



Designation: F2291 – 23b

Standard Practice for Design of Amusement Rides and Devices¹

This standard is issued under the fixed designation F2291; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This practice establishes criteria for the design of amusement rides, devices and major modifications to amusement rides and devices manufactured after the effective date of publication except as noted in 1.2.

1.2 This practice shall not apply to:

1.2.1 Patron directed amusement rides or devices (for example, go karts, bumper cars, bumper boats);

1.2.2 Artificial climbing walls;

1.2.3 Air-supported structures;

1.2.4 Dry slides;

1.2.5 Rides that are activated by a patron, deactivate automatically, do not require a restraint or restraints, and do not require the supervision or services of a trained operator to mitigate operational risks (examples: simple coin operated rides and arcade games with motion components);

1.2.6 Amusement rides or devices that involve the purposeful immersion of the patron's body partially or totally in the water and involves more than incidental patron water contact (for example, pools, water slides, lazy rivers, interactive aquatic play devices);

1.2.7 Amusement rides and devices whose design criteria are specifically addressed in another ASTM standard;

1.2.8 Portions of an amusement ride or device unaffected by a major modification;

1.2.9 Upgrades to electrical wiring, electrical motors and electrical components of amusement rides and devices provided the original design and safety criteria are maintained or enhanced; and

1.2.10 Pre-existing designs manufactured after the effective date of publication of this practice if the design is service proven or previously compliant and the manufacturer provides:

1.2.10.1 A historical summary of the amusement ride, device or major modification, and

1.2.10.2 A statement that the design is service proven or previously compliant as specified by Section 3.

¹ This practice is under the jurisdiction of ASTM Committee F24 on Amusement Rides and Devices and is the direct responsibility of Subcommittee F24.24 on Design, Manufacture, Installation and commissioning.

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1.2.10.3 Amusement rides and devices, and major modifications to amusement rides and devices may qualify as “previously compliant” for five years following the date of publication of this practice. Thereafter, amusement rides and devices, and major modifications to amusement rides and devices must qualify as “service proven” or meet the requirements of this practice.

1.3 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.

1.4 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.

1.5 *Units*—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.

1.6 This standard includes the following sections:

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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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- F770 Practice for Ownership, Operation, Maintenance, and Inspection of Amusement Rides and Devices
- F1193 Practice for Quality, Manufacture, and Construction of Amusement Rides and Devices
- F2137 Practice for Measuring the Dynamic Characteristics of Amusement Rides and Devices
- F2374 Practice for Design, Manufacture, Operation, and Maintenance of Inflatable Amusement Devices

2.2 ASTM Technical Publication:³

- STP-1330 Composite Materials: Fatigue and Fracture, 7th Volume

2.3 ACI Standards:⁴

- ACI-301 Specifications for Structural Concrete
- ACI-318 Building Code Requirements for Structural Concrete (ACI-318) and Commentary (318R)

2.4 AFPA, American Wood Council Standard:⁵

- NDS National Design Standard for ASD Design

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 ASTM International Headquarters, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

⁴ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333.

⁵ Available from American Forest and Paper Association (AF&PA), 1111 19th St., NW, Suite 800, Washington, DC 20036.

NDS 2005 National Design Specification for Wood Construction

2.5 AISC Manuals:⁶

- AISC 316 Manual on Steel Construction, Allowable Stress Design (ASD)

- AISC M015 Manual on Steel Construction, Load & Resistance Factor Design (LRFD)

2.6 ANSI Standards:⁷

- ANSI/AISC 360-16 Specifications for Structural Steel Buildings

- ANSI B93.114M Pneumatic Fluid Power—Systems Standard for Industrial Machinery

- ANSI B77.1 Passenger Ropeways—Aerial Tramways, Aerial Lifts, Surface Lifts, Tows and Conveyors—Safety Requirements

- ANSI Y32.10 Graphic Symbols for Fluid Power Diagrams

2.7 ASCE Standard:⁸

- ASCE 7 Minimum Design Loads for Buildings and Other Structures

- ASCE 16 Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction

- ASCE/SEI 7-22 Minimum Design Loads for Buildings and Other Structures

2.8 ASM Documents:⁹

- ASM Atlas of Fatigue Curves

2.9 ASME Standards:¹⁰

- ASME Boiler and Pressure Vessel Code

- ASME B15.1 Safety Standards for Mechanical Power Transmission Apparatus

- ASME A17.1 Safety Code for Elevators and Escalators

2.10 AWS Standards:¹¹

- ANSI/AWS D1.1/D1.1M Structural Welding Code—Steel

2.11 BSI Standards:¹²

- BS 5400-10 Steel, Concrete and Composite Bridges—Code of Practice for Fatigue

2.12 Building Codes:

- International Building Code (2018) Chapter 16, “Structural Design”

- National Building Code of Canada (2015) Companion-action load combinations

2.13 CDC (Center for Disease Control) Growth Charts:¹³

- CDC Basic Body Measurements

⁶ Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 3100, Chicago, IL 60601-2001.

⁷ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁸ Available from The American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191.

⁹ Available from American Society of Metals (ASM International), 9639 Kinsman Rd., Materials Park, OH 44073-0002.

¹⁰ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

¹¹ Available from The American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126.

¹² Available from British Standards Institute (BSI), 389 Chiswick High Rd., London W4 4AL, U.K.

¹³ Available from Centers for Disease Control & Prevention (CDC), 1600 Clifton Rd., Atlanta, GA 30333, website: <http://www.cdc.gov/> [Search: anthropometrics].