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Generic Miami restraint ratchet failure

NAFLIC has been made aware of an incident that occurred on a generic Miami device when a woman rolled out of her seat at the bottom of the ride cycle following the release of the main harness ratchet and failure of the secondary restraint lock arrangement. The passenger was unharmed in the incident.

Investigation into the cause of the failure of the two mechanisms has revealed issues that could apply to most versions of the device based on a Nottingham UK design. The original manufacturer of this particular ride was Kirdale Engineering Ltd.

The primary latching mechanism of the harness is a sleeved pawl ratchet which is contained in the lower cross-bar element of the drop down harness. The ratchet element, or 'Christmas Tree' (tree), rotates when the release mechanism is activated to allow the pawl to be pushed back into the sleeve and the harness to raise. In this particular instance it is believed that the pawl became stuck in a partially locked position with insufficient engagement to the ratchet to prevent the release of the harness.

It is further considered that the pawl may have previously locked in an extended position such that when the tree rotated the locked position caused permanent deformation of the tree, if the adjoining harness was in the fully depressed position. It has been observed by several operators that the trees are found to be bent, leading to maintenance, replacement or straightening being undertaken. In the particular device of the incident the sleeve for the pawl was found to be ridged internally and although there is a lubrication pocket at the base of the sleeve, there is significant potential for the pawl to become stuck.

The system of bars and cams that rotate the ratchet trees also has a connection to open the secondary locking mechanism comprising a cam plate fastened to the top hinge bar of the harness which prevents the harness opening by a laterally moving bar and block. The block, when moved out of the cam position, allows the cam and hinge to rotate and open the harness. There are adjustment threads to the connections of the movement bars which need to be accurately adjusted so that the lateral movement of the secondary locking mechanism bar occurs prior to the ratchet bar rotating enough to release the harness.

The consequence of poor adjustment can result in the lateral movement of the secondary lock occurring prematurely and with pressure on the harness cause wear of the hinge cam.

The ratchet pawl has a varying width of contact due to the angle of the tree and the downward arc of the harness. With pressure from a passenger this could lead to ratchet release (if there is some sticking of the pawl); the mismatch of the secondary release timing having caused wear of the secondary cam can then wedge open the secondary lock.

It is recommended that the sleeve bores containing the pawls are inspected annually by IBs and checked for free movement by operators daily.

The adjustment of the system of bars operating the secondary mechanism also requires inspection to ensure the laterally moving blocks are only actuated after the cessation of the ride cycle and prior to partial rotation of the ratchet trees.

In this particular instance the operator also installed additional harness clips to prevent the harness being raised unintentionally.



"Christmas tree" ratchet bar (tree)



Removed bar showing bend



Main adjustment bar to co-ordinate secondary mechanism with primary – note adjustment to right of photo



Note wear to cam plate due to harness being able to be raised before lateral movement has completed



Horizontal bar adjustment point

