

Product Safety and the Amusement Park Industry

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Product safety can be achieved by using the same type of management programs used to ensure employee safety, quality control and production control. Through structured, managerial programs, all functions of any product, from design to intended uses and foreseeable misuses, can be addressed as they relate to end-user safety.

Product safety is particularly important in the amusement park industry. Many rides involve rapid changes of direction at relatively high speeds, with rigid structural members or other riders nearby with which the rider's body may interact. Therefore, amusement rides must undergo the same intense scrutiny as any consumer product that carries a high severity and frequency injury potential in order to assure all involved—manufacturers, operators, users—that the activity does not subject consumers to uncontrolled hazards.

Since 1993, the number of ride-related injuries has grown. According to Consumer Product Safety Commission estimates, emergency room injuries from amusement rides totaled 10,400 in 1999, up from 7,700 in 1993. The Commission also

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reports “a marginally significant upward trend in fixed-site and total amusement-ride-related injuries from 1993 to 1999 due to a sharp increase in fixed site injuries beginning in 1997” (CPSC).

Amusement rides (especially water slides and roller coasters) are getting bigger and faster. With those changes come greater injury severity and frequency potential. This trend is likely to continue, as the public grows accustomed to current rides (the “scary” rides of 10 years ago no longer seem so exhilarating when compared to more-recent rides) and demands more for its entertainment dollar.

In response, the amusement industry—which includes ride designers and manufacturers, park owners and operators, must use a sound, logical managerial approach to the design, construction and management of amusement park rides. The discipline of product safety can provide the industry with such an approach. Any organization that designs, supplies or manages consumer products could learn from the boiler and pressure vessel industry. In the early 1900s, boiler and pressure vessel explosions—and resultant deaths and injuries—were relatively commonplace. Once the industry addressed the problem via rigid design standards and quality-control procedures, these explosions were drastically reduced.

BASIC ELEMENTS OF A PRODUCT SAFETY PROGRAM

Following is an outline of key elements of a sound product safety program that should be utilized by any firm involved in the amusement park industry, particularly those that design, manufacture and manage amusement rides.

Since the primary objective is to provide rides that are safe for their intended use, the first step is to devise proper procedures to accomplish this objective. This requires that a procedures manual be produced; it should describe (simply or elaborately, depending on the situation) the responsibilities during each phase of production, from original design concept to product installation and ultimate use. The manual is developed after the manufacturer has determined that the ride will, if manufactured properly, be safe for its users. (A ride owner will want to devise a procedures manual that details assembly of the ride if it is moved frequently, or maintenance, operation and testing procedures if it remains in one place.)

This manual is more than just a product

safety program document; it is an operating plan for the entire production process. The best way to comply with strict industry, regulatory, quality control and customer demands is to devise a manufacturing plan (detailed in a procedures manual) which ensures that all involved know what is expected of them. (Those involved in product safety would do well to review the intensive quality programs required of those manufacturing boilers and pressure vessels to American Society of Mechanical Engineers codes and use those programs as a guide to develop product safety programs.)

The procedures manual is a detailed work plan that tells those building a product exactly how to do it. For example, suppose a firm manufactures the “Gofastwhirligig” ride. The procedures manual would specify which steel to buy (for those who order structural materials); what torque to use when tightening bolts; and the type and frequency of quality-control checks.

From a product safety standpoint, several issues must be addressed in the manual. Notice that responsibilities become more specific as actual production approaches.

Management must:

- monitor federal and state laws, codes, and standards (e.g., World Waterpark Assn. Standards, American Society of Testing and Materials standards, and relevant state standards and laws);

- establish a recall system;

- make sure product safety reviews are performed on new products/redesigns;

- assign responsibility for audits (monitoring);

- assign responsibility of claims or complaint-handling procedures.

Marketing should:

- be aware of product liability exposure due to advertising, written warranties, implied warranties and verbal claims made about the product; it is management’s responsibility to make sure that marketing is aware of these issues;

- have advertisements and sales literature reviewed by the product design review committee for safety implications; this includes warning labels, use instructions, care instructions and instruction manuals;

- devise and follow procedures to handle and address complaints and claims;

- review disclaimers and hold-harmless agreements;

- offer new product safety features to owners of earlier products.

Engineering should:

- have copies of up-to-date regulations, standards, codes and laws;

- make sure that safety devices required by either design or safety design review are included in manufacturing specifications;

- conduct (or have conducted) tests to ensure that the product is designed for safe use under intended conditions and “foreseeable” misuse; the product’s life expectancy must be factored into all testing;

- test and document any safety-related features and critical safety items identified in the product specification;

- check product packaging for transportation;

- establish procedures for vendor-source control, including inspecting and testing incoming materials and parts;

- periodically review quality control and manufacturing records, as well as customer complaints.

Quality control should:

- have access to up-to-date copies of codes and standards;

- review incoming materials and component parts;

- verify, at final assembly inspection, that all required instructions and warnings are in place;

- review field failure reports and field complaints.

Manufacturing/purchasing should:

- document change information, work instructions and test methods;

- properly identify and handle all material;

- provide prompt written notice of supplier problems and non-conformances;

- ensure that vendor-supplied items are of acceptable quality.

Field service should:

- properly report user complaints or damage;

- gather appropriate documentation of user complaints or reports of damage;

- report any unsafe or defective condition found;

- be aware of product liability exposure from verbal warranties.

DESIGN SAFETY REVIEW

An effective product safety program must include a product design safety review. This formal, documented study of a design by specialists not directly associated with its development is a

ASTM Standards on Ride Safety

Practice F1159-97a: Standard Practice for the Design and Manufacture of Amusement Rides and Devices

Scope: This practice establishes information and procedures for the design and manufacture of amusement rides and devices.

Guide F846-92(1998): Standard Guide for Testing Performance of Amusement Rides and Devices

Scope: This guide covers the basic tests that shall be conducted on amusement rides and devices during prototype development, installation or erection, following major modifications and during normal operation to determine that the performance of a given ride meets the manufacturer's specified design criteria.

Guide F893-87(2000): Standard Guide for Inspection of Amusement Rides and Devices

Scope: This guide covers the inspections of amusement rides and devices during prototype development, production manufacturing, installation or erection, following major modification or overhaul, and during operation and maintenance periods.

Practice F853-98: Standard Practice for Maintenance Procedures for Amusement Rides and Devices

Scope: This practice establishes information for maintenance procedures of amusement rides and devices.

Source: www.astm.org.

Practice F770-93(2000): Standard Practice for Operation Procedures for Amusement Rides and Devices

Scope: This practice establishes information for operating procedures of amusement rides and devices.

Guide F1305-94: Standard Guide for the Classification of Amusement Ride and Device-Related Injuries and Illnesses

Scope: This guide provides a uniform procedure that should be used when classifying patron injury and illness data related to amusement rides and devices.

Specification F698-94(2000): Standard Specification for Physical Information to be Provided for Amusement Rides and Devices

Scope: This specification covers the minimum requirements for information that shall be provided by the manufacturer or seller of new amusement rides or devices as a part of the initial sale or transfer to the first end user.

Practice F1193-97: Standard Practice for an Amusement Ride and Device Manufacturer Quality Assurance Program

Scope: This practice covers minimum requirements for a quality assurance program.

These standards include the following statement as well: This standard does not purport to address all of the safety problems 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.

method of systematically scrutinizing a design for safety details. The review must be conducted in a logical, planned sequence, with all involved understanding why the review is being performed and what outcome is expected.

Documentation is a crucial detail in this process. It is vital that whoever asks—from a new manager to an accident investigator—can see the investigative research involved in the review. Also note the need to use specialists not directly associated with the product's development. At this stage, an impartial judgment is required because in some cases a designer may find it difficult to discuss constructive safety changes. (In all cases, however, the designer should be available for consultation if necessary.)

The definition also calls for review by specialists. Although each change—or even each design—need not be reviewed by product safety specialists, each change and design should undergo a safety review to determine to what extent (if any) specialists should be involved. Again, this stage of the review—and any actions taken—must be documented.

For example, a product safety coordinator may determine that no further review of a change in materials is needed because the new material is stronger than the old, or that the lengthening of a waterslide discharge chute does not affect the ride's safety. The coordinator must document that these issues were addressed as well as their outcome.

Note the mention of a product safety coordinator. In any organization, someone must be responsible for considering the safety of a design change, an unreviewed design or a new design. In a small operation, this may be the owner/general manager; in a mid-sized operation, it may be the quality control manager; in a larger organization, it may be the safety director or risk manager.

If this coordinator determines that a product may pose a problem, s/he must present these concerns to a product safety design review committee. Although company size will dictate committee size, the committee will typically include representatives from design, production, quality control, field service, marketing, legal and safety who can discuss problems logically and systematically. To ensure that the committee remains focused and effective, the firm should assign someone to the committee who

can make decisions and call meetings only as needed.

As noted, not all organizations have an in-house product safety specialist. However, product safety decision making is greatly facilitated when an experienced product safety professional is involved. If internal expertise is not available, a firm should hire an outside consultant.

A product design safety review should be performed on all new designs, design changes and old designs that have not been reviewed. Therefore, the product safety coordinator must be informed, in writing, of all new designs and any design changes. It is best to establish a formal system to ensure that this occurs. Otherwise, the entire safety program may be jeopardized; the one change that slips through undocumented may be the one that causes a costly product liability claim. Thus, all department heads must

understand that each change—no matter how trivial it seems—must be documented and reported to the coordinator before it is put into production.

DESIGN SAFETY IN THE AMUSEMENT PARK INDUSTRY

The amusement park industry is in a relatively unique position. Due to the diversity of the rides available, there is no single design and construction standard to which it can conform. As a result, each ride must undergo a unique product design safety review and have its own safety standard (which includes both the design review and procedures manual).

In addition, the industry must cater to people of all ages, body types and athletic ability, and must recognize that a flexible, lean teenager may be sitting in a ride next to her less-flexible, less-lean father. Currently, the industry is loosely regulat-

Hazard Patterns Associated with Amusement-Ride-Related Incidents

CPSC has identified several hazard patterns associated with amusement-ride-related incidents.

Mechanical failures include missing safety pins, broken welds or structural components, exposed electrical wires, broken drive trains, malfunctioning lap bars or other safety restraints, failure to shutoff, improper detachment of cars and improper detachment of structural components.

Operator behaviors include abruptly stopping the ride (e.g., following an apparent mechanical failure), improperly assembling or maintaining the ride, and defeating safety equipment such as brakes and automatic overheat cutoff switches.

Consumer behaviors include intentionally rocking cars, standing up, defeating safety restraints and sitting improperly.

Source: CPSC. "Amusement Ride-Related Injuries and Deaths in the United States: 1987-1999."

ed; those safety standards that have been developed (such as the World Waterpark Assn.'s "Considerations for Operating Safety" and various ASTM standards) are necessarily vague and cannot possibly address each existing or new amusement ride design.

Therefore, the industry must, in large part, provide its own safety standards. Furthermore, each designer or manufacturer who makes amusement-related equipment must establish its own safety standards if none exist. These stakeholders are the experts on all aspects of the ride and, therefore, are best able to predict what safety hazards users may encounter.

For example, the primary hazard to which a waterslide rider is subjected is that of coming into contact with a hard or stationary object while moving at a high rate of speed. It matters little how fast the rider goes, provided nothing impedes his/her path and the deceleration at the end is not too abrupt. Therefore, the goal is to keep the rider away from objects that s/he may bump into by making flat, smooth slide seams; ensuring the splashdown pool is large and deep enough; and allowing only one rider on the slide at a time.

Placing two riders on one inner tube and sending them down the twisting slide trough into a pool will put both riders next to an object to bump into (the other

rider) in the foreseeable event that they should fall out of the tube (either while in the slide trough or in the pool). Similarly, placing one rider in front of another on a go-kart ride provides an object for both to run into; reduces seatbelt effectiveness; and hinders vehicle maneuverability. A design safety review would quickly reveal the hazards of both approaches and presumably lead to their rejection.

If the review indicates that warnings are necessary, the review should be performed again in an effort to eliminate the need for warnings. Warnings are merely an admission that a safety hazard exists which was not (or could not be) properly addressed; it is much better to eliminate a hazard by engineering means rather than to rely on written or verbal warnings. Once the ride and thrill begin, such warnings will likely be forgotten. Those involved must also recognize that instructions or directions for use are not the same as warnings. Warnings must tell the rider what will occur if s/he does not comply with stated instructions.

If a warning is deemed necessary, those involved must recognize that it provides no physical protection against the safety hazard to which it is directed and, as a result, may be either unintentionally or intentionally ignored. Thus, it is important to make sure the consequences of disregarding the warning are not severe. If they are, the ride should be redesigned to eliminate these consequences.

Stakeholders must also remember that everyone is invited to use an amusement ride—not only the nimble and athletic. Therefore, it is not conducive to rely on a rider's agility, balance or reaction time to ensure safety. For example, suppose excessive ride speed could cause a rider to leave the ride track; one would not, therefore, create a foreseeable and unnecessary severe risk by giving the rider control of ride speed.

An amusement ride that relies on a user's physical ability or his/her understanding of how to avoid safety hazards should undergo intense safety review to ensure that the consequences of inability, lack of knowledge or disregard of instructions are not severe. In all cases, one should never overestimate the rider or his/her abilities to understand instructions or foresee impending danger.

Those in the amusement park business must scrutinize their industry and their individual organizations to deter-

mine whether enough effort is being devoted to anticipate safety hazards to which consumers are subjected, and to assess whether design approaches reduce or eliminate most hazards.

In the author's opinion, those within the industry must form better partnerships in order to develop educational programs, design standards, risk analysis assistance, human physical and psychological tolerance data, as well as a forum through which industry-wide safety can be researched and addressed. It may then be possible to develop specific safety standards for individual rides. Until that time, stakeholders—designers, manufacturers and owners—must strive to develop their own safety assessment and design and manufacturing standards. ■

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