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CONSUMER PRODUCT SAFETY COMMISSION
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MEMORANDUM

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SUBJECT: Amusement Ride-Related Injuries and Deaths

The attached report provides current information on amusement ride-related injuries and deaths.

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[redacted]

Amusement Ride-Related Injuries and Deaths

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June 1998

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Executive Summary

This report describes amusement ride-related fatalities and hospital emergency room-treated injuries . Injury data are presented for calendar years 1994 through 1997. Fatality data are presented1 for the period from 1 January 1987 through 1 June 1998.

- An estimated 8,700 hospital emergency room-treated injuries occurred in 199'7, with about 2,200 involving mobile rides, 4,600 involving fixed rides, and 1,900 involving rides of unknown mobility status.

- An estimated 3.6% of injuries in 1997 resulted in hospitalization. This compares to an overall hospitalization rate, across all products in NEISS, of about 4% in recent years.

- The number of amusement ride-related *non-occupational* fatal incidents from 1.987 through 1997 was an estimated 42 (95 % confidence interval = 35 to 50), for an estimated average of 3 . 8 fatal incidents each year during that 11 -year period.

- The number of amusement ride-related *occupational* fatal incidents from 1987 through 1997 was an estimated 4'7 (95 % confidence interval = 33 to SO), for an estimated average of 4.3 fatal incidents each year during that 11 -year period.

- A hazard sketch summar izing CPSC investigations of amusement ride incidents from 1990 to 18 May 1998 revealed mechanical failure as the most frequent cause of an incident in those cases.

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Amusement Ride-Related Injuries and Deaths

This report describes amusement ride-related fatalities and hospital emergency room-treated injuries . Injury data are presented for calendar years 1994 through 1997, and fatality data are presented for the period from 1 January 1987 through 1 June 1998. A hazard sketch is also presented summarizing CPSC investigations of reported amusement ride incidents from 1990 to 18 May 1998. This report replaces previous Division of Hazard Analysis reports summarizing amusement ride incidents. [1,2]

Definition of Amusement Rides

Section 3(a)(1) of the Consumer Product Safety Act defines an *amusement ride* as:

> . ..any mechanical device which carries or conveys passengers along, around, or over a fixed or restricted route within a defined area for the purpose of giving its passengers amusement, which is customarily controlled or directed by an individual who is employed for that purpose and who is not a consumer with respect to that device, and which is not permanently fixed to a site.

Although fixed-site rides are not included in Section 3(a)(1), incidents involving both mobile and fixed-site rides are included in the following analyses for comparison.

Amusement Ride-Related Injuries Reported in NEISS

Hospital emergency room data on non-occupational amusement ride-related injuries were obtained from the Consumer Product Safety Commission's (CPSC's) National Electronic Injury Surveillance System (NEISS) as follows. First, all records containing product code 1293 for the given calendar year were identified. Next, descriptive comments in the identified records were screened to eliminate injuries involving coin-operated rides or free-play attractions often found at restaurants or shopping centers, alpine and water slide amusements, wave machines, "moon walks, " mechanical bulls, and playground equipment. Based on the descriptive comments, in-scope incidents were classified by *mobility* (mobile, fixed, or unknown). **Table 1** gives results for calendar years 1994 through 1997. An estimated 8,700 hospital emergency room-treated injuries occurred in 1997, with about 2,200 involving mobile rides, 4,600 involving fixed rides, and 1,900 involving rides of unknown mobility status. Only an estimated 3.6 % of injuries in 1997 resulted in hospitalization. This rate compares to an overall hospitalization rate, across all products in NEISS, of about 4 % in recent years. Injury estimates for the years 1994, 1995, and 1996 have been adjusted to correct for a slight deterioration of the sampling frame between

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[1] Cassidy, *S., Deaths and Injuries Associated with Amusement Rides, 2* 1 May 1996.

[2] Morris, C.C. *Amusement Ride-Related Injuries and Deaths, 10* Oct 1997.

updates revealed in the 1997 update of the NEISS sampling frame and sample of hospitals.[3] The margin of error of the total estimates in Table 1, based on the 95 % confidence interval and generalized relative sampling error estimate, is 2,000 for 1994, 2,100 for 1995, 2,200 for 1996. and 2,300 for 1 997.[4] For example, the 95 % confidence interval for the total 1997 estimate of 8,700 injuries is 8,700 ± 2,300 = 6,400 to 11,000, the 95 % confidence interval for the 1996 estimate of 8,500 injuries is 8,500 ± 2,200 = 6,300 to 10,700, and so on.

Table 1
Estimated Non-Occupational Amusement Ride Injuries by Year and Mobility of Ride

Year	Fixed	Mobile	Unknown	Total
1997	4,600	2,200	1,900	8,700
1996	4,300	3,000	1,200	8,600
1995	- -	____	- - - -	7,700
1994	- -	____	____	7,400

Note: Details may not sum to totals due to rounding;
1994 and 1995 data were not broken down into Fixed, Mobile, and Unknown mobility categories.

Source: U. S . Consumer Product Safety Commission.

[3] Specifically, each estimate prior to 1997 was multiplied by an adjustment factor. The factor was 1.0264 for 1994 and 1.0293 for both 1995 and 1996.

[4] *National Electronic Injury Surveillance System (NEISS) Estimated Generalized Relative Sampling Errors,* Kessler, E. and Schroeder, T., CPSC, 1997. The authors give formnulas for the generalized relative sampling error and an associated 95 % confidence interval defined as $E \pm M$, where E is the NEISS estimate, $M = 1.96\ E/(1.70282\ \mathrm{LN}(E) - 7.94958)$, and $\mathrm{LN}(E)$ is the natural log of the estimate E.

Amusement Ride-Related Fatalities Reported in DTHS and IPII

CPSC's death certificates (DTHS), injury or potential injury incidents (IPII), and National Electronic Injury Surveillance System (NETSS) files were searched for records of fatal incidents involving amusernent rides from 1 January 1987 through 1 June 1998. Incidents were excluded if they involved any of the following: bungee jumping, coin-operated rides or free-play attractions such as found at restaurants or shopping centers, alpine and water slide amusements, water wave machines, " moon walks, " mechanical bulls, or playground equipment. In addition, non-occupational incidents were distinguished from occupational incidents . Non-occupational incidents involved non-employee victims injured while on, in, or around an in-scope amusement ride ; occupational incidents involved employees injured. while setting up, repairing, testing, or operating amusement ride equipment.

NEISS files recorded no amusement ride-related fatalities of any type from 1 January 1987 through 1 June 1998, but DTHS and IPII files recorded 28 occupational fatal incidents, 36 non-occupational fatal incidents, and 2 of unknown occupational status; each incident involved a single fatality . These counts are not derived from probability samples and do not account for all incidents. Capture-recapture analyses treating the DTHS and IPII files as independent samples were used to estimate the total number of occupational and non-occupational amusement ride-related fatalities over the 1 l-year period from 1987 through 1997. The margin of error for a 95 % confidence interval was also computed for each estimate. The total number of amusement ride-related occupational fatal incidents from 1987 through 1997 was an estimated 47 (95 % confidence interval = 33 to 50), for an annual average of 4.3. The total number of amusement ride-related non-occupational fatal incidents from 1987 through 1997 was an estimated 42 (95 % confidence interval = 35 to 50), for an annual average of 3.8.

Non-occupational fatal incidents were classified by *location* (state), *mobility* of the ride, and *type* of ride. *Mobility* refers to *fixed* rides as in amusement parks, *mobile* rides as in carnivals or fairs, or rides of *unknown* fixed or mobile status. The number of reported fatal amusement ride incidents is given below by mobility and **year (Table 2)**, type **(Table 3)**, and state **(Table 4)**. The 36 incidents included 2 1 *fixed* ride-related incidents (58.3 %), 7 *mobile* ride-related incidents (15.4 %), and 8 incidents involving an *unknown* mobile- versus fixed-ride site (22.2 %). Both incidents with unknown occupational status involved fixed rides. **Appendix A** lists the 36 documented non-occupational fatality cases.

Table 2
Non-Occupational Fatal Amusement Ride-Related Incidents by Year and Mobility of Ride

Year	Fixed	Mobile	Unknown	Total
1998	0	1	0	1
1997	2	0	1	3
1996	2	1	0	3
1995	2	1	0	3
1994	2	0	0	2
1993	1	1	2	4
1992	0	2	0	2
1991	3	0	0	3
1990	0	0	0	0
1989	3	0	0	3
1988	2	1	4	7
1987	4	0	1	5
Total	21	7	8	36

Source: U.S. Consumer Product Safety Commission.

Table 3
Non-Occupational Fatal Amusement Ride-Related Incidents from 1987 to 1998
by 'Type and Mobility of Ride

Type of Ride	Fixed	Mobile	Unknown	Total
Bumper Boat (Water)	1	0	0	1
Capsule	1	0	0	1
Ferris Wheel	2	0	0	2
Log (Water) Ride	1	0	0	1
Roller Coaster	8	0	1	9
Sleigh Ride	1	0	0	1
Train	2	0	0	2
Whirling Ride	2	4	3	9
Unknown	3	3	4	10
Total	21	7	8	36

Source: U.S. Consumer Product Safety Commission.

Table 4
Non-Occupational Fatal Amusement Ride-Related Incidents from 1987 to 1998 by State and Mobility

State	Fixed	Mobile	Unknown	Total
CA	1	0	0	1
CT	1	0	0	1
FL	0	2	2	4
GA	0	0	1	1
IA	0	0	1	1
IL	1	1	0	2
IN	1	0	0	1
MA	1	0	0	1
MD	0	0	1	1
MO	1	0	0	1
NE	1	0	0	1
NJ	3	0	0	3
NM	0	1	0	1
NV	1	0	0	1
NY	3	1	0	4
OH	1	0	1	2
OK	0	0	1	1
PA	1	0	0	1
SC	2	0	0	2
TN	0	0	1	1
TX	1	2	0	3
UT	2	0	0	2
Total	21	7	8	36

Source: U.S. Consumer Product Safety Commission.

Hazard Patterns Associated with Amusement Ride-Related Incidents

In-depth investigation (INDP) reports by CPSC staff from 1990 to date were reviewed to analyze hazard patterns associated with amusement ride-related incidents. Each of 65 in-scope investigated incidents was classified according to whether it was primarily the result of *consumer behavior* (of victim or other consumer), *operator behavior* (owner, actual ride operator, or other ride-related employee), *mechanical failure, design limitation* (problem inherent in design), or *unknown source.* Several incidents were classified as combinations of two causes (e.g., mechanical failure and operator behavior, such as when the operator abruptly stopped a ride upon hearing an unusual "thumping" sound due to a bent rail). **Table** 5 summarizes the results. Consumer behaviors included alcohol intoxication, intentionally rocking cars, standing up, defeating safety restraints, sitting improperly (e.g., sideways or with feet above lap bar), holding a child above the safety restraint, or intentionally restarting the ride while passengers were disembarking. Operator behaviors included stepping in front of the ride or being inadvertently

caught in the machinery, abruptly stopping the ride, improperly securing safety restraints, improperly assembling or maintaining the ride, and defeating safety equipment such as brakes and automatic overheat cutoff switches. Mechanical failures involved such problems as missing safety pins, broken welds or structural components, exposed electrical wires, broken drive chains, malfunctioning lap bars or other safety restraints, failure to shutoff, improper detachment of cars, and detachment of structural components. The design limitation classification was applied to a handpowered ride called the "Spaceball" in which the occupant is spun extremely rapidly. Five reports of eye hemorrhage, and one report of retinal tear and possible cerebral edema, were associated with this ride. In the latter case, the victim reported that the operator spun him longer a.nd more vigorously than usual.

Table 5
Number of Investigated Incidents by Primary Cause of Incident

Primary Cause	Number
Consumer Behavior (CB)	7
Operator Behavior (OB)	7
Mechanical Failure (MF)	34
Design Limitation (DL)	5
CB/MF	1
CB/OB	1
MF/OB	6
OB/DL	1
Unknown	3
Total	65

Source: U. S . Consumer Product Safety Commission.

Conclusion

Amusement ride-related fatalities and hospital emergency room-treated injuries were described. An estimated 8,700 hospital emergency room-treated injuries occurred in 1997, with about 2,200 involving mobile rides, 4,600 involving fixed rides, and 1,900 involving rides of unknown mobility status. Only an estimated 3.6 % of injuries resulted in hospitalization. This low rate compares favorably to the overall hospitalization rate (across all products in NEISS) of about 4 % percent for recent years. The number of amusement ride-related occupational fatal incidents from 1987 through 1997 was an estimated 47 (95 % confidence interval = 33 to 50). for an estimated annual average of 4.3. The number of amusement ride-related non-occupational fatal incidents from 1987 through 1997 was an estimated 42 (95 % confidence interval = 35 to 50), for an est i mated annual average of 3.8. A. hazard sketch summarizing CPSC investigations of amusement ride incidents from 1990 to 18 May 1998 revealed mechanical failure: as the most frequent cause of an incident in those cases.

Appendix A

Reported Non-Occupational Amusement Ride Fatalities from 1987 to 1 June 1998

Incident Date	State	Victim Age	Victim Sex	Ride Mobility	Ride Type	CPSC File(s)
03/19/98	TX	15	F	M	WHIRLING	IPII, INDP
07/11/97	NJ	49	M	F	ROLLER COASTER	DTHS, INDP
04/20/97	OK	14	M	U	ROLLER COASTER	DTHS
02/22/97	NV	3	F	F	WHIRLING	.DTHS, IPII, INDP
08/19/96	NY	52	M	F	U	.DTHS, INDP
08/16/96	IL	13	F	M	WHIRLING	.DTHS, IPII, INDP
08/11/96	IN	57	F	F	TRAIN	DTHS, IPII, INDP
11/25/95	FL	2	F	M	U	DTHS, IPII, INDP
06/30/95	MO	14	F	F	ROLLER COASTER	DTHS, IPII, INDP
06/14/95	PA	77	M	F	ROLLER COASTER	DTHS, INDP
08/11/94	CT	6	M	F	WHIRLING	DTHS, IPII, INDP
07/09/94	SC	6	F	F	BUMPER BOAT	DTHS, IPII, INDP
09/11/93	TX	50	M	M	U	DTHS
06/10/93	IL	67	F	F	SLEIGH RIDE	DTHS
06/09/93	OH	0	F	U	U	IPII
04/13/93	MD	32	M	U	WHIRLING	IPII
08/09/92	NY	11	F	M	WHIRLING	IPII
	NM	22	F	M	WHIRLING	!DTHS, IPII, INDP
08/11/91	NY	14	M	F	FERRIS WHEEL	IPII
07/20/91	SC	17	M	F	FERRIS WHEEL	IPII
06/09/91	OH	0	F	F	CAPSULE	IPII
07/03/89	CA	9	M	F	LOG RIDE	DTHS, IPII, INDP
06/09/89	UT	13	F	F	ROLLER COASTER	DTHS
04/30/89	UT	6	M	F	ROLLER COASTER	DTHS, IPII, INDP
11/23/88	FL	17	F	U	WHIRLING	DTHS, IPII, INDP
08/23/88	NY	26	M	F	ROLLER COASTER	IPII, INDP
08/10/88	NE	30	M	F	U	DTHS, IPII, INDP
05/15/88	GA	4	F	U	U	IPII, INDP
05/15/88	TN	5	F	U	WHIRLING	DTHS
03/26/88	FL	15	M	M	U	DTHS, IPII, INDP
01/01/88	FL	0	F	U	U	IPII
09/28/87	IA	213	M	U	U	IPII
07/18/87	MA	18	M	F	TRAIN	DTHS, IPII, INDP
06/17/87	NJ	19	F	F	ROLLER COASTER	DTHS, IPII, INDP
05/16/87	NJ	33	M	F	ROLLER COASTER	IPII, INDP
04/19/87	TX	15	M	F	U	DTHS

Note: F=FIXED or FEMALE, M=MOBILE or MALE, U=UNKNOWN.

Source: U.S. Consumer Product Safety Commission's Death Certificates File (DTHS), Injury or Potential. Injury Incidents File (IPII), and In-Depth Investigations File (INDP).