



Designation: F3158 – 22

Standard Practice for Patron Transportation Conveyors Used with a Water Related Amusement Ride or Device¹

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1. Scope

1.1 This practice applies to the classification, design, manufacture, construction, and operation of patron transportation conveyors, integral with the operation of water related amusement rides or devices as scoped in Practice F2376-21a.

1.2 This practice applies to conveyors used for patron loading/unloading or to transport patrons on rafts, tubes, or other vehicles. Loading, sequencing, transitioning, starting, and unloading conveyors that carry patrons are included in the scope of this practice.

1.3 This practice shall affect new conveying systems or major modifications of conveyors used in an amusement ride or attraction.

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 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.*

1.7 *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.*

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.

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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

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

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*:³

ANSI/ASME B20.1 Safety Standard for Conveyors and Related Equipment

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

2.3 *ASME Standard*:⁴

ASME A17.1 Safety code for Elevators and Escalators

3. Terminology

3.1 *Definitions of Terms Specific to This Standard*:

3.1.1 This space is reserved (see X1.1).

4. Classification

4.1 *Type 1 Riding Position Conveyor*—The conveyor may not move while a patron is on the conveyor unless the patron is in riding position on a ride vehicle. Type I conveyors may perform, but are not limited to, one or more of the following functions:

4.1.1 Transport,

4.1.2 Sequencing,

4.1.3 Acceleration,

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

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

- 4.1.4 Ingress, and
- 4.1.5 Egress.

4.2 *Type 2 Walk On/Off Conveyor*—Conveyors in which patrons are allowed to walk on or off of the moving conveyor during vehicle loading or unloading. These conveyors are also known as moving station conveyors.

5. Significance and Use

5.1 The purpose of this practice is to provide designers, engineers, manufactures, owners, and operators with criteria and references for use in designing, inspecting, and operating patron transportation conveyor systems which are integral with a water related ride or device.

6. Design Criteria

6.1 In addition to the design requirements of Section 5, General Design Criteria, of Practice F2291-21, the following considerations and requirements shall be included.

6.2 Geometry:

6.2.1 The length of a conveyor is defined from the center of the tail pulley to the center of the head pulley.

6.2.2 *Belt Width*—The actual width of the belt.

6.2.3 *Riding Surface Width*—The exposed width of the belt surface.

6.2.3.1 *Minimum Riding Surface Width for a Type 1 Riding Position Conveyor*—The width of the vehicle traction surface plus 4 in. (10 cm).

6.2.3.2 *Minimum Riding Surface Width for a Type 2 Walk On/Off Conveyor*—36 in. (0.92 m) minimum is required for patron travel.

6.2.4 The carrying side of the conveyor belt shall maintain a fixed path of travel under all load conditions and maintain contact with the support track, slide deck or support rollers.

6.2.5 Limits to the Maximum Slope Angle of the Belt:

6.2.5.1 *Type 1 Riding Position Conveyor*—The maximum slope shall be determined by ride analysis and shall be limited such that loaded vehicles being transported by the conveyor will not slide in a reverse direction. This slope analysis shall consider the maximum and minimum operational design conditions such as ride vehicle, live load, belt wear, expected water from the ride, and environmental conditions.

6.2.5.2 *Type 2 Walk On/Off Conveyor*—The maximum slope shall be determined by ride analysis and shall not exceed the following limitations:

(1) The angle of inclination from the horizontal shall not exceed 3° within 36 in. (0.92 m) of the ingress and egress ends.

(2) At the vehicle load position, the slope of the conveyor shall match the slope of vehicle travel at the load position.

(3) For conveyors running up an incline the angle of inclination of the conveyor shall not exceed 18° at any point. For conveyors intended to be accessible the inclination shall not exceed 10° at any point.

(4) The ride analysis for declining conveyors shall consider the slope of the conveyor, the deceleration rate under braking and the patron restraints.

6.2.6 *Maximum Cross Slope*—2 %.

6.3 *Patron Restraint, Clearance Envelope, and Containment Design Criteria:*

6.3.1 *Restraints*—The designer/engineer shall consider accelerations generated by the conveyor system in the ride analysis.

6.3.2 Clearance Envelope:

6.3.2.1 Type 1 Riding Position Conveyor:

(1) The clearance envelope shall be determined as outlined in subsection 6.6, Patron Clearance Envelope Analysis, of Practice F2291-21.

(2) If the pathway of the conveyor belt is used for emergency evacuation egress, then the minimum head room shall match the value listed in 6.3.2.2(2).

6.3.2.2 Type 2 Walk On/Off Conveyor:

(1) The clearance envelope shall be determined as outlined in subsection 6.6, Patron Clearance Envelope Analysis, of Practice F2291-21.

(2) The headroom shall be 7 ft (2.14 m) minimum over the patron path of travel, as measured vertically from the conveyor belt and ride vehicle access surfaces.

(3) Handrails and solid balustrades may be used as needed to assist and guide patrons while on the conveyor. These shall be considered in the “Patron Clearance Envelope Analysis.”

6.4 Speed and Acceleration Limits:

6.4.1 Maximum Belt Speed:

6.4.1.1 *Type 1 Riding Position Conveyor*—The conveyor belt must remain stationary until the patron is in riding position on the ride vehicle. Once the patron is in riding position on the ride vehicle, the maximum speed shall be based on the ride analysis, however the designer/engineer shall consider the accelerations entering a belt, between succeeding belts, and launch speed required at the belt exit in the ride analysis. These accelerations shall meet the requirements of 6.4.2.

6.4.1.2 Type 2 Walk On/Off Conveyor:

(1) The design speed of a Type 2 Walk On/Off Conveyor should be considered as part of the ride analysis.

(2) The designer/engineer shall consider lateral accelerations of the pedestrian when loading/unloading a conveyor.

(3) Additional design consideration should be taken when loading/unloading a conveyor at angles not parallel with the direction of travel. At a minimum the edge of the belt in the loading and unloading areas shall be marked in accordance with 6.11.9.

6.4.2 Acceleration/Deceleration:

6.4.2.1 *Type 1 Riding Position Conveyor*—Under all public operating conditions a conveyor shall not produce accelerations/decelerations that induce hazardous motion to a rider in the proper riding position and using the provided restraint device, such as handles on the ride vehicle.

6.4.2.2 *Type 2 Walk On/Off Conveyor*—The maximum accelerations/decelerations of the patron shall be determined by the ride analysis with regard to the conveyor belt construction, profile, and speed transitions.

6.4.2.3 When the conveyor may transport more than one patron at a time, the ride analysis shall consider the effects of acceleration and deceleration on all patrons standing or walking on the conveyor.

6.5 *Loads and Strengths*—The loads and strengths used in performing the calculations and analyses used in the design process shall be as defined in Section 8, Loads and Strengths,