Quest Engineering & Failure Analysis, Inc.
www.quest-engineering.com

March 24, 2022 Accident
Field Investigation Report
Free Fall
Icon Park, Orlando, Florida

Prepared for the Florida Department of Agriculture and Consumer Services, Bureau of Fair Ride Inspections

By: Quest Engineering and Failure Analysis, Inc.

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April 13, 2022

Michelle Faulk, Bureau Chief
Bureau of Fair Rides Inspection
Division of Consumer Services
Florida Department of Agriculture and Consumer Services
The Rhodes Building
2005 Apalachee Parkway
Tallahassee, Florida 32399

Re: Field Investigation Report
File: Free Fall Icon Park, Orlando, Florida
Quest No.: 10623

Dear Ms. Faulk:

We have completed our initial field assessment of the subject amusement ride device. This report presents observations and conclusions generated primarily from our field investigation and some video footage of the conditions surrounding the accident. We anticipate future work may include relating additional materials to the evidence included in this report.

Background

On March 24, 2022, Tyre Sampson was riding the Free Fall amusement ride when he fell from the ride onto the paver surface below. The accident was largely captured via surveillance video and cell phone images. These images show the process from entry into the ride area, through loading, ride operation to unloading of patrons, which includes the time of the fall. Significantly, Tyre Sampson is shown entering and riding Seat 1. The video also shows the extent to which the ride restraint harness was closed prior to the accident and that it was closed following the accident. It also clearly shows Tyre Sampson exiting from the seat, feet first during ride descent.

Work Performed

On April 4, 2022, representatives of Quest Engineering & Failure Analysis, Inc., visited the accident scene and performed our field investigation to document the accident scene and amusement ride. In conducting our work, we performed detailed photographic, video, measurement and testing activities.

Field Observations

The physical and mechanical components of the ride did not reveal any evidence of physical or mechanical failure. All systems inspected or observed physically and mechanically functioned. The systems demonstrated no evidence of distortion or fracture type failures. Photo 1 shows and overview of Seats 30, 1, 2 and 3.

Seat 1, which had been occupied by Tyre Sampson, demonstrated accident-related evidence in the form of longitudinal striations on the seat base. The striations are consistent with video evidence that he slid out of the seat by sliding forward across the seat base. Specifically, the striations were located on the seat "horn" which is a raised section on the front edge of the seat base that fits between the rider's legs and is part of the ride's restraint system. To exit the seat, a rider would need to slide forward over this horn. Attached photos 2 and 3 show the seat and evidence.

Video images show the position of the seat's restraint "harness" on Tyre Sampson. The "harness" is one of the terms used in the ride's Operations and Maintenance Manual to describe the device that lowers over the rider's shoulders down onto their torso and lap area to complete the overall restraint system for the ride. During our field investigation we used image transparencies to replicate the accident harness position to the time of the accident. For reference we measured the minimum gap between the harness and the seat horn and will refer to that throughout this report as the "restraint opening." The accident seat's restraint opening was measured to be more than six inches but less than seven inches with a most likely value nearer seven inches. Attached photos 4 and 5 show the accident seat prior to the accident and an investigation comparative photograph with the opening at seven inches.

When the harnesses were lowered to an acceptable ride-monitored height, two lights illuminated. One light on the side of each seat illuminated and another light for the particular seat also illuminated on the ride's main control panel.

We will refer to both of these lights collectively as "safety lights." Until the safety lights illuminated, the ride would not function. In an accident video, Seat 1's seat mounted safety light was illuminated. At our inspection, we positioned all seats to the maximum restraint opening which illuminated each seat's safety lights. The ride has 30 seats; however, one had previously been decommissioned and two had visibly larger openings than the remaining 27 seats. Measurements of the 27 seats revealed an average restraint opening 3.33 inches with a total range of 2.65 to 4.28 inches and is defined in this report as the "normal" restraint opening. The restraint opening for Seat 1 was 7.19 inches and Seat 2 was 6.51 inches. Attached photos 6 through 9 show comparisons between Seat 1 and Seat 22 which had and the average opening of 3.33 inches.

Each seat has a proximity sensor used to activate the safety lights when the harness is lowered to a preset location. Each proximity sensor is secured to the harness with a slotted plate that is adjustable and positioned by two socket head cap screws. The adjustment of the proximity sensor locations has a direct effect on the restraint opening gap. Inspection of the plates for Seats 1 and 2 revealed evidence that adjustments were made to their proximity sensor locations **after** the sensors were initially secured in place. On Seats 1 and 2, clear clamping marks from screw tightening exist on the plate that record the initial securement location of the proximity sensors. Geometric calculations reveal that the initial proximity sensor securement location for Seat 1 would have located the Seat 1 harness to near 3 inches, or a more closed location with a sensor and restraint opening similar to the unadjusted 27 seats. Photographs 10 through 12 show the Seat 1 plate location and clamping marks demonstrating the sensor was previously secured and then moved.

The evidence of adjustment after initial sensor securement was unique to Seats 1 and 2. Other seats did have light scrapes on the plates typical of fine tuning of the sensor location during ride set-up. But, only Seats 1 and 2 demonstrated the more distinctive clamping type marks which evidenced actual tightening of the screws onto the adjustment plate and then loosening and movement of the sensors to a new location.

Testing to assess the "compliance" or give of the harness and harness padding during loading was performed. The restraint opening could be expanded by approximately 3 inches when tested up to about 250 lbs. of opening force. In other words, the effective restraint opening will expand by several inches when forced. Photographs 13 and 14 show the measurement process and compliance of the seat and harness.

Regarding Seat 1, from video evidence at the time of the accident, the restraint opening initially was over 6 inches, but with the aforementioned compliance, may have grown to as much as 10 inches. During our investigation, two individuals were positioned in a seat with an opening ranging from 6 to 10 inches. Both individuals were able to slip through the restraint opening without any assistance. The individuals were 6'3" to 6'5" tall and weighed between 200 and 300 pounds.

Accelerometer testing revealed 4 G's decelerations (4 times the force of gravity).

Conclusions

The subject ride did not experience a mechanical or electrical failure.

Tyre Sampson was seated in Seat 1.

Prior to the time of the accident, Seat 1's harness proximity sensor was initially set to within the normal restraint opening range of near three inches.

Prior to the time of the accident, but subsequent to the initial setting, Seat 1's harness proximity sensor was manually loosened, adjusted, and tightened to allow a restraint opening of near 7 inches.

At the time of the accident, Seat 1's harness restraint opening was between 6 to 7 inches at the start of the ride. During slowing of the ride Tyre Sampson slipped through the gap between the seat and harness, which may have expanded several inches due to inherent seat and harness compliance.

The cause of the subject accident was that Tyre Sampson was not properly secured in the seat primarily due to mis-adjustment of the harness proximity sensor. The mis-adjustment of the sensor allowed both safety lights to illuminate, improperly satisfying the ride's electronic safety mechanisms and allowing the ride to commence even though the ride was unsafe.

There are many other potential contributions to the cause of the accident and this report in no way assures the safety of the ride in the normal, adjusted or unadjusted harness positions. A full review of the ride's design, safety, operation, restraint mechanisms and history should be performed as this report just focuses on the physical evidence of the failure of the ride to secure Tyre Sampson.

This report is based only on the information we have available to us at this time and may need to be updated if relevant additional facts and information become available.

Sincerely,

QUEST ENGINEERING & FAILURE ANALYSIS, INC.

G. Bryant Buchner, P.E.
Chief Engineer

GBB/kbc

Photo 1

Seat 1

Photo 2

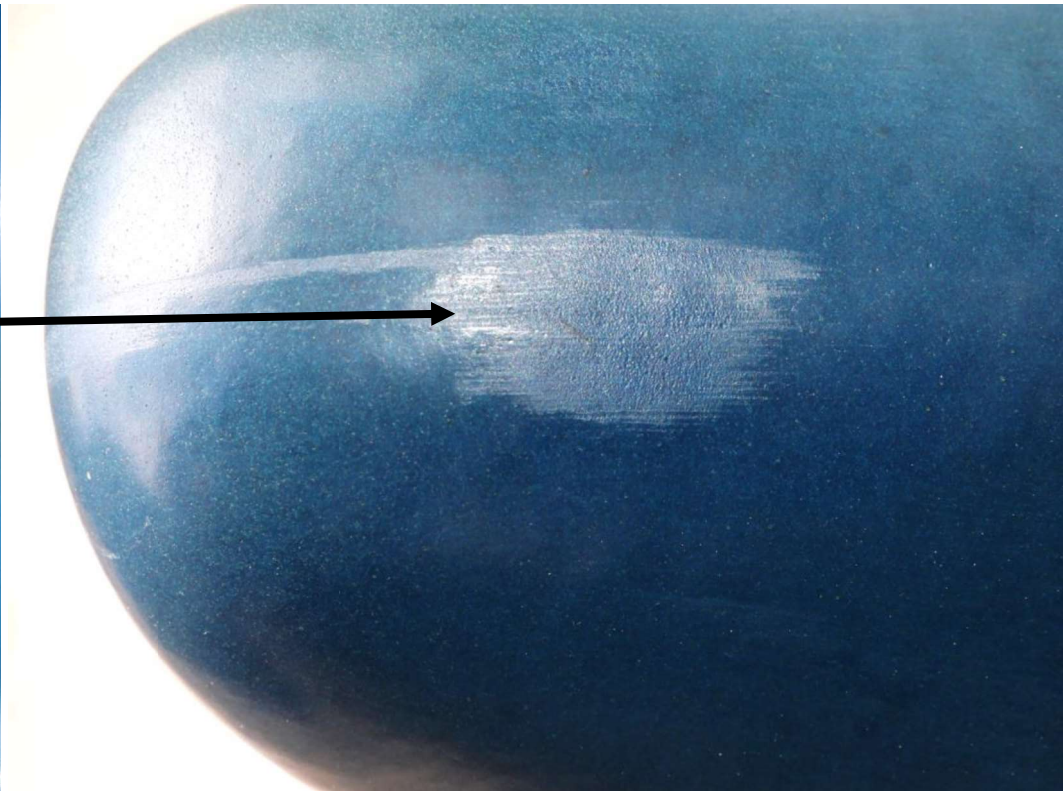

Photo 3

Photo 4

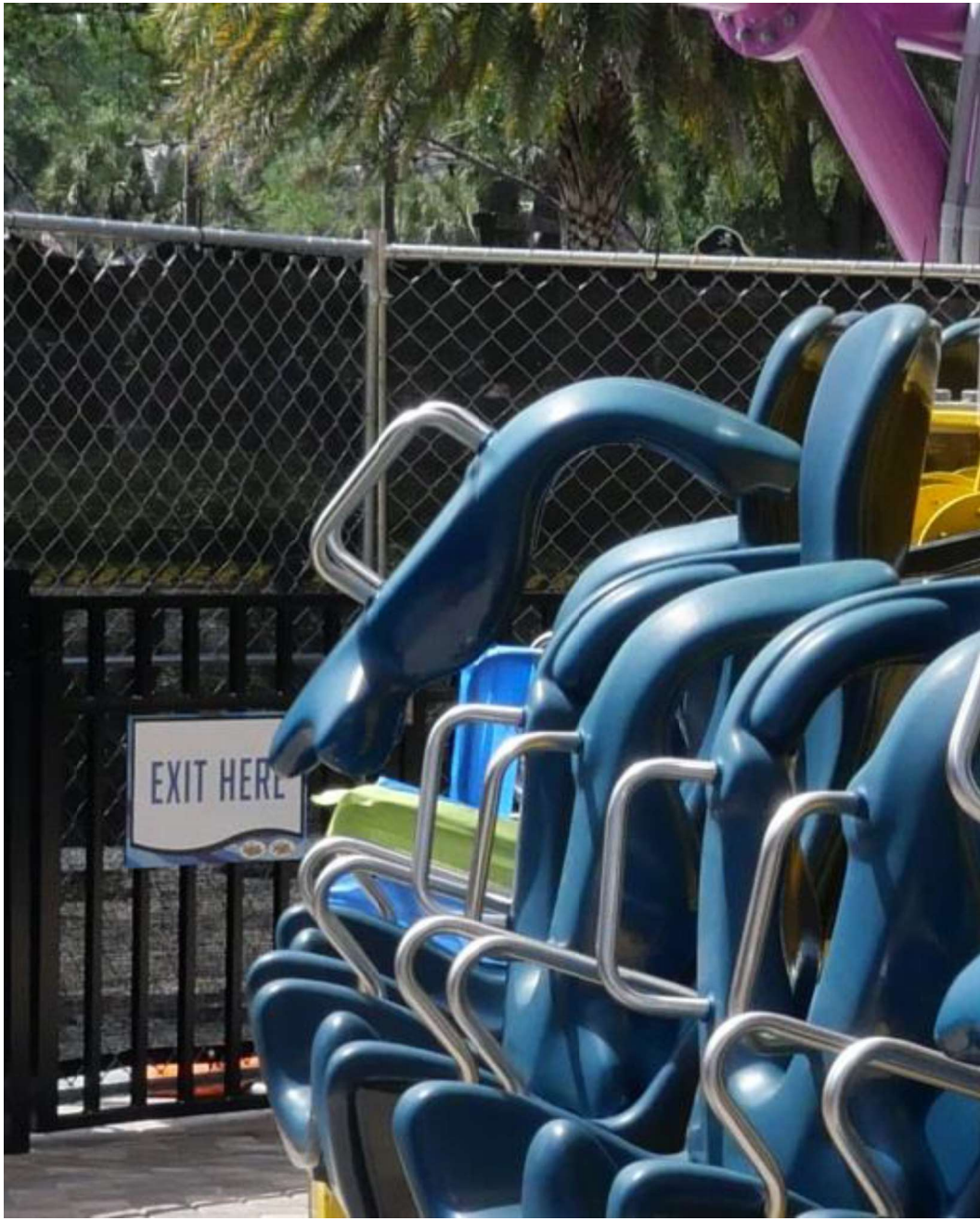

Photo 5

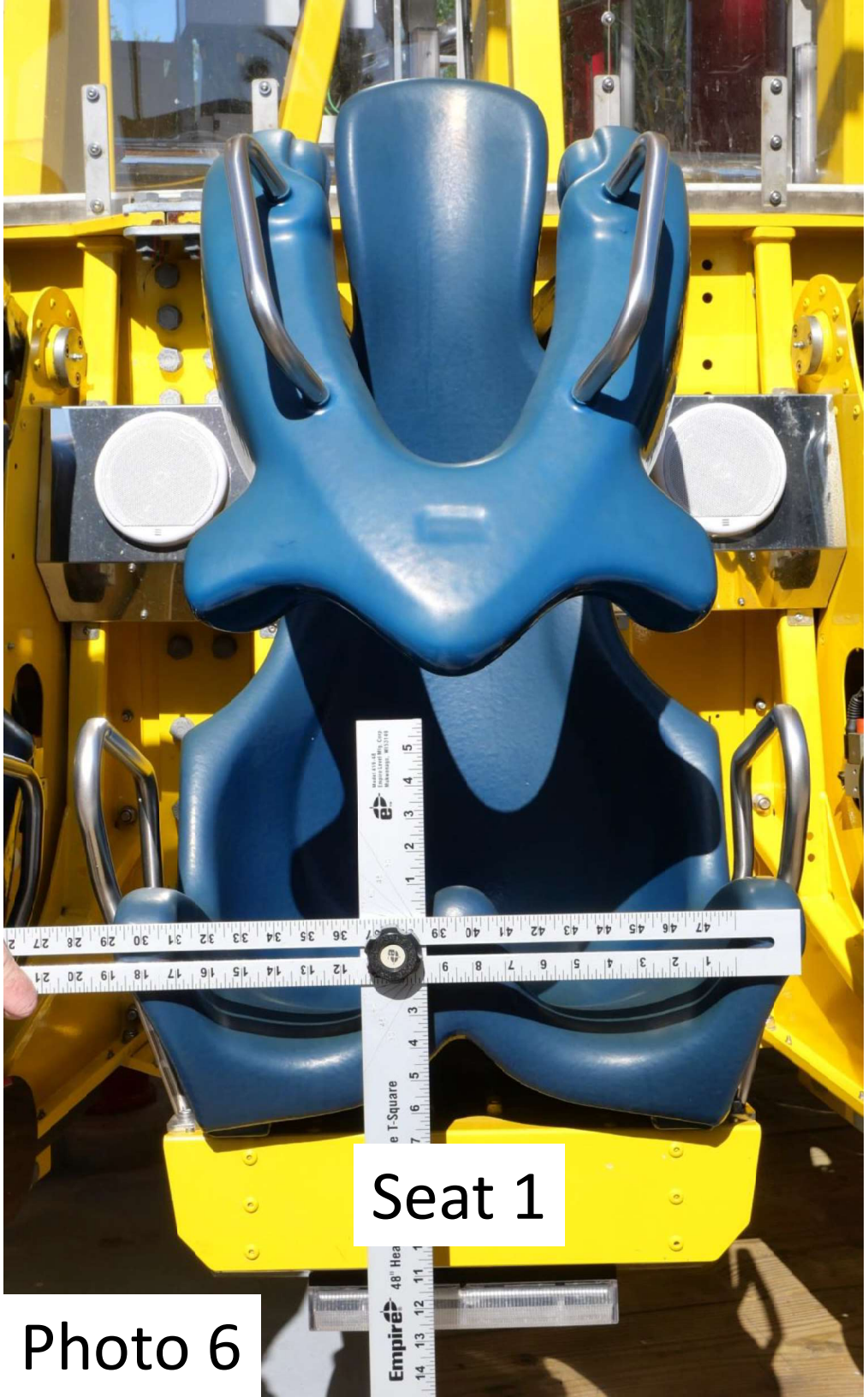

Photo 6

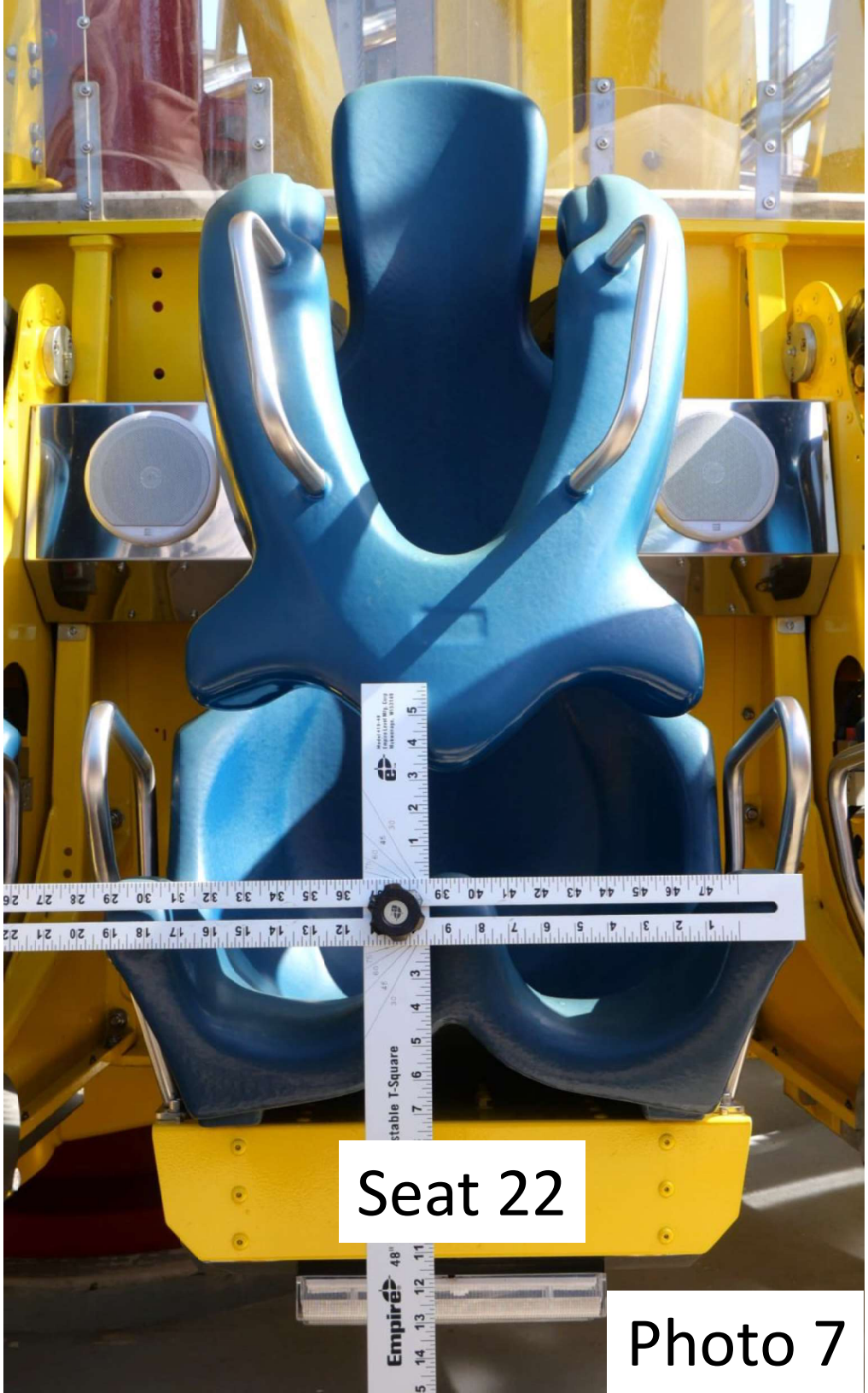

Photo 7

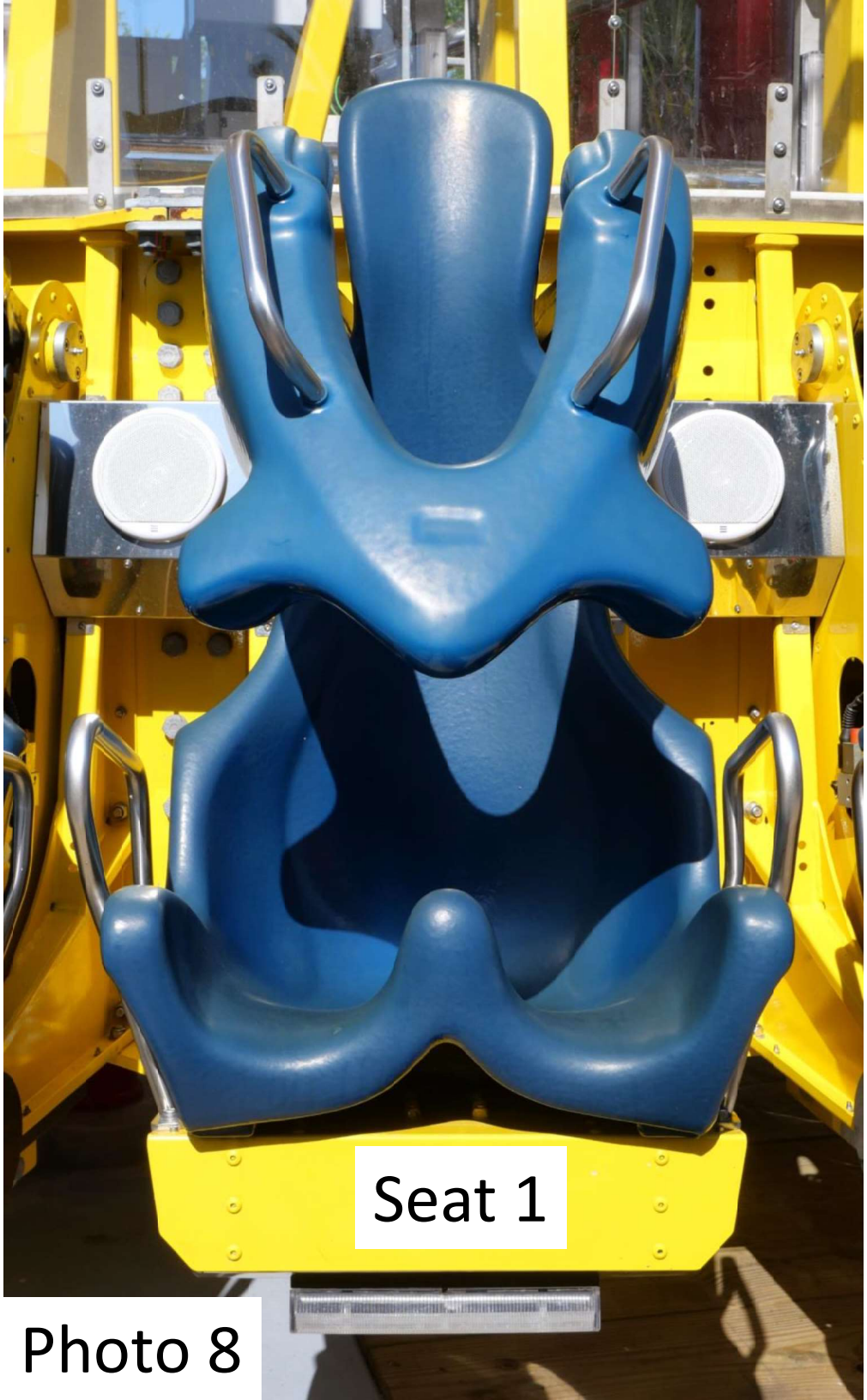

Photo 8

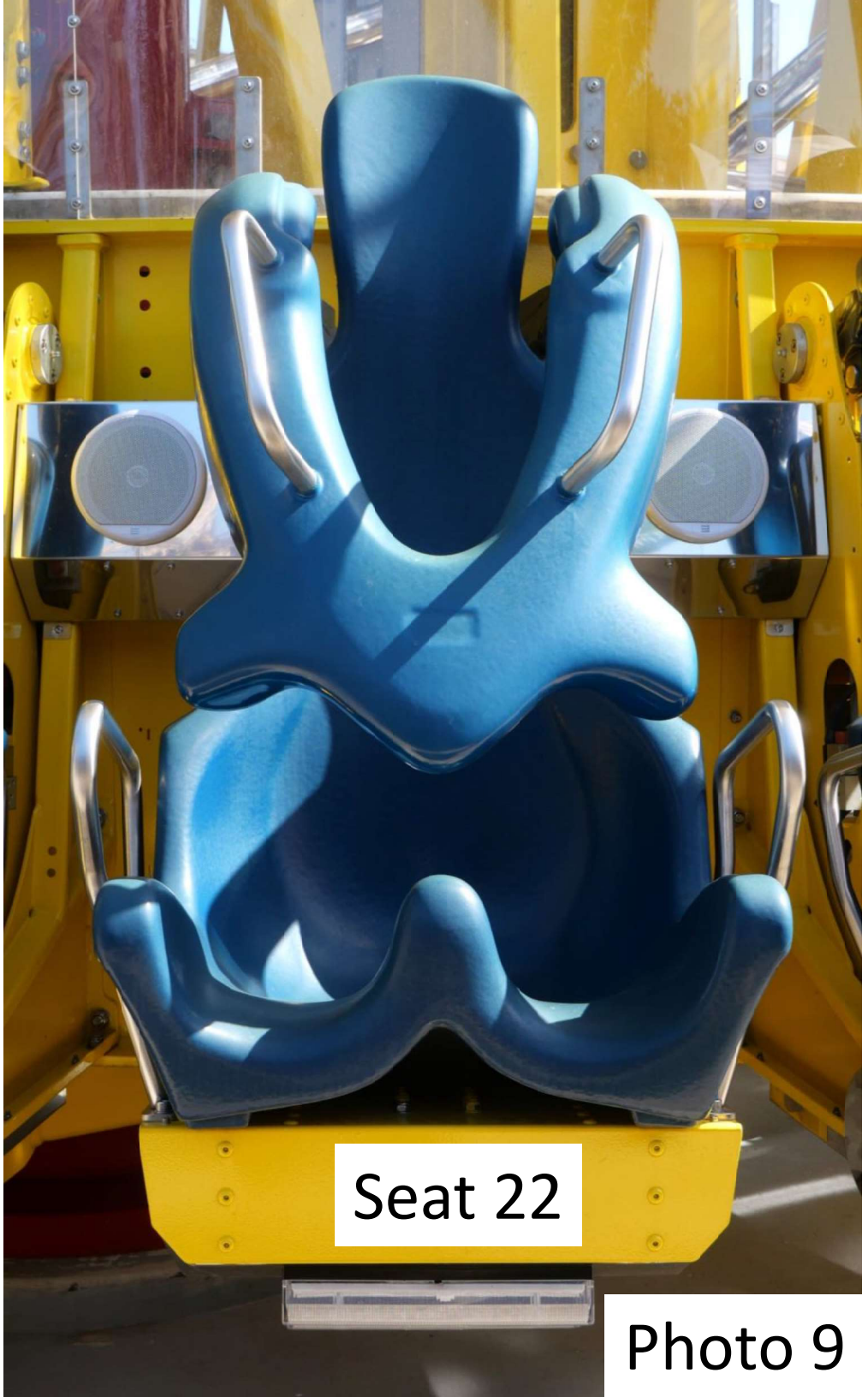

Photo 9

Photo 10

Sensor

Seat 1

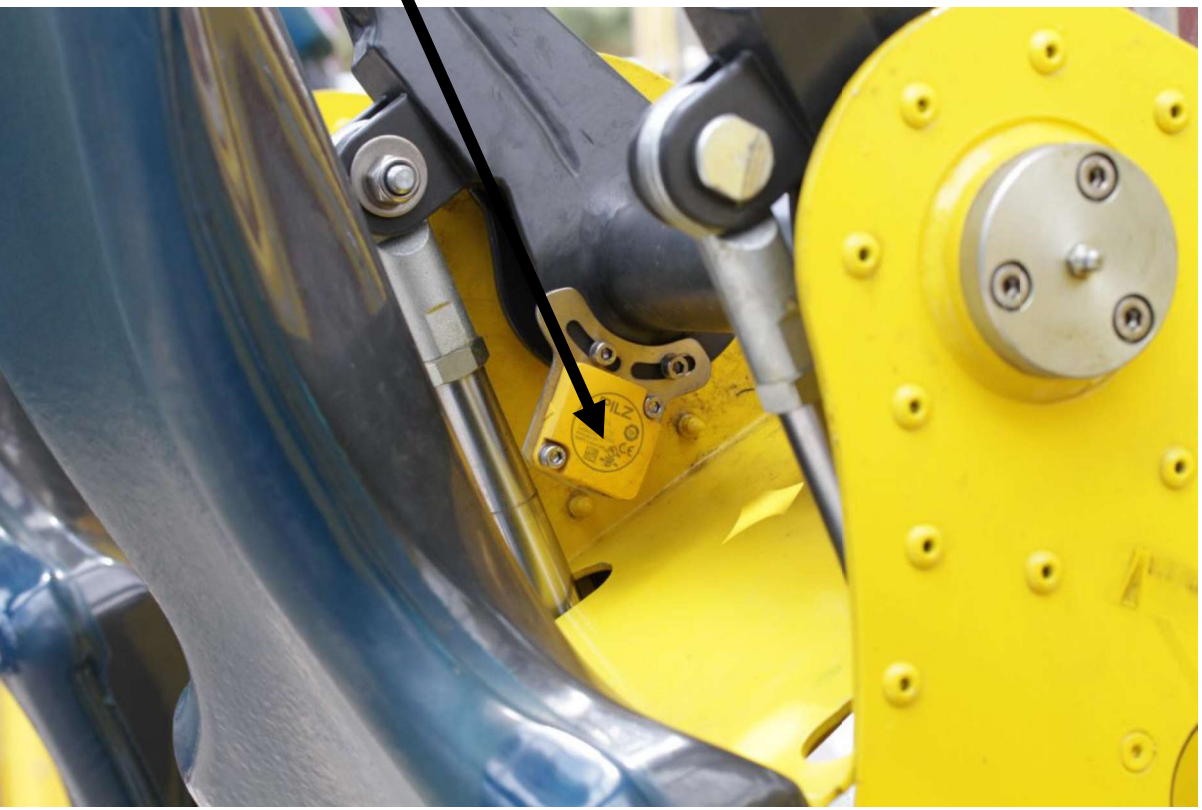

Photo 11

Clamping Mark

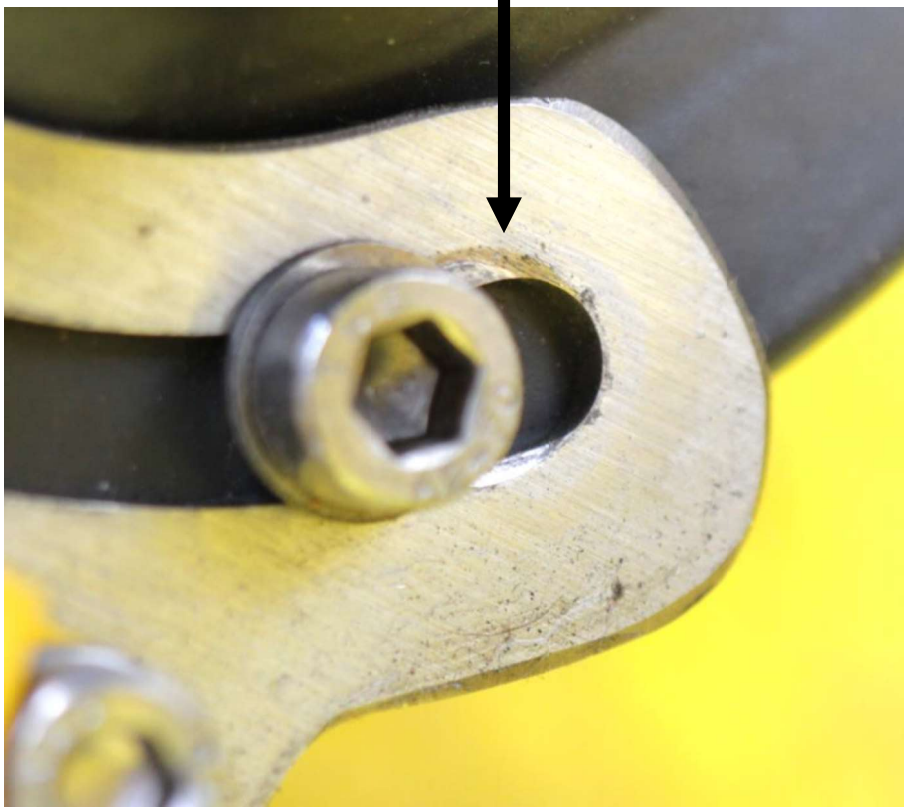

Photo 12

Photo 13

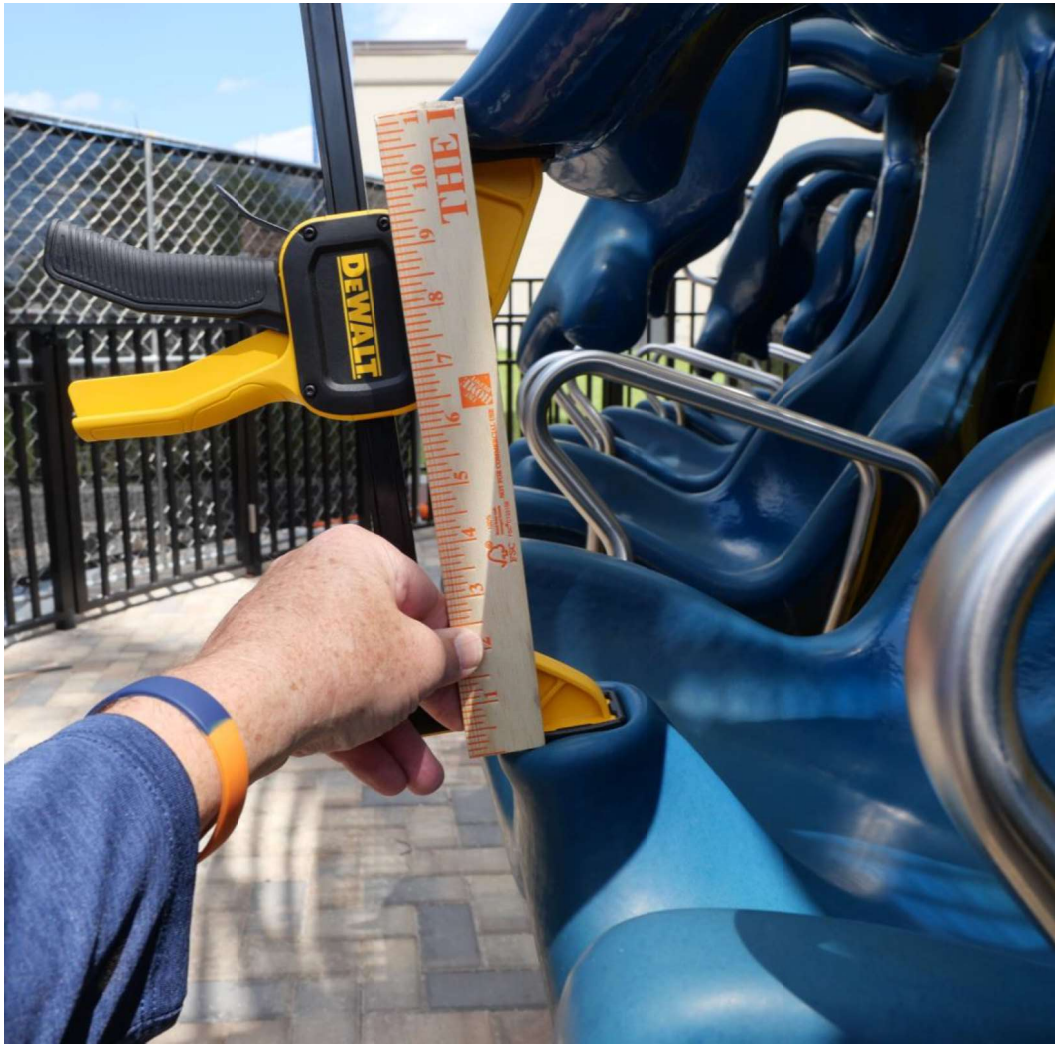

Photo 14