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**Special Crash Investigations:
On-Site Rollover Crash
Investigation;
Vehicle: 2021 Porsche Macan;
Location: California;
Crash Date: June 2022**

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16. Abstract This report documents the on-site investigation of a rollover crash selected by NHTSA's Special Crash Investigations group. SCI assigned the police report to Dynamic Science, Inc. via the Police Accident Report Sampling Engine program in August 2022. The vehicle was a 2021 Porsche Macan. This single-vehicle crash occurred at night in June 2022 in an interstate interchange in California. The Porsche was driven by a belted 32-year-old male. The Porsche departed the roadway and struck the concrete wall with its left plane. It crossed the gore between two roadways and the travel lanes and struck a metal guardrail. It penetrated the guardrail, rolled two quarter turns, left-side-leading, and struck the back of a second guardrail with its right plane. The driver exited the vehicle under his own power. There were no reported injuries, and he was not transported for medical treatment. The driver was arrested for driving under the influence of alcohol.			
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Special Crash Investigations
On-Site Rollover Crash Investigation
Case No. DS22018
Vehicle: 2021 Porsche Macan
Location: California
Crash Date: June 2022

Background

This report documents the on-site investigation of a rollover crash selected by the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration. SCI assigned the police crash report (PCR) to Dynamic Science, Inc. via the Police Accident Report Sampling Engine program in August 2022, with instructions to locate and submit vehicle images prior to initiating the investigation. The vehicle was a 2021 Porsche Macan. The team submitted images obtained from a salvage company to NHTSA in August 2022, and NHTSA assigned the case in August 2022. Permission to inspect the vehicle was obtained from the insurance company in September 2022 and the vehicle was inspected in September 2022. The Porsche air bag control module was not supported by the Bosch CDR tool and was not imaged.

This single-vehicle crash occurred at night in June 2022 in an interstate interchange in California. Conditions were dark with artificial lighting, and dry with clear visibility. The crash occurred on a transition ramp from a westbound interstate roadway to a southbound interstate roadway. The ramp curved to the right and had two travel lanes. It was bordered on the left by a concrete wall. The southbound roadway had four travel lanes and was bordered on the left by a metal guardrail. The Porsche (Figures 1 and 2) was driven by a belted 32-year-old male and was traveling in the left lane of the ramp at an unknown speed. The Porsche departed the roadway to the left and struck the concrete wall with its left plane. The vehicle crossed the gore area between the two roadways and traveled into the southbound travel lanes. It then crossed the travel lanes and struck a metal guardrail with its front plane. The vehicle penetrated the guardrail, rolled two quarter turns, left-side-leading, and struck the back of a second guardrail with its right plane.



Figure 1. 2021 Porsche Macan



Figure 2. 2021 Porsche Macan

The Porsche had been moved by a tow truck prior to police arrival. The driver exited the vehicle under his own power. He was not injured or medically transported. He was arrested for driving under the influence of alcohol.

The vehicle was towed from the scene due to damage and was declared a total loss by the insurance company.

Summary

Crash Site



Figure 3. Overhead view of interchange (image source: Google Maps © 2022 Maxar Technologies)



Figure 4. Ramp transition to southbound roadway, looking southeast

The crash site was in a multi-level interchange of interstate highways in California (Figure 3). The crash occurred on a transition ramp from a westbound interstate roadway to a southbound interstate roadway. The ramp curved to the right and had two travel lanes separated by a dashed white painted line. It was bordered on the left by a solid yellow painted line, a solid white painted line, a narrow asphalt shoulder, and a concrete wall. It was bordered on the right by a solid white painted line and a metal guardrail. The radius of curvature for the ramp was 41 m (135 ft). The superelevation is unknown. There were no rumble strips present. The calculated critical speed¹ for a roadway with this radius is 55.8 km/h (34.7 mph). There was a 32 km/h (20 mph) speed warning sign at the beginning of the ramp. The posted speed limit was 105 km/h (65 mph). The southbound roadway had two travel lanes approaching the transition ramp and was bordered on the left by a solid white painted line, an asphalt shoulder and metal guardrail. The southbound roadway separated from the northbound roadway by a dirt/gravel median and a second guardrail.

The weather at the nearest reporting station was 18°C (65°F), 87 percent humidity, and calm winds. Conditions at the time of the crash were dark with artificial lighting, clear, and dry. A crash diagram is included at the end of this technical report.

Pre-Crash

The Porsche was initially traveling westbound as it entered the on-ramp to transition to a southbound roadway (Figure 4) at a driver-reported speed of 80 km/h (50 mph) through the right curve. The driver said he did not see, hear, or feel anything that indicated activation of any avoidance features.

Crash

As the Porsche continued in the curve, the driver lost control and the vehicle departed the roadway to the left. The driver said he was avoiding an object in the roadway, but the police report did not support this. The left plane of the vehicle struck the wall (Event 1) in a

¹ Critical speed used in this context for the speed at which a vehicle will lose lateral control on a given roadway curve.

sideswiping type collision (Figure 5). The Porsche crossed the gore between the two roadways and entered the southbound travel lanes. It appears to have been in a clockwise yaw crossing the travel lanes, striking the guardrail with its front plane (Event 2). The WinSMASH program calculated a barrier equivalent speed of 20 km/h (12 mph). The Porsche penetrated the guardrail and began a left-side-leading rollover (Event 3). It continued into the median area, rolling two-quarter turns and struck the back side of the northbound roadway guardrail with its right plane (Event 4), where it came to rest (Figure 6).



Figure 5. Event 1 (wall), Event 2 (guardrail, looking southeast)



Figure 6. Event 2 (guardrail), Event 3 (rollover), Event 4 (guardrail, looking south)

Post-Crash

The driver exited the vehicle under his own power. He was not injured or medically transported. The driver was arrested for driving under the influence of alcohol. The vehicle had been moved by a tow truck prior to police arrival.

The vehicle was towed from the scene due to damage and was declared a total loss by the insurance company.

2021 Porsche Macan

Vehicle Description

The 2021 Porsche Macan was identified by the VIN WP1AA2A54MLxxxxxx. The manufacture date was January 2021. The Porsche was a 5-door compact utility vehicle with two rows of seating for five passengers. It had all-wheel drive, a 4-cylinder, 2.0-liter gasoline engine, and a 7-speed automatic transmission. The vehicle had manufacturer recommended size P265/45R20 tires with a cold tire pressure of 248 kPa (36 psi) for the front and P295/40R20 tires and cold tire pressure of 269 kPa (39 psi) for the rear. The Macan had Pirelli Scorpion tires of the recommended sizes for the left rear, right front, and right rear. The left front tire and wheel were missing. The vehicle had front-row bucket seats with adjustable head restraints that were not active. The driver's seat track was between the middle and rear-most track position at the time of inspection. The Porsche had standard safety equipment that included lane departure warning, front and rear parking sensors, brake assist, and automatic headlight leveling. According to the driver interview, none of the avoidance features were disabled prior to the crash.

The Porsche had direct and induced damage to the front, left, right, and top planes. For Event 1 wall impact, direct damage to the Porsche's left plane began 50 cm (19.6 in) aft of the left rear axle and extended 396 cm (155.9 in) forward (Figure 7). The damage near the front left bumper corner was masked by the damage from the guardrail impact. The collision deformation classification (CDC) was 12LDES1.



Figure 7. Left plane damage, 2021 Porsche



Figure 8. Front plane damage, 2021 Porsche Macan

For Event 2 guard rail impact, direct damage began at the front left bumper corner and extended to the front right bumper corner (Figure 8). Eleven measurements were taken at bumper level using the Nikon total station and the AutoCrush program calculated 6 crush measurements as follows: C1 = 15 cm (5.9 in), C2 = 14 cm (5.5 in), C3 = 12 cm (4.7 in), C4 = 8 cm (3.1 in), C5 = 3 cm (1.1 in), C6 = 1 cm (0.4 in). Maximum crush measured 15 cm (5.9 in) at C1 and the CDC for the Porsche in Event 2 was 11FDEW1.

For Event 3 rollover, direct damage extended from the front of the hood to the mid-point of the roof and measured 249 cm (98.0 in). Direct damage extended from roof side rail to roof side rail and measured 110 cm (43.3 in) from side to side (Figure 9). The maximum vertical crush was located the top of the left A-pillar and measured 2 cm (0.8 in). The CDC for the rollover was 00TYDO2.

The Porsche was on its roof when it struck the second guardrail with its right plane during Event 4. The direct damage began aft of C-pillar and extended to the right front fender (Figure 10). The CDC for this impact was 00RDMW2.



Figure 9. Roof crush, 2021 Porsche Macan



Figure 10. Right plane damage, 2021 Porsche

Rollover Discussion

According to the NHTSA online rating system,² the 2021 Porsche Macan does not have a rollover rating. An online search revealed no rollover test results for the vehicle. Typically, a rollover resistance test measures the risk of rollover in a single-vehicle, loss-of-control scenario. According to data obtained online,³ the vehicle had a calculated rollover stability rating of 1.29%. The Porsche sustained a two-quarter-turn climb-over type rollover after striking and penetrating the first guardrail. Police did not report the vehicle's exact final rest location and reported that the vehicle had been righted prior to their arrival. Based on available evidence it appears the Porsche came to rest on its roof in the median after the roll was interrupted by the right plane impact with the second guardrail. The belted driver remained in his seated position during the crash. Frontal, knee, and inflatable curtain (IC) air bags likely deployed during crash events prior to the rollover. The IC air bags were combination side impact/roll-sensing and the left IC air bag and likely remained inflated during the rollover. The driver was able to exit the vehicle under his own power.

²www.nhtsa.gov/vehicle/2021/PORSCHE/MACAN/SUV/AWD#safety-ratings-rollover

³ 4N6XPRT Systems, La Mesa, CA; citation unavailable.

Event Data Recorder

The Porsche air bag control module was not supported by the Bosch CDR tool and was not imaged.

Interior Damage

The Porsche sustained minor interior damage from impact forces. The middle portion of the windshield was fractured at the windshield header; the backlight, second row right (2), and roof glazing was disintegrated. The right rear door and rear hatch were jammed shut. The remaining doors remained closed and operational, and no intrusions were observed. Driver contact evidence was present on the seat belt and the deployed air bags.

Manual Restraint Systems



Figure 11. Driver's seat belt, 2021 Porsche



Figure 12. Driver's seat belt, 2021 Porsche Macan

The Porsche had lap and shoulder seat belts for all seat positions. Based on evidence obtained during the vehicle inspection, the Porsche driver was belted. His seat belt webbing and buckle were scuffed when loaded by the driver during the crash (Figure 11). The belt retractor pretensioner actuated, locking the belt in the used, unspooled position (Figure 12).

Supplemental Restraint Systems

The Porsche's supplemental restraint system had advanced air bags based on the Federal Motor Vehicle Safety Standards No. 208, *Occupant crash protection*, including driver's and passenger's frontal, driver knee, front row outboard seat-mounted side-impact, and front and second row IC air bags. The driver's frontal, knee and IC air bags deployed, and his seat belt pretensioned, likely in the Event 2 guardrail impact.

NHTSA Recalls and Investigations

Based on VIN-based searches queried in September 2022 and December 2024, no unrepaired recalls were associated with this vehicle.

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2021 Porsche Macan Occupant

Driver Demographics

Age/sex:	32 years/male
Height:	180 cm (71 in)
Weight:	73 kg (160 lb)
Eyewear:	None
Seat type:	Bucket with adjustable head restraint
Seat track position:	Between middle and rear-most
Manual restraint usage:	Lap and shoulder belt available, used
Usage source:	Vehicle inspection, interview
Air bags:	Frontal, knee, seat-mounted, IC air bags available; frontal, knee, and IC air bags deployed
Alcohol/drug data:	Alcohol present, test results unknown
Egress from vehicle:	Exited under his own power
Transport from scene:	None
Type of medical treatment:	None

Driver Injuries

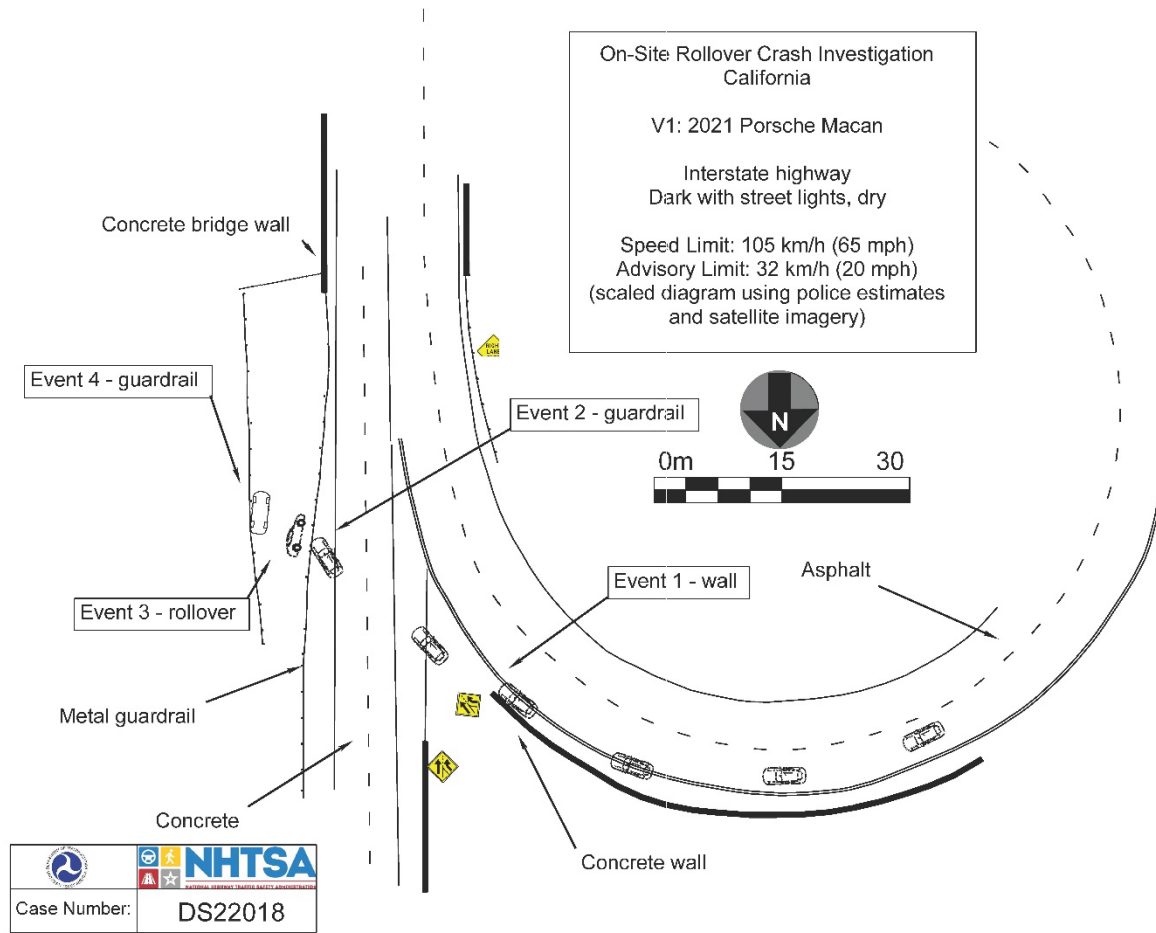
No reported injuries.

Driver Kinematics

The belted driver was seated forward-facing and actively operating the vehicle. The driver lost control of the vehicle in the curve, departed the roadway to the left and struck the concrete wall with the left plane of the vehicle. This was a sideswiping motion, and the driver was displaced slightly forward. As the vehicle entered the southbound travel lanes it began to yaw clockwise. At impact with the guardrail the driver's frontal, knee, and IC air bags deployed and his seat belt pretensioner actuated. The driver was displaced forward, loading the lap and shoulder belt, and contacting the frontal and knee air bags. The Porsche rolled two quarter-turns to the left and the driver was held in his seat by the pretensioned belt. The vehicle's top plane struck the ground, and the driver was displaced toward the roof where he remained for an unknown time. He was able to exit the vehicle under his own power, presumably through the driver's door. He was not injured and was taken from the scene by police.

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Crash Diagram



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