

Standards & Related Documents Committee

TECHNICAL BULLETIN - SEPTEMBER 2005

293. Miami Restraint Closing Forces

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In September 2004 the Committee received information, from an NFIT¹ member, about an accident in which a 10 year old girl was hurt on a Miami Trip ride manufactured by Fairmatt (no longer trading). [We are aware that a similar accident on a Miami occurred in Sweden back in 1996, although we do not know the ride manufacturer].

On this machine the restraint bar, which is of a very heavy construction, is held closed by hydraulic pressure. This design preceded the latching mechanism on later derivative models, including the Nottingham (UK) Ltd machine.

At the time of the accident investigation, the bar was being closed under full hydraulic pressure such that it was not possible for the NFIT member to prevent it from closing by his own physical effort. This NFIT member also informs us that he has checked some other manufacturers' Miami rides, including Emmett, on which the restraints are also coming down under excessive pressure. He was not, however, referring to restraints being powered down in all cases. That is to say, excessive forces sometimes result merely from inadequately balanced weight of the restraint (particularly when a single restraint serves a number of passengers).

We note that, nowadays, there is guidance which helps designers to decide the extent to which closing forces should be limited, particularly when powered shut. Paragraph 6.1.6.2.1 of EN 13814, published in December 2004, includes :-

“Passenger restraints and their locking devices shall be designed in such a manner as to prevent trapping and crushing of body parts. Passenger restraint devices shall have a configuration such as not to act on sensitive and fragile parts of the passenger's body.

Powered passenger restraint devices may create additional hazards giving rise to injuries. Their movement shall be slow and the maximum exerted force shall not be more than 0,15 kN (0,08 kN if children are also admitted) measured on the active edge of the device.”

¹ The Health and Safety Executive's National Fairground Inspection Team

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Then the wording in *Safety of Amusement Devices: Design* (NAFLIC; ISBN 0 9546161 0 3; October 2003), paragraph 33 of Chapter 9 says :-

“Power operated restraints should not act with excessive force on any sensitive or fragile part of the body - forces exceeding 0.15 kN at the point of restraint application are normally undesirable. The restraint should retract in response to an obstruction before there is sufficient force to cause injury.”

Whatever limiting values are used for new devices there may be a need for design dutyholders for some older devices to reassess whether modification might be justified. This need to reassess would certainly apply when it is known that accidents have occurred.

It has been suggested that some existing designs, where the restraint bar is heavy as described above, may be satisfactorily modified by the introduction of a spring to partially counterbalance the excess weight. This may well be the case. However, it is important that such springs should be properly designed, since spring fatigue failure (of badly designed springs) could result in sudden fall of a restraint. Thus, with poor spring design, modification may not necessarily adequately control the risk or even reduce it - at worst it could increase it.

Secondly, it should be noted that, in some cases, engagement of the latches may be dependent upon the presence of sufficient downward force. In such circumstances over-reduction of hydraulic pressure, or excessive counterbalance spring forces, could result in unreliable latching. There is therefore a need for careful consideration of the effect of modifications on the reliability of latching in order to avoid increasing the risk of passenger ejection.

Safety-critical modifications, as alterations to hydraulic pressures or the addition of counterbalance springs would be, need to be carefully designed and submitted to Design Review in accordance with *Fairgrounds and Amusement Parks - Guidance on Safe Practice* (HSG 175; HSE Books; ISBN 0 7176 1174 4).

There will, of course, be potential solutions other than those discussed here.

NAFLIC have been asked to pass this information to controllers of Miami rides produced by the 3 manufacturers mentioned above, so that controllers may instigate the appropriate assessment and make modifications if necessary.