,
l) zip line rider restrictions including age, height, weight and skill level,
m) job descriptions including training requirements, and
n) procedures regarding unusual occurrences.

43. MAINTENANCE MANUAL

(1) The maintenance manual shall describe the manufacturer's and designer's recommended maintenance procedures, including, but not limited to the following:

a) the types of lubricants required and frequency of application,
b) the definitions and measurements required to determine excessive wear and replacement criteria,
c) the recommended frequency of service to specific components,
d) load tests,
e) frequency of bolt tightening, torque values and bolt grades,
f) all personal protective equipment inspection and replacement criteria,
g) any NDT requirements, type and frequency,
h) daily, weekly, monthly and annual inspection checklist,
i) zip line wire rope maintenance and inspection criteria,
j) wire rope non-destructive testing requirements and intervals,
k) wire rope replacement/retirement criteria and intervals,
l) wire rope terminations, guy wires and anchors,
m) braking system maintenance and component replacement criteria,
n) corrosion protection,
o) control of water condensation and drainage,
p) structures and platforms,
q) trees, as applicable, and
r) rigging equipment: storage, inspection and retirement criteria.

(2) Wire rope maintenance shall include, but not be limited to, the following considerations:

a) that the type of lubricant and the frequency of lubrication shall be as recommended by the rope manufacturer or designer. A rope that has little or no motion, e.g., a tensioning rope or guy rope, shall be given special consideration for protection against corrosion,
b) that ropes shall be kept clean,
c) that rope connections shall be protected against corrosion, and
d) that saddles and roller chains shall be liberally lubricated.[i]

44. RESCUE

(1) The site shall have a documented rescue procedure. Equipment and trained persons shall be in place to rescue and retrieve any participant from any part of the zip line. These procedures shall consider unconscious or unresponsive riders.

(2) At all times during operation, the site shall have adequately trained staff on site such that a rescue could be completed from any point along the zip line. This shall be documented in the rescue procedure.

(3) Evacuation procedures shall take into consideration the type of harness used and thus the maximum length of time a person can remain suspended, and the worst case environmental conditions during all operating seasons.

(4) Additional measures and procedures will be in place when zip lines are going to be utilized after dark, during the winter months or in other exceptional conditions. Adequate emergency lighting must be available to facilitate rescue. Areas that cannot be accessed by emergency vehicles during the winter months shall be addressed. Likewise, vehicles that are used during the winter season that cannot be used during summer operation shall be addressed.

(5) Records of rescue training shall be maintained for each employee, including all class room and hands-on training and the date of completion.

(6) Rescue personnel shall be trained annually by an insured third party.

45. TRAINING AND FACILITATION

(1) The site shall have documented job descriptions and the corresponding required level of training.

(2) The Training document shall include items such as:

a) job descriptions for all paid and voluntary positions,
b) minimum ages of course facilitators and/or zip line attendants,
c) minimum hours of training required for each job description,
d) third party training requirements and renewal intervals,
e) education requirements,
f) list of job responsibilities and skills required,
g) CPR or First Aid training requirements, and
h) high angle rescue or equivalent training requirements and renewal intervals.

(3) For zip lines that form part of challenge courses, or any version of a pole or tree-mounted walking/climbing experience, annual and documented training from a properly insured third party is required for the site manager and all course facilitators. Site managers, whose day to day function is also a course facilitator, may train their own staff provided they have documented proof that they are certified by an insured third party to do so.

46. EQUIPMENT INSPECTION, TESTING, MAINTENANCE AND REPLACEMENT

(1) The zip line, supporting structures and all equipment shall be inspected as specified by the equipment manufacturers and according to the frequency and methods stated in the maintenance manual. The inspection results and maintenance shall be recorded in a log book.

(2) All equipment shall be replaced according to the manufacturer's recommendations.

(3) A piece of personal protective equipment ("PPE") shall be destroyed and removed from the site when any of the following occur:

a. it does not behave according to manufacturer's specifications,
b. it has reached the maximum usage as specified by the manufacturer,

c. it exhibits any abnormalities,
d. it has been exposed to damaging or unknown chemicals or solvents,
e. it has been subjected to loads greater than 20% of its designated working dynamic load,
f. it has exceeded the manufacturer's recommended total allowable ultra violet exposure time, expressed in number of hours, or
g. it has exceeded the expiry date as specified by the manufacturer.

(4) Retired rigging equipment shall not be used as decoration, used to hang other equipment or kept on site.

(5) Hardware shall be inspected daily. Hardware subject to abnormal loadings, impacted against hard surfaces, or having surface damage, shall be replaced.

(6) Carabiners shall be removed from service when the locking mechanisms fail to lock properly, the springs are worn, the wear criteria is exceeded or the locking gates deform.

47. EQUIPMENT STORAGE AND SECURITY

(1) All equipment shall be stored according to the manufacturer's recommendations.

(2) All equipment shall be stored in a secure structure, under lock and key, with access to keys being limited to the authorized persons.

(3) All equipment shall be stored in an orderly and efficient manner.

(4) All unserviceable equipment shall be removed from the site.

Roland Hadaller, P.Eng.,
Director, Ontario Regulation 209/01 (Elevating Devices), appointed under the *Technical Standards and Safety Act, 2000*.

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