



Designation: **F2461—09 F2461 – 16**

Standard Practice for Manufacture, Construction, Operation, and Maintenance of Aquatic Play Equipment¹

This standard is issued under the fixed designation F2461; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers information for manufacture, construction, operations and maintenance of aquatic play equipment and provides safety performance standards for various types of public aquatic play components and aquatic play composite structures.

1.2 Inclusions:

1.2.1 Climbable and climb-resistant aquatic play components, composite aquatic play structures, user controls, water sprays, fountains, and slides that occur on wet decks and wading, swimming or leisure pools. The play components specified herein occur for use in aquatic play areas.

1.2.2 Play equipment, fall zones, use zones for wet decks, wading pools, swimming pools and leisure pools.

1.2.3 This standard is intended to apply to Aquatic Play Equipment that is located in and around re-circulated and potable water recreational facilities. Such facilities include but are not limited to amusement parks, theme parks, water parks, family entertainment centers, municipal swimming pools and municipal parks.

1.2.4 Waterslides 6 ft in height or smaller.

1.3 Exclusions:

1.3.1 Playground equipment that does not have an entry or an exit onto or into a wet deck, wading pool, swimming pool or aquatic recreation pool.

1.3.2 Home playground or home pool equipment or play equipment as scoped in Consumer Safety Performance Specification **F1148** and ANSI/NSPI-5.

1.3.3 Waterslides as scoped in Practice **F2376-08**

1.3.4 Flotation devices used on water slides or in swimming pools.

1.3.5 Swimming pools as specified by ANSI/NSPI-1 or ANSI/IAF-9.

1.3.6 Products or facility elements specifically designed to provide access to and from pools for people with disabilities.

1.3.7 Water rides such as log flumes, raft rides, inner tube rides, waterslides or other attractions where the participant sits in a vehicle or is physically propelled or moved by or with water.

1.3.8 Sports equipment, fitness equipment, and diving equipment.

1.4 Compliance:

1.4.1 Where water is indirectly or directly added or applied to Consumer Safety Performance Specification **F1487-07A** play equipment, the equipment shall comply with this standard. Where a requirement for compliance to a section of the Consumer Safety Performance Specification **F1487-07A** standard is required by this standard, the section number is preceded with the standard's designation.

1.4.2 Soft contained play structures with aquatic play components shall comply with Safety Performance Specification **F1918-04** except as modified by this standard.

1.4.3 Aquatic play components and composite play structures represented, as complying with this safety performance standard shall meet all applicable requirements specified herein. Anyone representing compliance with this standard shall keep such essential records as are necessary to document any claim that the requirements within this standard have been met.

1.5 This standard includes the following sections:

¹ This practice is under the jurisdiction of ASTM Committee **F24** on Amusement Rides and Devices and is the direct responsibility of Subcommittee **F24.70** on Water Related Amusement Rides and Devices.

Current edition approved March 15, 2009 Nov. 1, 2016. Published May 2009 December 2016. Originally approved in 2009. Last previous edition approved in 2009 as **F2461 – 09**. DOI: [10.1520/F2461-09](https://doi.org/10.1520/F2461-09); [10.1520/F2461-16](https://doi.org/10.1520/F2461-16).

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1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard. (The conversion factor from inch-pound to metric units is 1 in. = 25.4 mm, and 1 lb = 4.4482 N.)

1.7 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

- F770 Practice for Ownership, Operation, Maintenance, and Inspection of Amusement Rides and Devices
- F853 Practice for Maintenance Procedures for Amusement Rides and Devices (Withdrawn 2014)³
- F1148 Consumer Safety Performance Specification for Home Playground Equipment
- F1193 Practice for Quality, Manufacture, and Construction of Amusement Rides and Devices
- F1292 Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment
- F1487 Consumer Safety Performance Specification for Playground Equipment for Public Use
- F1918 Safety Performance Specification for Soft Contained Play Equipment
- F2291 Practice for Design of Amusement Rides and Devices
- F2376 Practice for Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems

2.2 ANSI Standards:⁴

- ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
- ANSI A10.11 Personal and Debris Nets
- ANSI/IAF-9 American National Standard for Aquatic Recreation Facilities
- ANSI/NSPI-1 American National Standard for Public Swimming Pools
- ANSI/NSPI-5 American National Standard for Residential Inground Swimming Pools

2.3 Other Standards:

- NFPA 70 National Electric Code (NEC)⁵

3. Terminology

- 3.1 Reserved for future inclusions.

4. Manufacturing and Materials

4.1 Aquatic play components shall comply with Consumer Safety Performance Specification F1487-07A Section 4 except as modified by this standard.

4.2 *Durability*—Aquatic play components and composite play systems shall be manufactured and constructed only of materials that have a demonstrated durability in the aquatic playground, swimming pool or similar setting.

4.2.1 Any new materials shall have documented performance and material properties or tested accordingly for durability by the equipment manufacturer.

4.3 *Compatibility*—Materials used in the manufacture of aquatic play components shall not create an unsanitary or toxic condition for users and the aquatic environment in which they are installed.

4.4 Materials:

- 4.4.1 *Metals*—Refer to Consumer Safety Performance Specification F1487-07a, Sections 4.1.1 and 4.1.2.
- 4.4.2 *Plastics*—Refer to Consumer Safety Performance Specification F1487-07a, Section 4.1.1.
- 4.4.3 *Wood*—Refer to Consumer Safety Performance Specification F1487-07a, Section 4.1.3.

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.

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

4.4.4 *Concrete*—Concrete footings and slabs shall comply with local jurisdiction or equal to the requirements of the International Building Code.

4.4.5 *Foam*—Foam materials used in aquatic play components shall be skinned or of a closed cell type. Foam materials that are subject to ultraviolet (UV) degradation shall be protected against ultraviolet light or include ultraviolet degradation inhibitors. Foam products shall not leach any chemicals that could affect water chemistry.

4.4.6 Automotive or industrial tires are not permitted in the aquatic play environment.

4.5 *Components:*

4.5.1 *Netting*—Netting material for structural purpose, subject to UV degradation, shall be protected from U/V exposure or include U/V degradation inhibitors.

4.5.2 *Fasteners and Cables*—Fasteners are required to comply with Practice F2291-06A, Section 16 and also Consumer Safety Performance Specification F1487-07a Section 4.2.1 to Section 4.2.2 inclusive.

4.5.2.1 Fasteners in aquatic play components when located on walking, stepping, sitting and sliding surfaces of aquatic play components and wet decks shall be flush, and without any sharp or abrasive finish.

4.5.2.2 All fasteners used to construct Aquatic Play Equipment shall be maintained and consistent as specified by the manufacturer.

4.5.2.3 All fasteners, connecting, and covering devices shall be corrosion resistant or be provided with a corrosion-resistant coating.

4.5.2.4 When installed in accordance with the manufacturer's specifications, fasteners, connecting, and covering devices shall not loosen or be removable without the use of tools.

4.5.2.5 Hardware in moving joints shall also be secured against unintentional loosening.

4.5.2.6 Moving suspended elements shall be connected to the fixed support with bearings or bearing surfaces that serve to reduce friction or wear.

4.5.2.7 Steel cable that is permanently affixed to a hanger assembly performs as a bearing surface. Cable ends shall be inaccessible or capped to prevent injury from frayed wires. Cables and steel-cored ropes should be protected to prevent fraying, loosening, unraveling, or excessive shifting of joints.

4.5.3 *Electrical Components*—Electrical components that require power to operate, should be installed with the materials, voltage and grounding requirements as required by local governing authorities and NFPA 70.

4.5.4 Coatings shall comply with Consumer Safety Performance Specification F1487-07A, Section 4.1.

4.5.5 Replacement Parts for Aquatic Play Equipment shall be:

4.5.5.1 Procured from the original manufacturer of the aquatic play equipment, using the appropriate manufacturer-supplied identifying nomenclature; or

4.5.5.2 Procured or produced to meet or exceed the manufacturer's minimum specification.

5. Design

5.1 *Load Calculations:*

5.1.1 *Slide Beds*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.4.1.4.

5.1.2 *Loading Test Criteria*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.2.

5.1.3 *Components and Structures Subjected to Vertical Loads*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.4 through Section 12.4.1.1 inclusive.

5.1.4 *Structures Containing Two or More Longitudinal Components*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.4.1.2.

5.1.5 *Individual Surfaces*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.4.1.3.

5.1.6 *Components with Designated Occupancy*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.4.1.5.

5.1.7 *Components Subjected to Lateral Loads*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.5 through Section 12.5.2 inclusive.

5.1.8 *Alternative Testing for Structural Integrity*—Refer to Consumer Safety Performance Specification F1487-07a, Section 12.6.

5.2 *Structural Design:*

5.2.1 Structural integrity tests shall be conducted by manufacturers as per Practice F2291-06A, Section 8.6 through 8.16 inclusive.

5.2.1.1 In multi-level, composite play structures provide lateral sway brace loads of 24 lb per ft (350 N/m) parallel and 10 lb per ft (145.9 N/m) perpendicular to the floor or platform level.

5.2.1.2 *Wind Load*—For structures with elevated platforms where the height of the platform is larger than the width or depth of the elevated platform, the composite structure shall be designed to withstand 100 mph wind (3 s gust) for non-operational conditions. The calculation shall take into account roofs, dump buckets, awnings, flags, banners, or any other element that may affect the wind load calculations.

5.2.1.3 Structural calculations shall consider the combination of loads corresponding to foreseeable severe conditions.

5.2.2 *Platforms, Walking or Climbing Surfaces*—Structural engineering of composite play structure platforms with 20 % slope or less shall be based upon a live load as per Practice F2291-06a, Section 8.15 and occupancy of 3 ft² per person.

5.2.3 *Stairs, Guardrails, and Handrails:*

5.2.3.1 Guardrails shall be designed to comply with Practice F2291 Section 14, with the exception that the maximum opening size shall reject a torso probe as specified in Consumer Safety Performance Specification F1487-07a Fig A1.2 (see Appendix X1).

5.2.3.2 Stairs and handrails shall be designed to comply with Practice F2291 Section 14.

5.2.4 Netting Reserved for future.

5.2.5 For the purposes of calculations, the water load on an aquatic play component surfaces other than water slides shall be designed to the amount of live load on an aquatic play component or other surfaces of the composite play structure. Where used, Design/Engineers shall consider impact and dynamic loads such as water bucket dumps, and shall be included in the live loading design of structures, platforms and roofs.

5.2.6 Overhead play elements. Overhead climbing elements shall be designed to withstand a 200-lb (890 N) per lineal foot live load. Their mounting and connectors shall be designed to accommodate the total live loading of the free spanned element.

5.3 *Access and Egress*—Aquatic play components shall comply with Consumer Safety Performance Specification F1487-07A Section 6 and 7 except as provided herein.

5.3.1 Composite play structures utilizing multiple aquatic play components are permitted in wet decks, wading pools and as a means of access to a pool when it conforms to the requirements of Consumer Safety Performance Specification F1487-07 A Sections 9.7 and 9.8 and the requirements of this standard.

5.3.2 Unenclosed level, stair or ramp entries are permitted.

5.3.3 Unless otherwise specified herein, aquatic play components are permitted to be accessed to and from wet decks and from the perimeter of or from within wading pools, swimming pools or leisure pools.

5.3.4 All means of entry and egress shall be slip resistant.

5.3.5 Access to and from composite play structures and soft contained play systems is permitted from pool decks, wet decks and from inside the pool.

5.4 *Climb Resistance*—The following are climb-resistant under this standard:

5.4.1 Aquatic play components that lack a designated play surface or handgrips, or both, within 84 in. of the ground or deck.

5.4.2 Equipment flush with the play surface. Protrusions from play surfaces shall not exceed VA thickness and shall have rounded, radiused, or angular edges to prevent hand and foot holds.

5.4.3 Horizontal or angled members 60 in. (1625 mm) or more above the ground or deck surface.

5.4.4 Slanted members with more than 30° slope from horizontal.

5.4.5 Rounded or sloped shield over horizontal pipe flanges or structural connections that limit foot and hand holds.

5.4.6 Controls and operating mechanisms that are purposely designed to discourage or inhibit climbing.

5.5 *Component Layout and Use Zones:*

5.5.1 The dimensions and configuration of the Aquatic play component use zone shall be dependent upon the type of play equipment, as specified in Consumer Safety Performance Specification F1487-07A Section 9.1 through 9.9 and except as modified herein.

5.5.2 The use zones of aquatic play components and composite structures that provide access to and from a pool shall comply with the requirements of Consumer Safety Performance Specification F1487-07A.

5.5.3 *Use Zones*—The designer/manufacturer shall determine a use zone for each play component. Use zones are not to be determined by the area of incidental water splash, such as that of dumping buckets, but determined by the area intended to be occupied by persons.

5.5.3.1 Use zones shall provide a 72-in. clearance between objects unless they are functionally linked.

5.5.3.2 Use zones are permitted to overlap with aquatic play use zones.

5.5.3.3 Use zones are not permitted to overlap water slide landing zones.

5.5.3.4 Climb resistant aquatic play components, composite structures, and their entries are not required to provide impact attenuation materials within their use zones.

5.5.3.5 Structures having aquatic play components shall have use zones per Consumer Safety Performance Specification F1487-07A.

(1) Full enclosure of the user areas shall include areas above guards or guardrails and over the top of user platforms.

(2) Enclosures above barriers shall not permit the passage of Torso Probe and Head Probe above guards or guardrails. Per Consumer Safety Performance Specification F1487, Fig. A1.2 and Fig. A1.3 (see Appendix X1).

(3) Netting used to fully enclose a device shall comply with the requirements of Safety Performance Specification F1918, Section 6.8.

5.5.4 The placement of aquatic play components and composite play structures and their minimum use zone areas that provide access into or from a pool or wet deck shall be coordinated with other pool facility elements as provided herein.

5.5.4.1 Except for those aquatic play components that provide a direct path into a pool and the run of water slides, aquatic play component use zone shall not overlap the required clear floor areas on pool decks of facilities or equipment designed to provide access into the pool. The use zone and composite or soft contained play structures shall not encroach within 48 in. (1220 mm) of the poolside of the facility or equipment.

5.5.4.2 The use zone of other equipment shall not overlap water slide run-outs, tethered floatable or log roll use zones or upper body equipment spanning from pool decks over pool water bodies. The use zone overlapping water bodies shall not overlap water slide, plunge pool use zones, diving area use zones of diving boards, stationary or floating platforms.

5.5.4.3 Floating aquatic play equipment in water bodies that do not provide climbing support for standing or kneeling may have a use zone extending to within 48 in. (1220 mm) to the pool edge, underwater benches, underwater structures protruding above the pool floor surface, pool entry/exit structure or accessibility facility or structures. Floating play structures and their supports are required to be placed a minimum of 36 in. (914 mm) apart in wave pools, lazy rivers or other pools with directional currents.

5.5.4.4 In the design of water falling or spraying features, designers shall take into consideration the impact pressure to patrons at the potential point of impact.

5.6 *Winterization*—In climates subject to freezing temperatures, the design of aquatic play equipment and any water supply or pool systems shall take into account protection from damage due to freezing. The designer/engineer shall provide the appropriate procedures to guard against freezing damage shall be included in the Operations and Maintenance instructions for aquatic play equipment.

6. Performance Requirements

6.1 *General:*

6.1.1 *Limb Entrapment:*

6.1.1.1 Sliding surfaces shall be constructed in such a manner as to provide a smooth continuous sliding surface, with no gaps or spaces that might create an entrapment hazard as outlined in Practice F2376-08.

6.1.1.2 Grates, slots and openings accessible to the public shall be designed to minimize entrapment. Should they exceed $\frac{1}{4}$ inch width or length, or both, it is recommended they be oriented perpendicular to the dominant direction of travel.

6.1.2 Diving boards or diving or jumping platforms are not permitted.

6.2 *Decks*—All decks should be slip resistant.

6.2.1 Submerged walking surfaces, which are underwater beneath and around Aquatic Play Equipment, shall be slip resistant. In addition they shall slope to drain or incorporate self-draining features in order to keep standing water off the structure, unless the structure, or portions thereof, is specifically designed to accommodate such water.

6.2.2 *Wet Decks:*

6.2.2.1 In plans or drawings, the designer shall specify the boundary of wet decks. The total area and boundary of the wet deck shall include the planned water spray area of the equipment located on the wet deck, and shall include a reasonable amount of area overspray due to average meteorological conditions during times of planned use of the facility.

6.2.2.2 Wet decks are permitted to be any material utilized for swimming pool decks or floors as permitted by the swimming pool building codes of the authority having jurisdiction or as otherwise defined by this section.

6.2.2.3 Impact attenuation materials are not required. Impact attenuation, if used shall not affect the performance of the water filtration, treatment and circulation system.

6.3 *Water Delivery:*

6.3.1 The pump(s), which supply water to the aquatic play components, shall be sized to deliver the proper flow at the pressure recommended by the component manufacturer.

6.3.2 *Spray Nozzles and Orifices:*

6.3.2.1 All orifices or water nozzle openings accessible to the public user shall be designed to minimize finger entrapment.

6.3.2.2 Where the aperture of spray nozzles are within the reach of the intended user, they shall comply with the following.

(1) Spray nozzles with small aperture sprays are recommended that comply with Consumer Safety Performance Specification F1487-07A Section 6.5.1.1.

(2) Nozzles are considered within the reach of users ages 2 through 5 years old if the aperture is positioned 60 in. (1524 mm) or less above decks or platform walking surfaces, and within 18 in. (457 mm) of lateral reach range from a user's standing or seated area. Nozzles are considered to be within the reach range of 5 to through adult user if the aperture is positioned 84 in. (2134 mm) above the deck or platform walking surface and within 24 in. (610 mm) of lateral reach range of the user's standing or seated area.

6.3.2.3 User controlled spray shall not spray outside of the boundary of the wet deck or the pool water body and associated deck.

6.3.3 *Operator Control Valves:*

6.3.3.1 The water supply to Aquatic Play Components shall be equipped with a control device.

6.3.3.2 The control device shall be in a location that is not accessible to the general public. The control device can be in addition to another valve which the patron may use to control the water flow, but the operator control valve shall always be upstream from the patron accessible valve so that the patron may never obtain a higher force from the water effect or source than shall be capable of being set by the operator, contractor or manufacturer at the operator control valve.

6.3.3.3 If it is determined that a control device should have a non-adjustable operating “set point” once the operator or manufacturer has determined the appropriate setting for that control valve, the valve shall be marked by durable means and secured in place.

6.3.3.4 Valves installed under decks or within aquatic recreation equipment, shall be provided with access covers to permit access for operation, service, and maintenance of equipment. Covers shall only be removable with tools.

6.3.3.5 It is recommended that operator control valves be made accessible only with the use of the manufacturer-supplied, tamper resistant, security hardware.

6.4 *Drainage:*

6.4.1 *Grates*—Suction grates shall be sized and located according to ANSI/IAF-9, Section 9.

6.4.2 Surrounding pedestrian circulation and landscaped areas shall be sloped to not drain into the wet deck area.

6.4.3 The wet deck shall be sloped not greater than 1:12 slope ratio, so that under normal operating condition water does not leave the wet deck boundary and flow onto other paved or landscaped areas or pools.

6.4.4 Drainage from wet decks shall go to a water recirculation system designed to accommodate the total water capacity of the facility, or when approved by the authority having jurisdiction, to storm or sanitary sewer system.

6.4.5 A main gravity drain shall be located at the lowest point of the wet deck or facility area to permit the complete drainage of standing water.

6.4.6 Drains shall be covered by a secure grating, which requires the use of a tool to remove the grate.

6.5 *Water Treatment:*

6.5.1 The water that feeds an attraction or device shall be either from a potable water source, the swimming pool in which the attraction or device is located, or a separate reservoir of water that is filtered and treated according to the standards required for the type of pool in which the attraction is located. If the water source is from the swimming pool or a separate reservoir it must be chemically treated according to the standards required by the governing authority.

6.5.2 Recirculation systems are required to operate as per ANSI/IAF-9, Section 7 through 10 inclusive.

6.5.3 Water returned through the filtration system to a collector, surge tank or reservoir shall be treated prior to returning to the aquatic play component.

6.5.4 The water circulation, filtration and treatment system shall be designed to accommodate the total water capacity of all aquatic play components. Reservoirs or holding tanks sizing must consider and incorporate calculations for transit time, pipe size, velocity, and draw down due to external conditions and overflow.

6.6 *Play Structures:*

6.6.1 Composite structures shall be configured to discourage diving off or from facility into a pool, wading pool or wet deck.

6.6.2 Interior crawl or climb areas shall not be located below the water surface due to movement of the structure or changes in the water elevation.

6.6.3 Except at methods of entry and exit for each event, and dry slide or water slide transition areas and exits, a composite structure with platform levels more than 20 in. above ground, wet deck or pool floor level shall have guardrails.

6.7 *Soft Contained Play:*

6.7.1 Soft contained play structures are permitted in wet decks and as a means of access to pool when it conforms to the requirements of Safety Performance Specification **F1918** and as modified by the requirements of this standard.

6.7.2 Soft contained play structures shall be so designed to prevent water accumulation within the equipment.

6.7.3 The incorporation of water to the exterior or interior of soft contained play structures shall not interfere with user in a manner to cause falls or entrapment within the structure.

6.7.4 Except for portions of ramped, stair or net crawl access, no user sections of soft contained play structures shall be submerged.

6.7.5 Soft contained play structure entries and exits on a pool deck shall be oriented away from the edge of the pool or pool coping, and shall maintain a minimum of 72 in. clearance to pool stair, ramp or transfer tier structures and their grab bars or handrails.

6.8 *Elevated Elements:*

6.8.1 Enclosed or semi-enclosed areas under elevated elements shall not be accessed by a submerged water route.

6.8.2 The area under elevated elements that do not meet this requirement shall be barricaded or otherwise enclosed to prevent user access.

6.8.3 Enclosures at ground, deck, or water body level that do not permit visual supervision from areas outside the wet deck or pool water body are not recommended by this standard.

6.9 *Slides:*

6.9.1 Water slides may be installed in conjunction with composite play structures or soft contained play systems.

6.9.2 Where incorporated with aquatic play environments and other aquatic play components or composite structures, slides shall comply with Consumer Safety Performance Specification **F1487-07A** Section 6.4.1.