Incident Summary #II-1546083-2023 (#35112) (FINAL)

SUPPORTING INFORMATION	Incident Date		May 6, 2023
	Location		Nanaimo
	Regulated industry sector		Amusement Rides and Devices - Amusement ride
	Impact – Injury	Qty injuries	1
		Injury description	Rider experienced a seizure minutes after exiting the ride.
		Injury rating	Moderate
	Impact – Damage	Damage description	A primary safety restraining device failed on an amusement ride gondola relying on the redundant secondary safety device to secure the rider.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		While riding on an amusement ride, a passenger's restraint system loosened, frightening the rider. Shortly after the ride ended, the rider experienced a seizure and received medical attention.
INVESTIGATION CONCLUSIONS	Site, system and components		The amusement ride was manufactured in the Netherlands, is named "SPEED" and is a "Booster" design. The ride consists of a vertical arm attached at its pivot point to the base of the ride. Gondolas are attached at either end consisting of four riders each, two facing forwards and two facing backwards (Photo 1). Rider's load and unload at the bottom of the ride while the opposite gondola is at maximum height. When operating, the arm and the gondolas spin at a maximum speed of 9 revolutions per minute (RPM) while each gondola freely spins independently flipping the riders head over heels several times. The ride reaches a height of 117 feet (35.8M) and riders can be subject to forces up to 3.5G. The ride is designed to be mobile and collapses down onto a mobile trailer unit that can be transported to different locations. The amusement ride is part of a traveling fair that sets up in different locations during the operating season. The gondolas have restraint systems to secure the riders in the seats. The restraints consist of a padded, over the shoulder, bar with a primary locking mechanism and a secondary redundant locking mechanism. The primary system consists of hydraulic actuators which hold down the restraints when they are manually lowered, fitting to the size of the individual riders. The secondary system consists of a sliding metal bar that blocks a cam, affixed to the restraint bars, from opening the restraints in the event of a primary system failure. When offloading riders, electronic solenoids deactivate the secondary system sliding bar then other solenoids release the primary hydraulic hold down system and the restraint bars rise automatically to the fully open positions. The solenoids on the primary system hydraulic lines are normally closed and must be energized to open. The restraint systems remain mechanically locked in the down position by the secondary locking mechanism which physically prevents the restraint from opening in the event of a primary hydraulic system failure. If the primary system fails, loosening of the restraint could occur before the secondary locking mechanism catches the restraint depending on the size of the rider. The "horn" is a raised area on the gondola seats between the rider's legs that prevents riders from slipping out from underneath the over the shoulder restraints. To release a passenger in the event of a failure of the primary restraint bar release system, a manual valve knob can be opened, bypassing the solenoid., and raising the restraint bar. The secondary restraint system has electronic monitoring sensors. When

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	restraints are in the locked position; restraint position indicator lights illuminate on the gondolas and control panel and allow the ride to operate. If the monitoring sensors indicate a restraint bar is not lowered and locked in place by the secondary restraint locking mechanism, the ride will not operate. There is no electronic monitoring of the primary restraint locking mechanism. The manufactures operation manual requires the ride operators to verify that riders are properly secured by of the over shoulder restraints. Company policy is to conduct a "pull test" for every rider before starting the ride. When riders are loaded into the gondola seats, a ride operator pushes down on each individual restraint bar and momentarily pulls back on it to ensure it secures in the locked location tight to the rider. The amusement ride receives an annual service and inspection completed by a designated manufacturer technician. The service involves a full visual inspection and functionality tests of the safety system as outlined by the manufacturers "Functional safety checklist". When the amusement ride is set up at a new location, the ride operator for the unit does a setup inspection and completes a "Setup inspection checklist" for the specific ride. The checklist consists of a 32-point inspection that documents either an "OK" for a satisfactory result or a "UN" for an unsatisfactory result. According to the instructions at the top of the checklist form, any problems identified during the inspection are to be reported to the maintenance department or ride superintendent. After the ride is setup and operational, the ride operator for the unit does a daily maintenance and inspection check prior to opening for the day and completes a "Daily inspection and maintenance" form. The form consists of a 38-point inspection that documents either an "OK" for a satisfactory result or a "UN" for an unsatisfactory result. According to the instructions at the top of the checklist form, any problems identified during the inspection are to be reported immediately to the ride supervisor before continuing inspection or repair.
Failure scenario(s)	The amusement ride received its annual inspection from a manufacturer's representative on June 1-2, 2022. The inspection noted that one of the gondola seat's restraint solenoids was weak and instructed to consider its replacement. On May 2nd, 2023, the set-up inspection of the ride was completed by the main ride operator after it arrived at the fair location in Nanaimo. As part of the setup inspection, the solenoid valves for the primary seat restraints were tested and one of the solenoids was found to intermittently fail to open the restraint which required manual opening of the hydraulic line bypass valve knob to open the restraint to release the rider. The operator identified on the inspection form that "*restraints for the proper operation and condition*" as "UN"(*Unsatisfactory)* and added comments that a solenoid coil on a gondola was not working and needed parts on order. The operator completed the form but did not otherwise directly notify the owner or management of the unsatisfactory condition. The ride was put into operation for the fair. After identifying the issue, the ride operator removed and disassembled a component of the intermittently operating solenoid valve, then cleaned and reinstalled it. This partially resolved the issue but the solenoid still experienced continued intermittent operation which required the manual hydraulic line bypass valve knob to be opened to release passengers when the ride ended. The solenoid continued to experience the same issue throughout the next few days including the day of the incident where it happened multiple times. On the day of the incident, it was three days into the operation of the fair. Around 8pm, a rider entered the ride and sat in the chair with the intermittently operating solenoid valve. The restraint systems engaged and satisfied the safety monitoring systems which allowed the ride to begin operating. During the ride the primary restraint system

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	hydraulics failed to hold pressure and the restraint bar raised up to a maximum of 7" (Photo 5) before the cam contacted the secondary restraint system which would not allow it to raise any further. The rider became frightened and called out to the ride operator to stop the ride. The ride operator did not hear the calls from the rider and allowed the ride to finish after its regular timed interval. Shortly after exiting the ride, the rider experienced a seizure, were attended to on site by a first aid attendant before emergency medical responders arrived and they were transported to a hospital for further medical attention.
Facts and evidence	**Interview Statements** **Owner & manager** • Around 8pm on the day of the incident, they were informed of a person complaining that a lap bar came up on the Speed ride and there was a first aid call of for person having a seizure. • They were not initially aware the two incidents were connected. • The first aid attendant attended to the individual until an ambulance arrived to take the person to the hospital. • The ride was closed for approximately 20 minutes, and they tested the functionality of the restraint systems. They did not find any evidence of failures and put the ride back into operation for the remainder of the evening until they closed at 10pm. • The ride remained closed the next day while a more thorough inspection and testing took place, again with no evidence of failures found. • The ride was reopened two days after the incident. • They had not been aware of or had not received any direct communication from the ride operators of any issues with the ride restraints during setup or operation of the ride at that ride location. • They were not aware of the unsatisfactory designation given to the ride restraints on the set-up inspection checklist or the daily inspection and maintenance form. **Ride operator** • They had filled out the "Setup inspection checklist" and "Daily inspection and maintenance" forms documenting "unsatisfactory" for the ride restraints but did not otherwise directly inform the management or owner of the situation. • The primary solenoid valve would, at times, fail to open requiring manual operation of the bypass valve to open the restraints to release the riders on the one seat. • To try to fix the problem, they had removed the solenoid valve, cleaned it, and reassembled it which improved the functionality, but it still continued to have intermittent issues. • During operation of the ride, after setup and leading up to the incident, the valve had failed multiple times requiring opening of the bypass valve knob to release the riders from the one seat. • The seat with the intermittent restraint valve operation was the same seat the rider rode in that experienced the medical issue. **Documents** **Inspection forms** • **Annual inspection service report (June 1-2, 2022)** – Passed tests for restraints on all gondolas but it identified a gondola restraint solenoid as "*weak*" and informed to consider replacement. • **Set up inspection checklist (May 2, 2023**) – Checklist item for "*Check restraints for proper operation and condition"* documented as unsatisfactory

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	with addition comment "*Car 3-2 solenoid coil on seat 4 not working need parts on order". (*Completed by the main ride operator.) • **Daily inspection and maintenance form (May 4-8, 2023)** – Checklist item for "*SEATS: Check for proper operation and condition"* was documented as unsatisfactory on day 1 (May 4th) and OK on days 2-4 (May 5-7). (Completed by the main ride operator.) **Engineering inspection and testing report** After the incident, the owner hired an independent professional engineer to conduct a ride restraint safety review (May 12-13, 2023). Inspection and testing, following the testing procedures outlined in the manufacturers "Functional safety checklist", were completed, and the engineering report identified the following: • *"The primary restraint mechanism is a non-monitored infinite position hydraulic restraint. The secondary restraint mechanism is a single position non-adjustable monitored mechanical stop".* • The riders are exposed to in excess of 1G out of the gondola which requires an "*Area 5 compliant restraint system, a Class 5 restraint with redundancy*" which the ride complies with. • Test 8.1 to measure leakage of the hydraulic system of the primary restraint system was conducted. The test involves fully closing the restraints then pulling back on the restraint bar for 1 minute and measure for any increase in distance from the shortest distance from the restraining bar to the seat back. The maximum allowable distance increase is 0.39" (10mm). • All 8 gondola seats were tested, and all passed except for seat 4 on gondola 1 that failed measuring an increase in distance of 6.5" (165mm). **Manufacturer notification** After notification of the incident and review of the professional engineering inspection and testing report, the manufacturer released a notification for the model of ride involved in the incident instructing the following: *"The manual release valve on the primary restraint locking actuator is to be used for evacuation purposes only. It is not allowed to use the valve during normal operational procedures."* *"After the manual release valve on the primary restraint locking actuator has been used to evacuate a patron from the seat, the valve must be closed again. Before allowing new patrons in the evacuated seat again, the normal and safe functionality of the restraint locking actuator must be tested by pulling the restraint bar and verifying that the actuator is holding the restraint bar in its position without allowing any opening movement."*
Causes and contributing factors	The primary restraining device on the gondola chair likely failed to operate correctly due to an internal leak of the restraining device's hydraulic system. Contributing factors to the incident: • The intermittently operating restraining device solenoid not being effectively repaired or replaced after being identified during the annual inspection, setup inspection and daily inspections. • The decision to continue operation of the ride with an intermittently operating restraining device solenoid. • Ineffective communication of the restraint solenoid issue to the management and ownership.

Photo 1 – Amusement ride set up - one side of the rotating arm with a 4-person rider gondola at the end.

Photo 2 – Rider gondola at the lower base loading location.

Photo 3 – Rider gondola - Restraint bars in the fully open (front) and fully closed (rear) positions.

Photo 4 – Front rider seat, the restraint bar in the fully closed position (left) and the position locked by the secondary restraint mechanism (right).

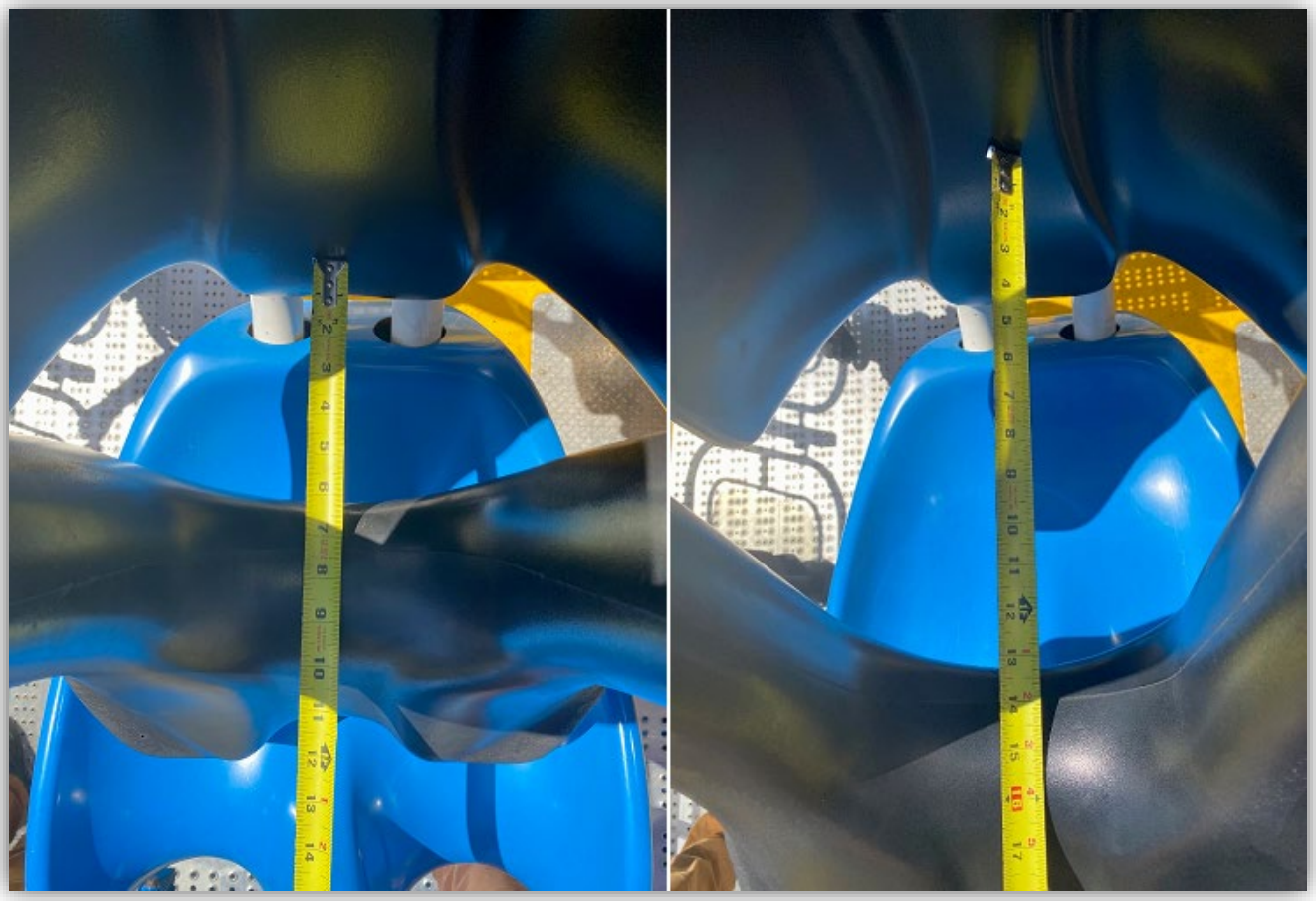

Photo 5 – Top view of the restraint bar in the fully closed position (left) and with the restraint bar cam against the secondary safety lock bar (right) showing a difference of approximately 7”.

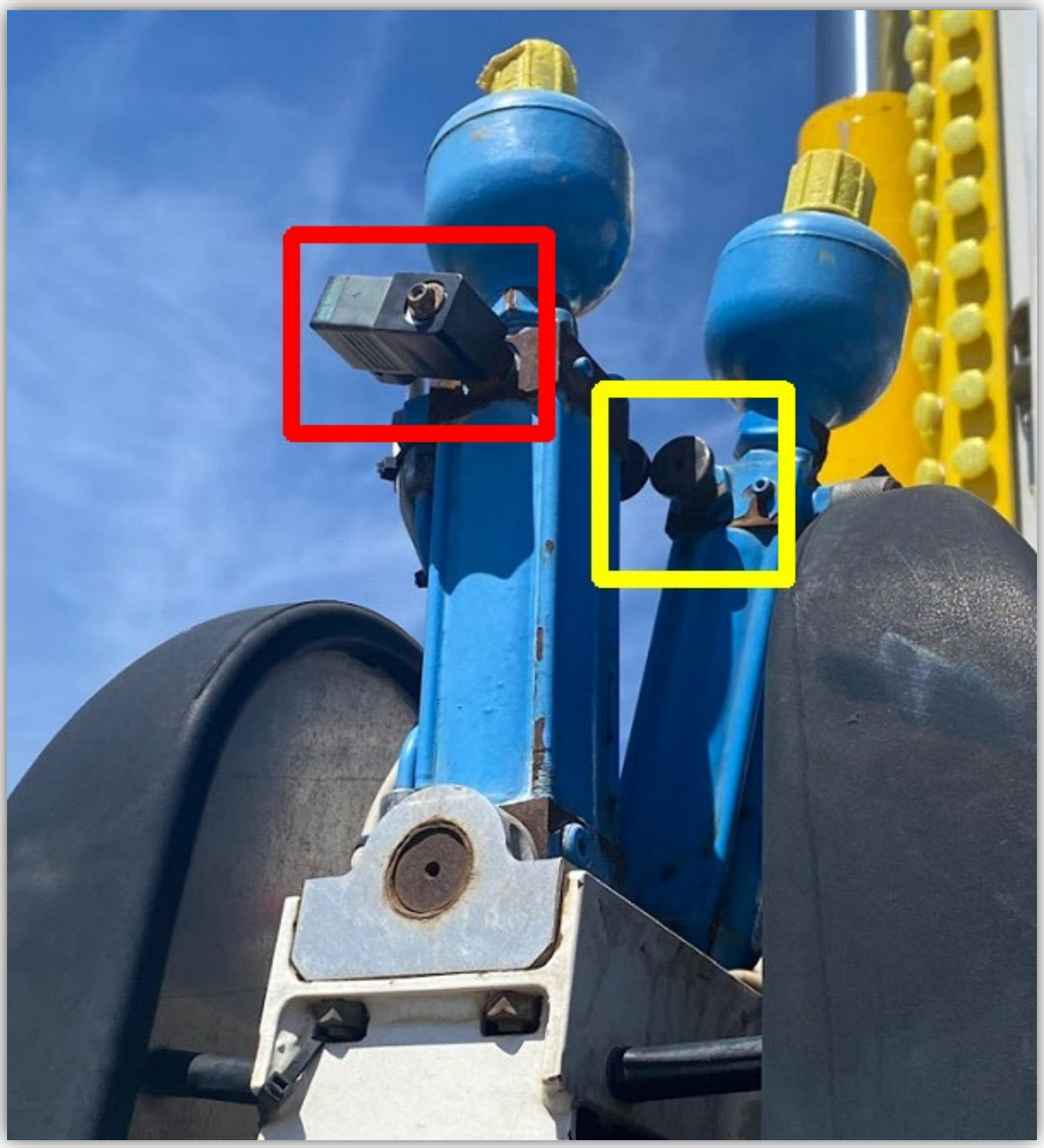

Photo 6 – Primary restraint hydraulic actuators. [**RED**] an electric solenoid, [**YELLOW**] manual hydraulic bypass valve knob.

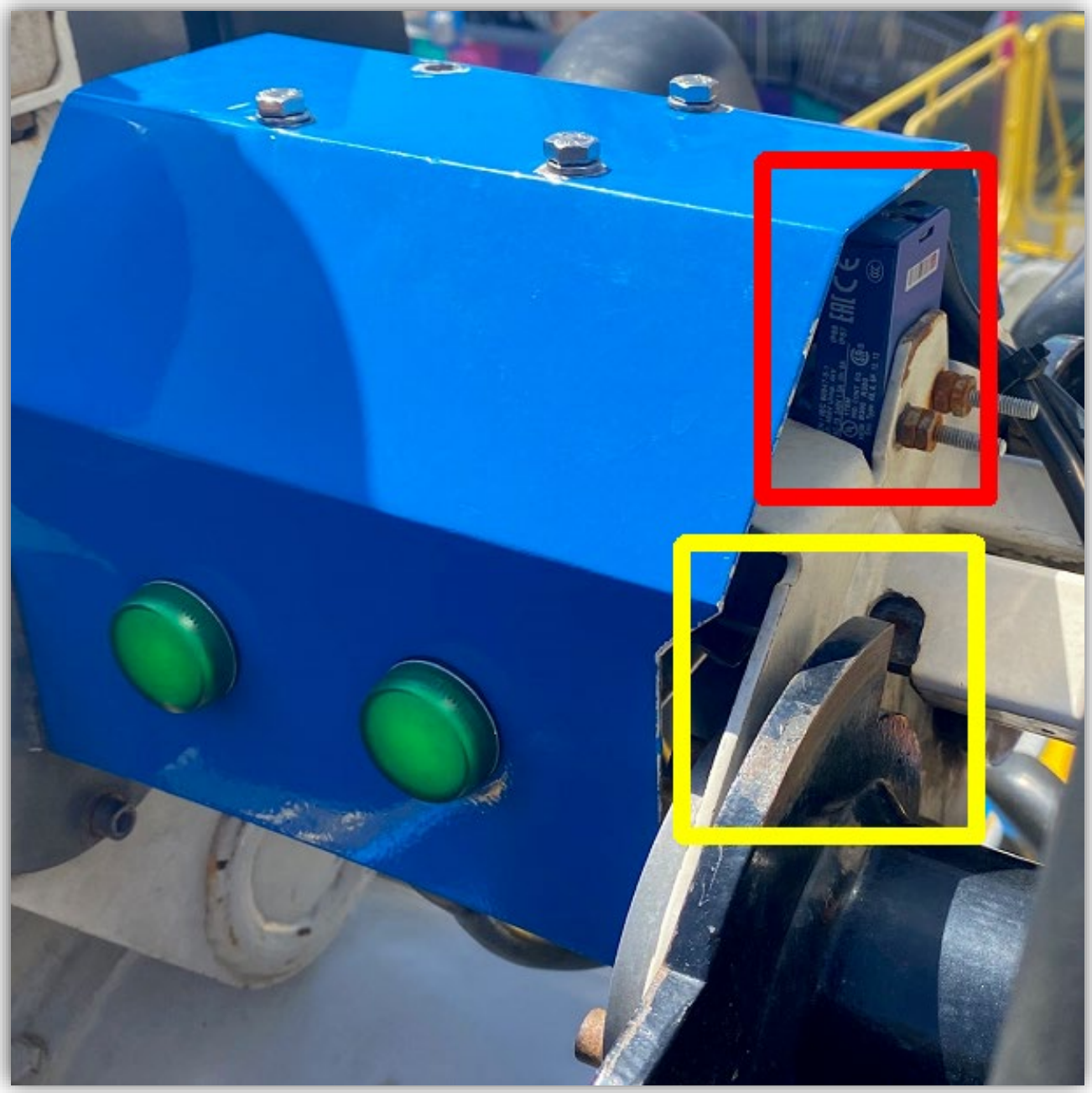

Photo 7 – Green indicator lights which illuminate when restraint is locked in the lower position. [**RED**] safety sensor. [**YELLOW**] restraint bar cam and secondary locking system.

Photo 8 – Closeup of restraint bar cam and secondary locking bar. [**YELLOW**] Distance from cam to steel rod with the restraint in the fully closed position.

Photo 9 – Safety switch ensuring restraint bar is in the correct position to begin ride operation.

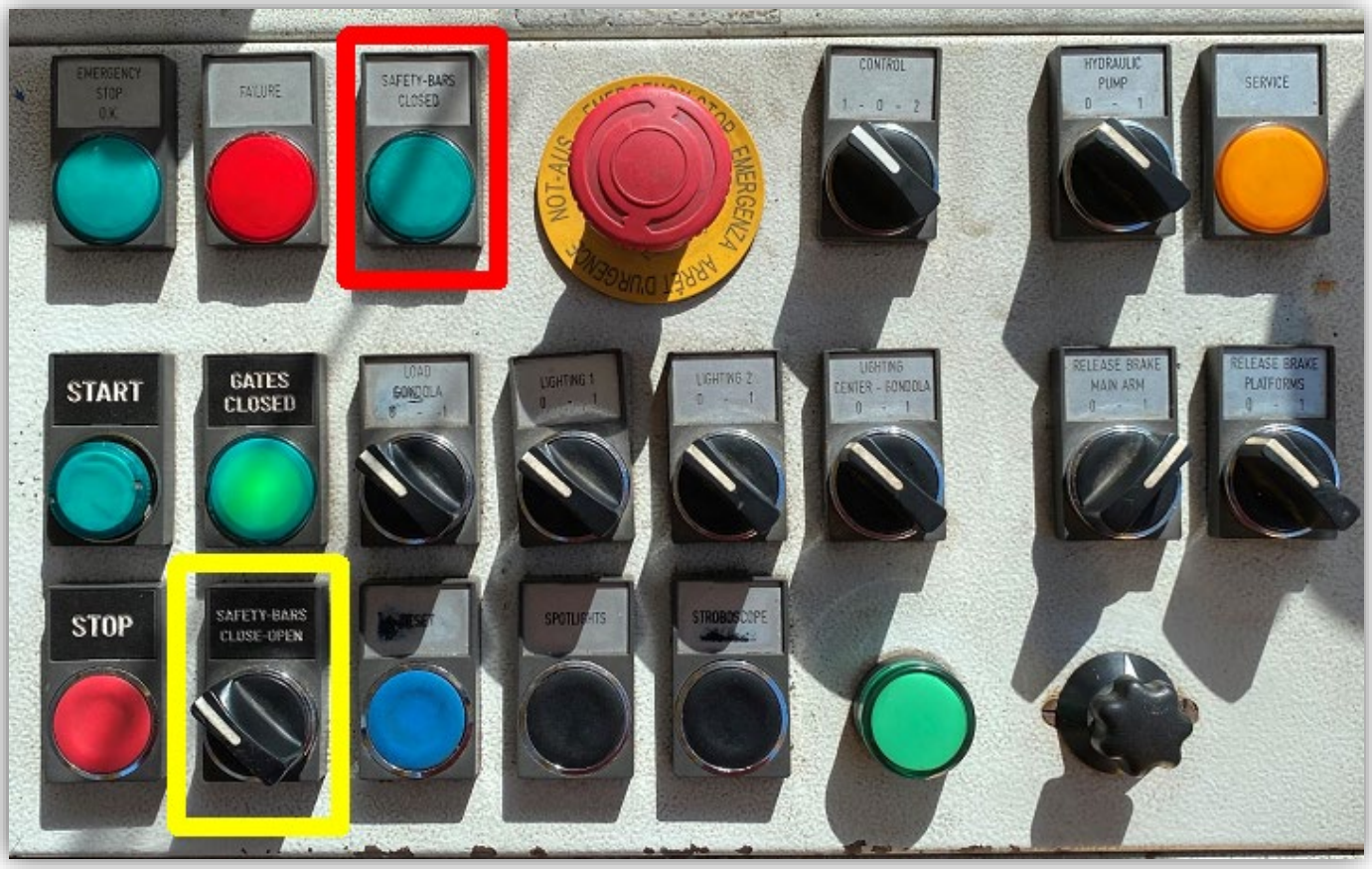

Photo 10 – Ride control center. [**YELLOW**] switch to operate the safety restraint bars. [**RED**] the indicator light identifying all safety restraint bars are closed.