



Designation: F2959 – 16

Standard Practice for Aerial Adventure Courses¹

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1. Scope

1.1 This practice establishes criteria for the Design, Manufacture, Installation, Operation, Maintenance, Auditing and Major Modification of Aerial Adventure Courses which occur(s) after the effective date of publication of this document except as noted in 1.3.

1.2 This practice applies to the following devices when operated for concession or commercial recreation:

- 1.2.1 Zip Lines.
- 1.2.2 Ropes Courses.
- 1.2.3 Challenge Courses.
- 1.2.4 Aerial Trekking Courses.
- 1.2.5 Canopy Tours.
- 1.2.6 Manufactured Climbing Walls.

1.3 This practice shall not apply to the following:

1.3.1 Aerial Adventure Courses when operated exclusively under the following applications:

- 1.3.1.1 Educational curriculum.
- 1.3.1.2 Physical fitness purposes.
- 1.3.1.3 Organized competitive events.
- 1.3.1.4 Therapeutic programs.
- 1.3.1.5 Training purposes.
- 1.3.1.6 Team and confidence building.
- 1.3.1.7 Playground equipment covered by Consumer Safety

Performance Specification F1487.

1.3.2 Amusement rides and devices whose design criteria are specifically addressed in another ASTM standard.

1.3.3 Portions of an Aerial Adventure Course unaffected by a major modification.

1.3.4 Upgrades to electrical wiring, electrical motors and electrical components of Aerial Adventure Courses provided the original design and safety criteria are maintained or enhanced.

1.3.5 Pre-existing designs for Aerial Adventure Courses that are installed after the publication date of this practice if the design is service proven or previously compliant as specified by 1.3.5.1.

1.3.5.1 Aerial Adventure Course designs may qualify as “previously compliant” for five years following the date of publication of this practice. Thereafter, an Aerial Adventure Course design must qualify as “service proven” as defined in Practice F2291 or meet the requirements of this practice.

1.4 This practice includes an annex (mandatory), which provides additional information (for example, rationale, background, interpretations, drawings, commentary, and so forth) to improve the user’s understanding and application of the criteria presented in this practice. The annex information shall be interpreted as mandatory design criteria.

1.5 This practice includes an appendix (non-mandatory), which provides additional information (for example, rationale, background, interpretations, drawings, commentary, and so forth.) to improve the user’s understanding and application of the criteria presented in this practice. The appendix information shall not be interpreted as mandatory design criteria.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Some specific hazards statements are given in Section 7 on Hazards.*

2. Referenced Documents

2.1 *ASTM Standards:*²

F747 Terminology Relating to Amusement Rides and Devices

F770 Practice for Ownership, Operation, Maintenance, and Inspection of Amusement Rides and Devices

F846 Guide for Testing Performance of Amusement Rides and Devices (Withdrawn 2013)³

F1193 Practice for Quality, Manufacture, and Construction of Amusement Rides and Devices

F1487 Consumer Safety Performance Specification for Playground Equipment for Public Use

¹ This practice is under the jurisdiction of ASTM Committee F24 on Amusement Rides and Devices and is the direct responsibility of Subcommittee F24.61 on Adventure Attractions.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

F1772 Specification for Harnesses for Rescue, Safety, and Sport Activities

F1957 Test Method for Composite Foam Hardness-Durometer Hardness

F2137 Practice for Measuring the Dynamic Characteristics of Amusement Rides and Devices

F2291 Practice for Design of Amusement Rides and Devices

F2375 Practice for Design, Manufacture, Installation and Testing of Climbing Nets and Netting/Mesh used in Amusement Rides, Devices, Play Areas and Attractions

F2974 Guide for Auditing Amusement Rides and Devices

2.2 *ANSI Standards*:⁴

ANSI B77 Passenger Ropeways - Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors - Safety Requirements

ANSI Z359 Fall Protection Code

2.3 *European Standard*:⁵

EN 12277 Mountaineering equipment - Harnesses - Safety requirements and test methods

2.4 *NFPA Standard*:⁶

NFPA 1983 Standard on Life Safety Rope and Equipment for Emergency Services

2.5 *UIAA Standard*:⁷

UIAA 105 Mountaineering and Climbing Equipment: Harnesses

3. Terminology

3.1 Terminology shall be in accordance with Terminology **F747**.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *aerial trekking course, n*—self-guided aerial adventure course containing elements intended to be obstacles.

3.2.2 *canopy tour, n*—aerial adventure course which provides patron access to the canopy of a forest.

3.2.3 *challenge course, n*—guided aerial adventure course containing elements intended to be obstacles.

3.2.4 *ropes course, n*—synonym for a challenge course.

3.2.5 *zip line, n*—an aerial adventure course element over an open span consisting of an inclined wire or fiber rope on which harnessed patron(s) suspended from a pulley or trolley are able to traverse with the primary force for propulsion being gravity.

3.3 *Abbreviations*:

3.3.1 *AAC, n*—aerial adventure course

3.3.2 *PSE, n*—personal safety equipment

4. Significance and Use

4.1 The rationale for developing a separate standard practice for Aerial Adventure Courses is based on the unique functional,

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

⁶ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁷ Available from International Mountaineering and Climbing Federation (UIAA), 61 Postfach CH-3000 Bern 23 Switzerland, <http://www.theuiaa.org/index.php>.

operational and patron participation requirements when compared to amusement rides and devices.

4.2 The purpose of this practice is to provide designers, manufacturers, constructors, system integrators, owners/operators, and auditors with criteria and references for use in the design, manufacture, construction, installation, integration, operation, maintenance, auditing, and major modification of Aerial Adventure Courses.

4.3 Unless this practice expressly provides otherwise in a particular provision, the term “Aerial Adventure Course” is to be used in place of “Amusement Rides and Devices” herein.

5. Ownership, Operation, Maintenance, Inspection, and Training Requirements

5.1 Ownership, operation, maintenance, inspection, and training requirements for aerial adventure courses shall be in accordance with Practice **F770**, and the exceptions and inclusions unique to aerial adventure courses. For convenience, all of these inclusions and exceptions have been incorporated into Practice **F770** and are shown below.

5.2 Changes to common terms in Practice **F770-15** are:

5.2.1 Replace the term “amusement rides and devices” with “aerial adventure courses.”

5.2.2 Replace the terms “amusement ride or device” or “ride or device” with “aerial adventure course.”

5.2.3 Replace the term “ride analysis” with “device analysis.”

5.2.4 Replace the term “passenger” with “patron.”

5.2.5 Replace the term “riders” with “patrons,” and

5.2.6 Replace the term “rider” with “patron.”

5.3 *Significance and Use*—The purpose of this practice is to delineate information and to establish procedures for the operation, maintenance, inspection, and training of aerial adventure courses.

5.4 *Owner/Operator’s Responsibility*:

5.4.1 The owner/operator shall develop a program with necessary tasks and training to operate, maintain, and inspect the aerial adventure course, as designed. The program shall include, but not be limited to:

5.4.1.1 An operations program as outlined in **5.5**,

5.4.1.2 A maintenance program as outlined in **5.6**,

5.4.1.3 An inspection program as outlined in **5.7**, and

5.4.1.4 A training program as outlined in **5.8**.

5.5 *Operations Program*:

5.5.1 *Operating Document*—Each owner/operator shall prepare an operating document for each aerial adventure course or element based on the recommended instructions and specifications provided by the manufacturer. This operating document shall be made available to each aerial adventure course operator and attendant. The operating document shall include, but not be limited to:

5.5.1.1 Specific operation policies and procedures with pertinent information from the manufacturer’s instructions, including, but not limited to:

(1) Description of the aerial adventure course operation;

(2) Specific duties of the assigned operator(s) and attendant(s) position(s) of the aerial adventure course;

(3) General safety procedures;

(4) Instructions on specific procedures to follow in the event of unusual conditions or an interruption of operation, including an evacuation plan outlined in 5.5.2;

(5) Additional instructions from the owner/operator; and

(6) The owner/operator shall also consider environmental condition(s) including, but not limited to, wind, rain, ice, and lightning when developing operating procedures.

5.5.1.2 Specific emergency procedures in the event of an abnormal condition or interruption in service.

5.5.2 *Evacuation Plan*—The owner/operator shall have and maintain an evacuation plan for each aerial adventure course.

5.5.2.1 The owner/operator shall consider:

(1) Standard load/unload area evacuations are the preferred method;

(2) Aerial adventure course manufacturer's recommendations;

(3) Conditions of the environment that could impact an evacuation;

(4) Personnel responsible for performing an evacuation;

(5) Notification and cooperation with the outside agencies and entities intended to participate in an evacuation;

(6) Identification and location of equipment to support an evacuation;

(7) Equipment that may be required to communicate with patrons during an evacuation process;

(8) Access and egress requirements for personnel and equipment to evacuate the aerial adventure course;

(9) Actions required prior to evacuation to prevent inadvertent motion of the aerial adventure course, patron(s), vehicle(s), carrier(s), and surrounding equipment in the evacuation pathway;

(10) Order or sequence of evacuation to evacuate patrons efficiently and safely;

(11) An appropriate means of egress for evacuees;

(12) Removal of patrons unable to assist in their own evacuation because of disability, medical conditions, or other reasons.; and

(13) Procedures for arranging medical assistance as required during an evacuation.

5.5.2.2 The owner/operator shall provide and document training on the evacuation plan.

5.5.2.3 The owner/operator shall periodically review the evacuation plan and make adjustments as needed.

5.5.2.4 The evacuation plan shall include an access plan for performing evacuation, first aid and ground care of evacuated patrons.

5.5.3 *Denying Entry*—The owner/operator of an aerial adventure course may deny entry to the aerial adventure course to any person, if in the opinion of the owner/operator the entry may cause above normal exposure to risk of discomfort or injury to the person who desires to enter, or if in the opinion of the owner/operator the entry may jeopardize the safety of other patrons or employees.

5.5.3.1 Aerial adventure course operators should be given guidelines on the special considerations concerning patron

size, and the special considerations applicable to physically disabled and mentally impaired patrons, related to their particular aerial adventure course.

5.5.4 *Signage*—Signs presented by the owner/operator for instruction to the public shall be prominently placed and, bold in design, with wording short, simple, and to the point.

5.5.4.1 Signs to display operational instructions or requirements, or both, for use of the aerial adventure course may be posted at the waiting/loading area or other appropriate location and may include height, weight and other essential requirements and other duties and obligations of the patrons such as but not limited to those listed in 5.9.

5.5.4.2 Entrances to machinery rooms or restricted areas, or both should be posted when necessary to warn unauthorized persons not to enter.

5.6 *Maintenance Program:*

5.6.1 *Maintenance Documents*—Each owner/operator of an aerial adventure course shall read and become familiar with the contents of the designer/engineer, manufacturer, and training entity's maintenance instructions and specifications when received. Based on the designer/engineer, manufacturer, and training entity's requirements, each owner/operator shall implement a program of maintenance, testing, and inspection providing for the duties and responsibilities necessary in the care of each aerial adventure course. This program of maintenance shall include a checklist to be made available to each person performing the regularly scheduled maintenance on each aerial adventure course. The owner/operator's checklist (on an aerial adventure course basis) shall include, but not be limited to:

5.6.1.1 Description of preventive maintenance assignments to be performed;

5.6.1.2 Description of inspections to be performed;

5.6.1.3 Special safety instructions, where applicable;

5.6.1.4 The inspection criteria requirements, frequency, and retirement criteria shall be developed for the aerial adventure course components, including, but not limited to:

(1) Wire rope;

(a) Wire rope shall be subject to detailed visual inspection at regularly established intervals based on usage, but not to exceed one year by a qualified wire rope inspector, or immediately after any event possibly affecting the integrity of the wire rope. The following items shall be considered in determining the continued use of the wire rope:

- Broken wires,

- Displaced or loose wire,

- Physical damage at impact areas on wire rope,

- Visual inspection of impact areas on zip lines,

- *Diameter Reduction*—Original diameter of wire rope shall be recorded at time of commissioning and recorded for use in determining subsequent diameter reduction calculations, and

- Tensioning procedures to ensure wire rope tensions are within specified operating parameters;

- (2) Wire-rope-associated hardware;

- (3) Anchorage systems;

- (4) Personal safety equipment (PSE);

- (5) Support structures and connection hardware; and

(6) All components in the primary load path not listed above.

5.6.1.5 When one or more live tree(s) are utilized in an aerial adventure course, qualified person(s) shall perform an arboricultural inspection to determine that the tree(s) are healthy and suitable for the intended use and that the original design intent is maintained. The inspections shall be performed:

- (1) At a frequency of not less than once per year;
- (2) After the occurrence of any significant environmental event, such as hurricane, tornado, lightning, ice storms, earthquake, flooding or drought;
- (3) After any change in surrounding environment that could alter the health and integrity of the trees utilized, such as removal of adjacent trees or development of adjoining properties;
- (4) Physical damage such as a major limb failure, when there is a change in the visible health of the tree or canopy, or both, as a result of disease or insect infestation; and
- (5) *Arborist inspection criteria requirements:*
 - (a) The arborist shall provide a written report evaluating the health and suitability of the tree(s) for the intended use, and
 - (b) The owner operator shall retain all arborist's inspection reports and maintenance records performed on the trees based on the arborist's report;

5.6.1.6 Any additional recommendations of the owner/operator; and

5.6.1.7 When developing the check lists as described in 5.6.1, the following terms are to be defined as follows:

- (1) *Inspection*—Visual procedure;
- (2) *Test*—Functional check;
- (3) *Quantitative measurement or analysis*—Use of equipment to measure or analyze; and
- (4) *Diagnosis*—Decision or conclusion based on data compiled from an inspection, test, quantitative measurement or analysis, or a combination thereof.

5.6.1.8 All inspection and maintenance and repair tasks performed shall be documented and available for review. All reports from outside agencies that may be required as specified by the designer/engineer shall form part of the documentation.

5.6.2 *Replacement Parts for Aerial Adventure Courses:*

5.6.2.1 Replacement parts for aerial adventure courses shall be:

- (1) Procured from the original manufacturer of the aerial adventure course, using the appropriate manufacturer-supplied identifying nomenclature; or
- (2) Procured or produced using appropriate original manufacturing drawings or specifications, or both, if available; or
- (3) Procured or produced using specifications derived from sufficient analysis to ensure parts of equivalent functions and quality, to those provided by the original manufacturer and in accordance with Practice F1193.

5.6.2.2 The manufacture of replacement parts for aerial adventure courses shall conform to the applicable sections of Practice F1193.

5.6.3 The owner/operator shall be responsible for implementing a program of testing based on the recommendations of the section on Non-Destructive Testing Requirements of Practice F1193.

5.7 *Inspection Program:*

5.7.1 *Pre-Opening Inspection*—Owner/operators of aerial adventure course shall have an inspection program consistent with the inspections outlined in this practice and Practice F1193.

5.7.2 The operator(s) of each aerial adventure course shall conduct and document a daily pre-opening inspection of each aerial adventure course or element prior to carrying patrons. This inspection shall include but not be limited to the following:

5.7.2.1 Perform a visual inspection of the following components of the course, as applicable:

- (1) Platforms, stairways, pathways, ramps, support structures, and trees included in and directly adjacent to the course;
- (2) All fencing, guarding, and barricades;
- (3) Course restraint and zip line hardware including wire rope, attachment hardware, and anchor system;
- (4) Counterweight or other tension control system components;
- (5) Personal safety equipment such as harnesses, lanyard, carabineers, pulleys/trolleys, and so forth; and
- (6) Patron clearance envelope.

5.7.2.2 Verify proper operation of the following, as applicable:

- (1) Specified manual and automatic patron control equipment,
- (2) Specified safety related control system components,
- (3) Braking systems, and
- (4) Communication systems.

5.7.2.3 Ensure access routes and platforms are clear of debris such as ice and snow to the extent necessary to permit inspection and operation.

5.7.2.4 Additional instructions deemed necessary by the owner/operator.

5.7.3 Inspection documents deemed appropriate by the owner/operator to be maintained in the aerial adventure course file shall be filed in accordance with the procedures outlined in this practice and Practice F1193.

5.7.4 The owner/operator of an aerial adventure course shall promptly notify the manufacturer of an incident, failure, or malfunction which, in the owner/operator's judgment, may affect the continued proper operation of the aerial adventure course and is information of which the manufacturer should be aware.

5.8 *Training Program:*

5.8.1 *Operator Training*—The owner/operator shall provide and document training under the supervision of a trainer for each operator and attendant of an aerial adventure course. This training shall include, but not be limited to the following:

5.8.1.1 Instructions on aerial adventure course operating procedures;

5.8.1.2 Instructions on specific duties of the assigned operator and attendant position(s) of the aerial adventure course;