Designation: F1159 – 03a

Standard Practice for Design and Manufacture of Patron Directed, Artificial Climbing Walls, Dry Slide, Coin Operated and Purposeful Water Immersion Amusement Rides and Devices and Air-Supported Structures[1]

This standard is issued under the fixed designation F1159; 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 establishes information and procedures for the design and manufacture of patron directed amusement rides or devices (for example, go karts, bumper cars, bumper boats), artificial climbing walls, dry slides, coin operated rides, and amusement rides and devices that involve the purposeful immersion of the patron's body partially or totally in the water and involve more than incidental patron contact (for example, pools, water slides, lazy rivers, interactive aquatic play devices), and air-supported structures.

1.2 *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]

F846 Guide for Testing Performance of Amusement Rides and Devices

F2007 Practice for Design, Manufacture, and Operation of Concession Go-Karts and Facilities

2.2 *Federal Documents:*[3]

Dept. of Health, Education, and Welfare *Pediatric Growth Development Chart*, 1983

OSHA 29 CFR Fall Protection Systems Criteria and Practices Part 1926.502 (d)

USDA Agricultural Handbook 72, Rev. 0—*The Wood Handbook*, by the U.S. Dept. of Agricultural Forest Products Laboratory

2.3 *Society of Automotive Engineers Standards:*[4]

SAE J 833 Recommended Practice for USA Human Physical Dimensions

SAE Hydraulic Fluid Standards

SAEJ-10 Pneumatic Storage Tanks

SAE Pneumatic Tubing Standards

2.4 *American Society of Mechanical Engineers Documents:*[5]

ASME Boiler and Pressure Vessel Code, Section VIII, Division 1

ASME Welding Standards

2.5 *American Institute of Steel Construction Document:*[6]

AISC Manual on Steel Construction

2.6 *American Welding Society Standard:*[7]

ANSI/AWS D1.1 Structural Welding Code

2.7 *National Fire Protection Association Standard:*[8]

National Electrical Code

2.8 *ANSI Standard:*[9]

ANSI (NFPA/JIC) T2.24.1–1991 Hydraulic Fluid Power Systems Standard for Stationary Industrial Machinery,[9]

3. Significance and Use

3.1 This practice provides designers and manufacturers of patron directed amusement rides or devices (for example, go karts, bumper cars, bumper boats), artificial climbing walls, dry slides, coin operated rides, water amusement rides or devices (involve the purposeful immersion of the patron's body partially or totally in the water and involve more than incidental

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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] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[4] Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

[6] Available from the Institute of Steel Construction, P.O. Box 4588, Chicago, IL 60680.

[7] Available from the American Welding Society, 550 N. LeJeune Rd., Miami, FL 33126.

[8] Available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

[9] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

patron contact (for example, pools, water slides, lazy rivers, interactive aquatic play devices)), and air-supported structures with design references and criteria to use in designing and manufacturing of patron directed amusement rides or devices, artificial climging walls, dry slides, coin operated rides, purposeful immersion water amusement rides or devices, and air-supported structures.

4. Procedures for Developing Documentation and Records

4.1 *Design and Calculations*—Manufacturers' basic documentation and engineering analysis shall include, but not be limited to, the following:

4.1.1 Performance characteristics of structural, mechanical, and electrical components, and

4.1.2 Forces on passengers due to the action of the ride based on design loading.

4.2 *Drawings and Records*—Records shall be kept on the characteristics and forces explained in 4.1.1 and 4.1.2 for all versions and revisions of a ride or device so long as deemed appropriate by the designer/manufacturer.

4.3 *Testing*—Document and record the testing performance of amusement rides and devices in accordance with the tests given in Guide F846.

DESIGN PROCEDURES

5. Designing in Accordance with Passenger Weights

5.1 The weight assigned to an adult passenger, for design purposes, shall be 170 lb (77 kg) or 12 lb/in. (5.4 kg/25.4 mm) of hip width at the seat, whichever is greater. Reference SAE J 833 on USA Human Physical Dimensions, using the "medium man" for passenger weight.

5.2 The weight assigned to a 12-year-old child passenger, for design purposes, shall be 90 lb (41 kg) or 9 lb/in. (4.1 kg/25.4 mm) of hip width at the seat, whichever is greater. Reference U.S. Department of Health, Education, and Welfare Pediatric Growth Development Chart 1983.

6. Passenger Carrying Devices

6.1 *Design of Seats*—Design passenger seating to provide adequate support padding and containment for the passenger's body during operation, and to be consistent with the design intent of the ride.

6.2 *Methods of Restraint*—Where appropriate, base the passenger restraint on the design intent of the ride or device with consideration given, but not limited to, the height, speed, and forces on passengers.

6.3 *Passenger Clearance*—Design clearance to minimize the opportunity for contact between a contained passenger and any object where said contact is likely to cause injury during operation of a ride or device.

7. Amusement Ride and Device Structures

7.1 *Metal Structures*—Where applicable, design metal structures in accordance with the AISC *Manual of Steel Construction*, as applicable.

7.1.1 Allowable loads or stresses as indicated in the AISC *Manual of Steel Construction* shall be reduced as deemed adequate by the manufacturer/designer, to allow for special combinations of conditions which may include, but are not limited to, stress concentrations, shock, dynamics, load cycles, degree of risk, and environment.

7.2 *Timber Structures*—Design timber structures in accordance with USDA Agricultural Handbook 72, Revision 0, *The Wood Handbook.*

7.2.1 Allowable loads or stresses as indicated by the above data shall be reduced as deemed adequate by the manufacturer/designer to allow for special combinations of conditions that may include, but are not limited to, stress concentrations, shock, dynamics, load cycles, degree of risk, and environment.

7.3 *Welding*—Welding and welding procedures shall be in accordance with American Welding Society (ANSI/AWS D1.1) or American Society of Mechanical Engineers, or other equivalent standards, and be performed by appropriately certified or qualified welders as required by the standard.

7.4 *Bolting Specifications*—All threaded fasteners used on an amusement ride or device in connecting components shall meet accepted engineering standards for each application in the system, and grade shall be identified where appropriate.

7.5 *Chain and Wire Rope*—Chain and wire rope used in ride systems shall meet existing industrial ratings considering the loads, conditions, dynamics, and potential fatigue involved.

7.6 *Air-Supported Structures*—Where applicable, air-supported structures shall be designed and manufactured with flame-resistant materials that meet or exceed a 2-s flame-out standard.

7.6.1 Hold-down provisions shall be designed for the structure to allow operation of the device within the wind conditions specified by the manufacturer.

7.6.2 Provision shall be made to ensure that patrons cannot conceal themselves from the operator's view.

7.6.3 Enclosed structures shall have within 100 ft of the normal point of egress adequately lighted emergency exits.

7.6.4 Power failure, of an inflation means, shall not increase the risk of injury to anyone on the device.

7.7 *Fall Protection*—The manufacturer of an amusement ride or device shall provide appropriate anchorage points for attachment of personal fall arrest systems that may be used during routine assembly, disassembly, maintenance, and inspection. Personal fall arrest systems shall meet the minimum design requirements specified in OSHA 29 CFR PART 1926.502 (d).

8. Electrical Components

8.1 Design, manufacture, and install electrical components in accordance with the National Electric Code or the equivalent.

8.2 Emergency stop circuits shall be energized systems which are fail-safe in case of power failure.

8.3 The emergency stop switches shall be manually reset. The resetting of the stop switch shall not start the ride.

9. Hydraulic Components

9.1 The applicable provisions of ANSI (NFPA/JIC) T2.24.1–1991 or the equivalent shall be used as the standard for the design and manufacture of fixed and portable Amusement Rides and Devices except as expanded or modified in the