

CHAPTER 14A
CARNIVAL-AMUSEMENT RIDES

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SUBCHAPTER 1. GENERAL PROVISIONS

5:14A-1.1 Title; scope; intent

(a) These rules shall be known and may be cited as chapter 14A, Carnival-Amusement Rides of Title 5, N.J.A.C.

(b) The purpose of this chapter is to provide reasonable standards for the design, construction and operation of amusement rides for the safety of the public.

(c) No person shall manufacture or sell for use in this State, operate, arrange for or cause to be used any ride that is not in compliance with this chapter.

1. No person shall change a ride in any way that makes the ride less conforming with the provisions of this chapter.

(d) This chapter shall apply to:

1. An amusement ride subject to the Carnival-Amusement Ride Safety Act, N.J.S.A. 5:3-31 et seq.;

2. An amusement ride as defined in N.J.A.C. 5:14A-1.2;

i. Amusement ride shall include a water slide exceeding 15 feet in height with the height of a water slide calculated as the difference in elevation between the highest point on the sliding surface and the lowest allowable elevation of the water surface into which the slide discharges; and

ii. A water amusement ride as defined in N.J.A.C. 5:14A-1.2;

3. Any mechanical device which carries, conveys, or directs riders along, around, or over a fixed or restricted route or course for the purpose of giving its riders amusement, pleasure, thrills or excitement; and

4. Any rider or gravity propelled ride, including, but not limited to, any water slide or water-based recreation equipment when located in an amusement area or park in which there are other rides covered by the Act.

(e) This chapter shall not apply to:

1. A locomotive weighing more than seven tons, operating on a track the length of which is one-half mile or greater, the gage of which is three feet or greater, and the weight of which is at least 60 pounds per yard;

i. Such locomotives shall be under the jurisdiction of the New Jersey Department of Transportation for the purposes of safety inspection;

1. If a voice communication or signal system is required under N.J.A.C. 5:14A-9.13, to the extent that the manufacturer has been involved in its development, it shall be included in the manufacturer's documentation to the Department.

5:14A-7.3 Patron containment and restraint

(a) Patron containment:

1. The amusement ride or device shall be designed to support and contain the patron(s) during operation. This support and containment shall be consistent with the intended action of the ride or device.

2. Parts of amusement rides and devices that patrons may reasonably be expected to contact shall be smooth, free from unprotected protruding studs, bolts and screws, sharp edges and corners, rough or splintered surfaces, and considered for padding as appropriate.

3. Ride or device vehicle doors:

i. When amusement ride or device patron vehicles are provided with doors, measures shall be taken to ensure that the doors do not open during operation, failure or in case of emergency, unless otherwise determined by the Ride Analysis.

ii. Powered doors shall be designed to minimize pinch points and entrapment areas. The doors (opening and closing) movement shall be controlled and the maximum exerted force, measured on the edge of the door at the furthestmost point from the hinge or pivot, shall not exceed 30 pounds (133 Newtons (N)).

(b) Security of patron containment system :

1. Any system or systems used to support and contain the patron(s) shall be securely fixed to the structure of the ride or device and shall have adequate strength for the intended forces produced by the ride or device and the reasonably foreseeable actions of the patron(s).

(c) Patron restraints:

1. Patron restraints shall be provided based on the Patron Restraint and Containment Analysis and other criteria defined in this subchapter and shall take into consideration the nature of the amusement ride or device and the intended adult or child patron physical characteristics based on anthropomorphic data such as Dreyfuss Human Scale 4/5/6, 7/8/9 or SAE J833, and Center for Disease Control Growth Charts.

2. Restraint devices shall be provided in cases where it is reasonably foreseeable that patrons could be lifted or ejected from their seat or riding position by the acceleration of the amusement ride or device, or by seat inclination, during the ride or device cycle and other reasonably foreseeable situations, for example, the application of emergency brakes or vehicles stopped in inverted positions.

3. Where kiddie rides or devices do not provide fully enclosed compartment, (that is, so as to reject a four-inch diameter sphere at all openings), a latching restraint shall be provided unless the Patron Restraint and Containment Analysis indicates a locking restraint is needed or a restraint is not appropriate (for example, a kiddie canoe ride). For either latching or locking restraints, the final latching or locking position shall be adjustable in relation to the patron.

4. The Patron Restraint and Containment Analysis may identify the need for a restraint system for reasons other than acceleration or seat inclination. The analysis shall also evaluate the need for locking or latching functions when restraints are required.

5. A manual restraint release shall be provided for authorized personnel use.

i. The manual release should be conveniently located and easily accessed by authorized personnel without crawling over, under or otherwise coming in direct contact with the patrons.

ii. External or unmonitored internal non-mechanical stored energy, for example, battery, accumulator, hydraulic or pneumatic, shall not be used for a manual release unless otherwise determined by the Ride Analysis.

iii. Special tools shall not be required to operate the manual release unless otherwise determined by the Ride Analysis.

6. The design shall take into consideration the evacuation of patrons from any reasonably foreseeable position or situation on the ride or device including emergency stops and stops in unplanned locations. The Patron Restraint and Containment Analysis shall address whether individual or group restraints releases are appropriate. The design for emergency evacuation shall be such that riders shall be kept safely on the ride or shall be safely evacuating.

7. The design shall specify the state, locked or unlocked, of the restraint system in the event of unintended stop, for example, emergency stop or loss of power. This specification shall be based on the results of the Ride Analysis.

8. Restraints shall be designed such that the opportunity for pinching or unintentional trapping of fingers, hands, feet and other parts of the patron's body is minimized.

9. The maximum exerted force produced by any powered patron restraint device while opening or closing shall not be more than 18 pounds (0.08 kilo Newton (kN)), measured on the active surfaces contacting the rider. Force limiting systems, if used to achieve this, shall be configured so that the failure of any one element of that system will still result in force being limited to 18 pounds (0.08 kN).

10. The design shall take into account the patron induced loads, for example, bracing, etc., in addition to the loads and criteria specified in this subchapter.

11. The physical information provided in accordance with ASTM F 698-94 shall be consistent with the patron restraint system, if any.

(d) Restraint configuration:

1. The Restraint Diagram shown in Figure 2 below shall be used as part the Patron Restraint and Containment Analysis for determining if a restraint is required and if required, what type. The Restraint Diagram identifies and graphically illustrates five distinctive areas of theoretical acceleration. Each of the five distinctive areas may require a different class of restraint as indicated in this subchapter. The Restraint Diagram applies for "sustained acceleration" levels only. It is not to be applied for "impact acceleration."

2. The application of the Restraint Diagram is to be used in connection with the Ride Analysis or other factors or requirements of this subchapter. Where indicated, another class of restraint shall be provided. The following needs shall be taken into consideration in designing the restraint system:

- i. Duration of the acceleration;
- ii. Height of the patron carrying device above grade or other objects;
- iii. Wind effects;
- iv. Unexpected stopping positions of the patron units, for example, up side down;
- v. Lateral accelerations, for example, where lateral accelerations are equal to or greater than 0.5 g's, special consideration shall be given to the design of seats, backrest, headrest, padding and restraints; and
- vi. The intended nature of the amusement ride or device.

(e) Any ride where it is possible for a rider to slide laterally shall be designed to adequately and safely contain the rider in the ride. When designing ride pieces which riders will slide into, the design shall account for the rider and any fellow riders who will be sliding into those pieces while being contained by the ride.

(f) Restraints shall not be required for water slides, wave pools, water play areas, lazy rivers or other, similar rides.

(g) Where restraints are required because of the dynamics of the ride or elevation of the ride, they shall not be able to be unlocked by the riders.

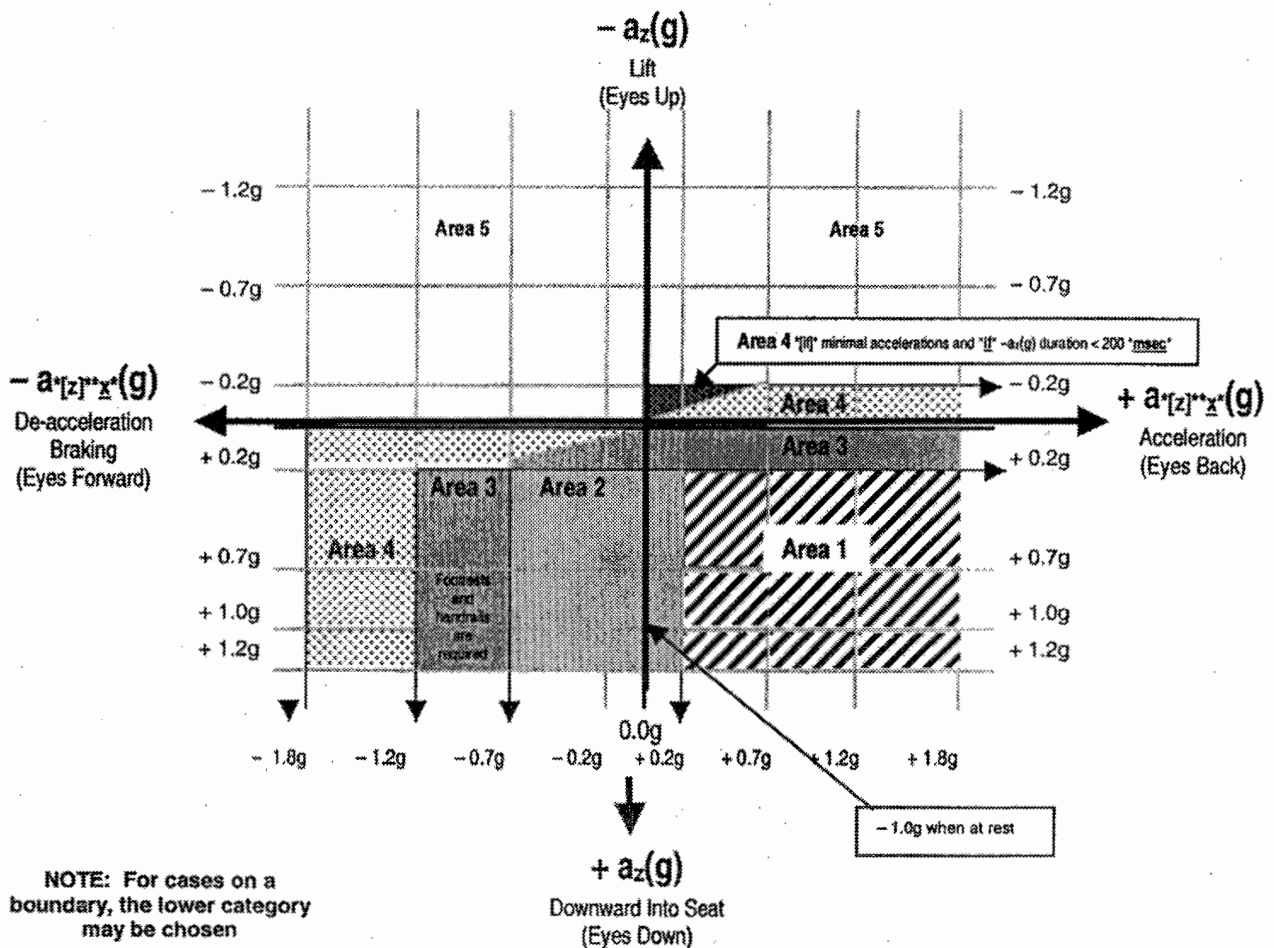
(h) If G_x exceeds +0.2 g for more than 0.2 seconds, a backrest shall be required. If G_x exceeds +0.5 g for more than 0.2 seconds, a full backrest shall be required. If G_x exceeds 1.5 g for more than 0.2 seconds, see Note 1 on Figure 5 in N.J.A.C. 5:14A-7.5. If $+G_x$ exceeds +2.5 g for more than 0.2 seconds, a headrest, which discourages both lateral movement and movement away from the headrest, shall be required. As used in this subsection, a backrest does not allow a person to slide off the seat backwards. A full backrest supports the torso up to the shoulders. A headrest supports the back of the head.

(i) Unless the ride analysis indicates otherwise, if there are accelerations in the X or Z direction that exceed 1 g or G_y exceeds 0.5 g in either direction, there shall be hand holds (including, for example, the lap bar) with a 1½ inch maximum diameter for the riders to grasp to help support themselves.

(j) For any ride in which accelerations exceed 2 g or are less than -2 g in any direction, the rider shall be well and closely restrained in the direction to resist the acceleration.

1. One of the following may be used as an alternative method of rider protection:

- i. The ride dynamics shall be designed such that no impact or only light impact with the restraint takes place while still keeping the rider well restrained;
- ii. Ride padding shall be designed to absorb impact load; or
- iii. Another means acceptable to the Department shall be used.



(k) Restraint criteria: Referring to areas on the Restraint Diagram shown in Figure 2 above, the following restraint classes shall be used:

1. Area 1: Based solely on the dynamic forces, no restraint is required.

i. Exception: A restraint shall be required if the Patron Restraint and Containment Analysis indicates that a restraint is necessary.

2. Area 2: A Class 2 restraint is required unless patrons are provided sufficient support and the means to react to the forces, for example, handrails, footrest or other devices. A Class 2 restraint device shall have at least the following:

i. Number of riders per restraint device: The restraint device may be for an individual patron or it may be a collective device for more than one patron;

ii. Final latching position relative to the rider: The final latching position may be fixed or variable in relation to the patron;

iii. Type of latching: The patron or operator may latch the restraint;

iv. Type of unlatching: The patron or operator may unlatch the restraint;

v. Type of latching indication: No indication is required;

vi. Means of activation: The restraint may be manually or automatically opened and closed; and

vii. Redundancy of latching device: A redundant design is not required.

3. Area 3: A Class 3 restraint is required. A Class 3 restraint device shall have at least the following:

i. Number of patrons per restraint device: The restraint device may be for an individual patron or a collective device for more than one patron;

ii. Final latching position relative to the rider: The final latching position must be adjustable in relation to the patron, for example, a bar or a rail with multiple latching positions;

iii. Type of latching: The restraint device may be manually or automatically latched. The manufacturer shall provide instructions that the operator shall verify the restraint device is latched;

iv. Type of unlatching: The patron may manually unlatch the restraint or the operator may manually or automatically unlatch the restraint;

v. Type of external correct or incorrect indication: No external indication is required other than a visual check of the restraint itself;

vi. Means of activation: The restraint may be manually opened and closed; and

vii. Redundancy of latching device: A redundant design is not required. The design shall be such that failure of the primary system is detected, automatically or manually, within one ride or device cycle.

4. Area 4: A Class 4 restraint is required. A Class 4 restraint device shall have at least the following:

i. Number of riders per device: A restraint device shall be provided for each individual patron;

ii. Final latching position relative to the rider: The final latching position of the restraint must be adjustable in relation to the patrons, for example, a bar or a rail with multiple latching positions;

iii. Type of locking: The restraint device shall be automatically locked;

iv. Type of unlocking: Only the operator shall manually or automatically unlock the restraint;

v. Type of external correct or incorrect indication: No external indication is required other than a visual check of the restraint itself;

vi. Means of activation: The restraint may be opened or closed manually or with power; and

vii. Redundancy of locking device: Redundant design shall be provided for the locking device function.

5. Area 5: A Class 5 restraint is required. A Class 5 restraint shall have at least the following:

i. Number of riders per device: A restraint device shall be provided for each individual patron;

ii. Final latching position relative to the rider: The final latching position of the restraint must be adjustable in relation to the patrons, for example, a bar or a rail with multiple latching positions;

iii. Type of locking: The restraint device shall be automatically locked;

iv. Type of unlocking: Only the operator shall manually or automatically unlock the restraint;

v. Type of external correct or incorrect indication: An external indication is required. Detecting the failure of either locking device shall either bring the ride to a cycle stop or inhibit cycle start;

vi. Means of activation: The restraint may be opened or closed manually or with power;

vii. Redundancy of locking device: Redundant locking devices are required; and

viii. Restraint configuration: Two restraints, for example, shoulder and lap bar, or one fail safe restraint device are required.

6. Secondary Restraints for Class 5: A Class 5 restraint configuration may be achieved by the use of two independent restraints or one fail-safe restraint. When two independent restraints are used, the secondary restraint device shall have the following minimum characteristics:

i. Number of riders per device: The restraint device may be for an individual patron or a collective device for more than one patron;

ii. Final latching position relative to the rider: The final latching position may be fixed or variable in relation to the patron;

iii. Type of locking: Only the operator may manually or automatically lock the restraint;

iv. Type of unlocking: Only the operator only shall manually or automatically unlock the restraint;

v. Type of external correct or incorrect indication: No external indication is required other than a visual check of the restraint itself;

vi. Means of Activation: The restraint may be opened or closed manually or with power; and

vii. Redundancy of locking device: The actuation means of the locking device shall be redundant.

5:14A-7.4 Patron clearance envelope design criteria

(a) Amusement rides and devices shall be designed to provide a patron clearance envelope adequate to minimize the opportunity for contact between the patron and other objects where said contact is likely to cause injury.

(b) The shape and size of the required clearance envelope shall be based on the appropriate patron model and the design of the patron containment system, if any. The minimum patron model shall be based on Dreyfuss Human Scale 4/5/6, 7/8/9 or SAE J833, or CDC 95th percentile with an additional (extended) arm and leg reach of three inches (effectively a 99.9th percentile) male, adult or child, as appropriate. The following shall be considered:

1. The intended patron size and height and any specified restriction for minimum or maximum patron height;

2. The shape(s) and configuration of the patron containment system including:

i. Seats, armrest, seat back and sides, foot well or other;

ii. Associated restraint system(s), if provided, for example, lap bar, seat belt, shoulder restraint, cage, or other; and

iii. The ability, as limited by the patron containment, of the rider to extend any part of their body, for example, arms and legs outward beyond the perimeters of the vehicle;

3. The physical nature of surrounding objects or surfaces that might otherwise be contacted, for example sharp, hard, rough or abrasive, ability to snag or trap and hold, or other attributes that may produce undesirable contact for the riders of the ride or device;

4. The relative speeds and directions that contact might take place;

5. The reasonably foreseeable changes that are likely to occur in the location or nature of the surroundings, for example, other adjacent moving vehicles or objects and their physical nature and speeds; and

6. The possibility of variations in the position or orientation of the patron carrying device (for example, angular movement, side movement, unrestrained or undampened motion or free swinging).

(c) The Patron Clearance Envelope Analysis shall be in accordance with N.J.A.C. 5:14A-7.4. These formats and the following definitions may be used as a guideline for determining minimum patron clearance envelope for amusement rides and devices:

1. The reach distance shall be the maximum reach limited only by the vehicle and seat geometry and restraint system. The possibility of a patron extending arms or legs through vehicle openings or beyond the reasonably foreseeable reach shall be considered. The Ride Analysis

performed in accordance with N.J.A.C. 5:14A-7.2 may modify these requirements.

2. Where the design of an amusement ride or device allows contact within the clearance envelope between patrons and surrounding surfaces or objects, the manufacturer shall take reasonably appropriate measures to ensure that those surfaces or objects are configured to avoid hostile features such as splinters, sharp or sharply angled features or edges, protruding items, pinch points or entrapment areas. This requirement is especially important in a ride or device load/unload area where patron control and assistance devices are provided.

3. When the design of an amusement ride or device allows patron-to-patron contact, appropriate steps shall be taken to ensure that the potential contact is appropriate for the amusement ride's or device's intended use and the intended patron experience. Patron safety shall be addressed as dictated by the Ride Analysis.

(d) The design shall specify a means by which direct measurement may be taken to confirm that the intended patron clearance envelope is attained in the completed amusement ride or device assembled in its operating location.

1. The specified means shall include points from which measurements shall be taken. The locations of these points shall be illustrated with appropriate drawings in the manufacturer provided instructions or they may be physical markers on the amusement ride or device.

2. The determined means and clearance distances shall be shown in a convenient form and illustrated both graphically and numerically. Illustrations similar to Figures 3 and 4 below are one acceptable method.

FIGURE 3
SAMPLE RIDER CLEARANCE ENVELOPE—FRONT VIEW

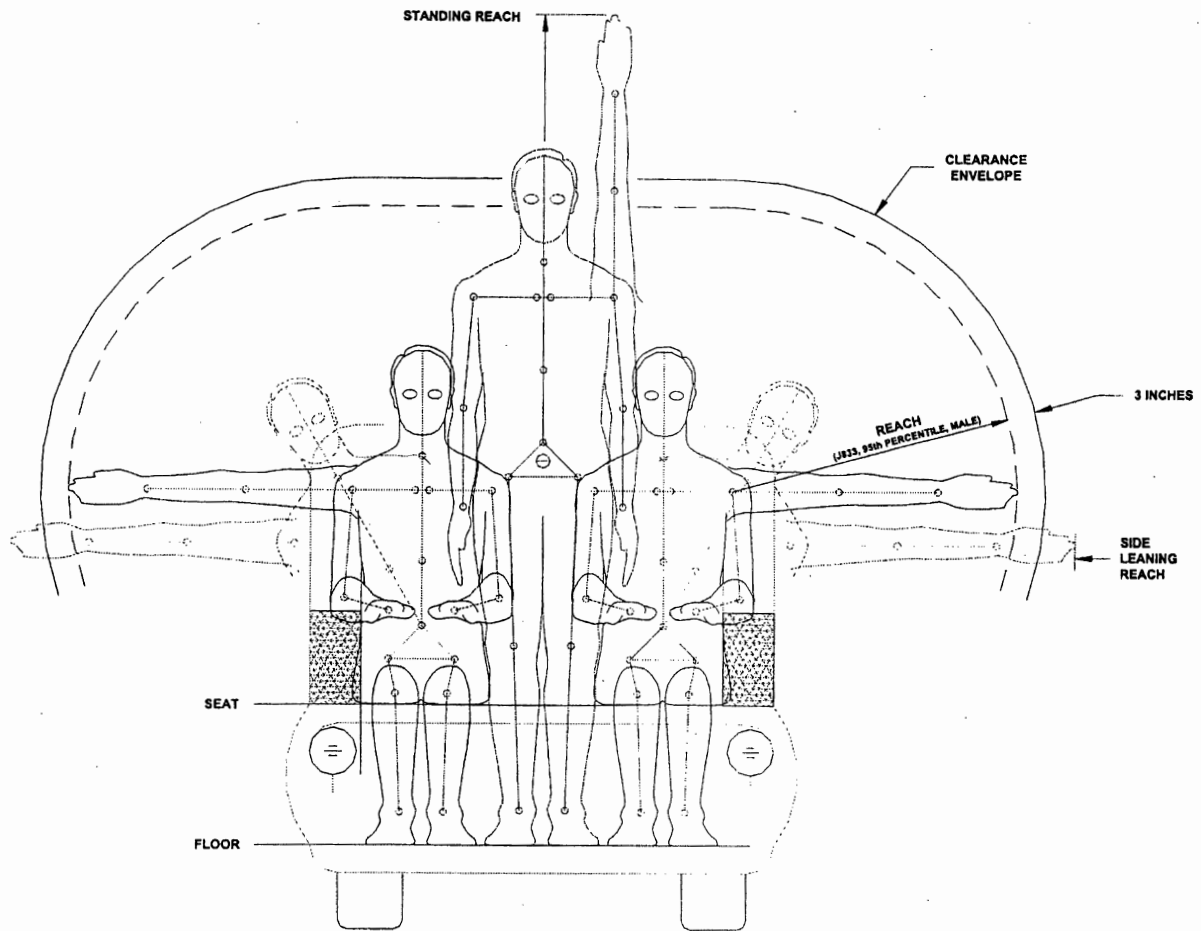
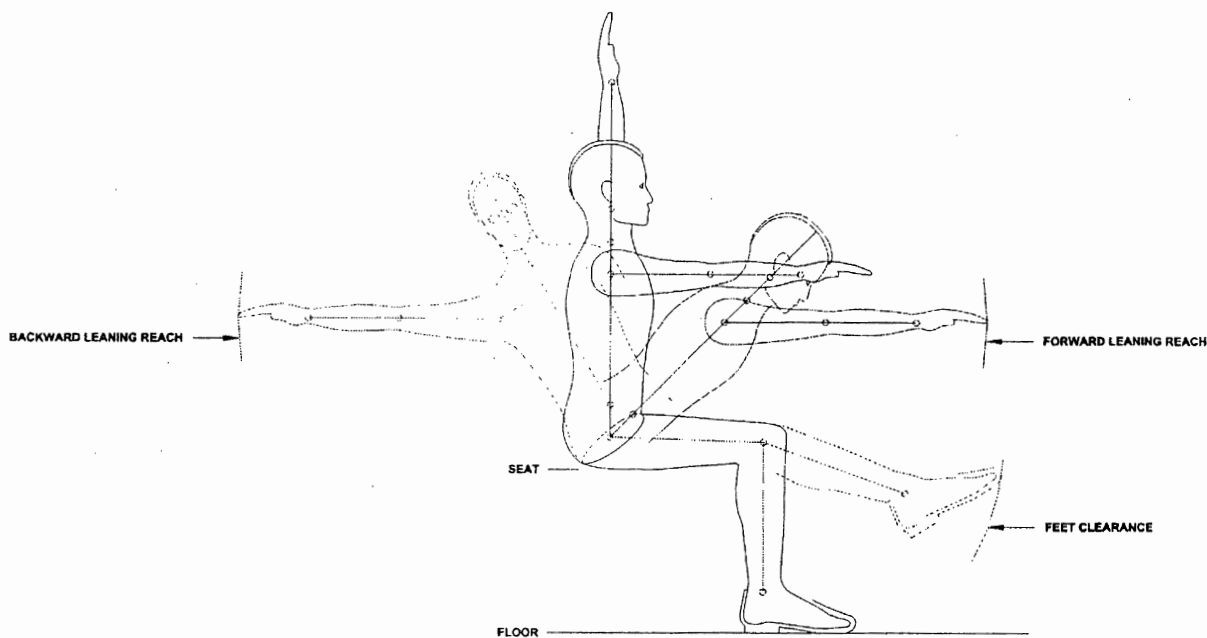


FIGURE 4
SAMPLE RIDER CLEARANCE ENVELOPE—SIDE VIEW



(e) Any moveable system or device designed to encroach on the clearance envelope, that is, loading/unloading platforms, decks or other devices, shall be designed in a failsafe manner in order to prevent undesirable contact.

(f) The design shall include advisory signs or warning signs based on the attributes of the amusement ride or device. The recommendations included with the design shall be clear and concise, but are not intended to be the final wording of the signs that may be generated and displayed at the ride or device.

(g) Secondary safety devices such as latching belts, straps or other devices that limit the travel of a primary restraint device are acceptable.

5:14A-7.5 Acceleration limits

(a) Amusement rides and devices shall be designed such that the accelerations are within the limits specified in this subchapter. Any ride submitted for type certification/amended type certification or individual approval/supplemental modification certification with g's in excess of 75 percent of the limits of this subchapter shall be tested in accordance with ASTM F 2137-01. Any ride that has peaks greater than 75 percent of any value in the pulse width of less than 60 seconds in Figures 5 through 9 below, no matter how long its total run time, requires a Department-witnessed accelerometer test at the time of the acceptance inspection. For a carnival ride, this test may be performed at the factory by a third party testing agency.

(b) Amusement rides and devices or modifications that are designed to operate outside the acceleration limits herein shall include justification in the Ride Analysis. The justification shall include a review by a biodynamic expert.

(c) Acceleration can vary greatly depending on the type and design of the amusement ride or device and the effect of these accelerations is dependent on many factors that may be considered in the design. Accelerations shall be coordinated with the intended physical orientation of the patron during the operating cycle. Rides and devices with patron containment systems shall be designed such that the patron is suitably contained and positioned to accept these accelerations. The Patron Restraint and Containment Analysis shall consider cases related to patron position within the restraint as determined by the Ride Analysis. Figure 1 in N.J.A.C. 5:14A-7.2 illustrates the coordinate system utilized.

1. For roller coasters, the maximum pitch, roll, and yaw design acceleration rates on the rider are (1 rev/sec^2) or $(2\pi\text{r/sec}^2)$. Higher values may be used if demonstrated to be safe in the Ride Analysis. These are not to be used to exceed maximum acceleration rates from Figures 5 through 9 below.

(d) Sustained acceleration limits are shown in Figures 5, 6, 7, 8 and 9 below. The following definitions apply:

1. Acceleration units are "g's" (32.2 ft/sec/sec or 9.81 m/sec/sec).
2. The limits are based on low pass filtered data with a cutoff frequency of five Hz. The filter to be applied

shall be either a 2 pole Butterworth applied in both the forward and reverse directions, or a 4 pole Butterworth applied in the forward direction conforming to SAE J 211. Cutoff frequency is defined to be that frequency where the magnitude response of the filter is the square root of $\frac{1}{2}$.

3. Impacts are not addressed by this section.

4. Acceleration limits herein are for patrons 48 inches in height and above. The Ride Analysis shall determine whether more restrictive limits are appropriate for an amusement ride or device that accommodates patrons under 48 inches in height. This determination shall consider biodynamic effects on the patrons.

5. The coordinates and measurement point for the acceleration limits are in accordance with ASTM F 2137-01 Section 12 "Standardized Amusement Ride Characterization Test" (SARC Test).

6. The limits specified for all axes are for total net acceleration, inclusive of earth's gravity. A motionless body would therefore have a magnitude of one g measured in the axis perpendicular to the earth's surface, and a zero g magnitude in the axes parallel to the earth's surface.

7. Steady state values in the charts are not limited in time unless otherwise specified. Sustained exposure shall not exceed 90 seconds in a single event.

i. Sustained exposure in +Gz shall not exceed 40 seconds in a single event.

8. The Patron Restraint and Containment Analysis shall be used to determine the type of restraint. The type and performance of the restraint system selected may require a reduction in the acceleration limit. These limits are provided for the following basic restraints types:

i. Base Case (Class 4 or 5 Restraint): For the purpose of acceleration limits, the class 4 restraint used as the base case herein also provides support to the lower body in all directions and maintains patron contact with the seat at all times.

ii. Over-the-Shoulder (Class 5 Restraint)

iii. Prone Restraint: A prone restraint is one in which the patron is oriented face down at a point or points during the ride cycle. A prone restraint is a restraint designed to allow the patron to accept higher acceleration in the -Gx (eyes front) as compared to the Base Case and Over-the-Shoulder restraints.