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Special Crash Investigations Remote Vehicle Fire Child Restraint System Investigation Vehicle: 1995 Chevrolet Blazer Location: Kansas Crash Date: July 2013

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems.

This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

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16. Abstract

This report documents the remote investigation of a crash-related fire in a 1995 Chevrolet Blazer in which a 19-month-old male was seated in a child restraint system (CRS) located in the second row center seating position. This crash occurred on a four-lane, divided interstate highway. The Chevrolet was a 4-door sport utility vehicle (SUV) equipped with a driver's frontal air bag. A belted 21-year-old female driver and a 19-month-old male second row center passenger occupied the vehicle. The child was seated in a forward-facing CRS of unknown make and model. The Chevrolet was traveling northwest approaching an acceleration lane from an interchange area. A non-contact vehicle merged from the acceleration lane into the Chevrolet's lane. The driver of the Chevrolet steered left to avoid hitting the back plane of the non-contact vehicle and then overcorrected right. The Blazer began to rotate clockwise, and rolled over (event 1) left side leading, an estimated 16 quarter turns. The vehicle came to final rest upright and caught fire (event 2). Passersby removed the driver and the second row passenger from the vehicle. The fire then fully engulfed the vehicle. A fire department responded to the crash scene and extinguished the fire. The Chevrolet's driver sustained critical injuries and was transported by ambulance to a hospital where she was pronounced deceased. The second row center passenger sustained police-reported "C" (possible) injuries and was transported by ambulance to a hospital where he was treated in the emergency room and then transferred by helicopter to a second hospital where he was treated in the emergency room and released. The vehicle was towed from the crash scene due to damage.

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TABLE OF CONTENTS

Background **1**
Crash Summary **2**
Crash Site 2
Pre-Crash 2
Crash 3
Post-Crash and Fire-Related Discussion 3
1995 Chevrolet Blazer **3**
Description 3
Exterior Damage 3
Interior Damage **4**
Manual Restraint Systems **4**
Supplemental Restraint Systems **4**
Child Restraint System **4**
1995 Chevrolet Blazer Occupants **5**
Driver Demographics 5
Driver Injuries 5
Driver Kinematics 7
Second Row Center Occupant Demographics 8
Second Row Center Occupant Injuries 8
Second Row Center Occupant Kinematics 8
Crash Diagram **10**

INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
REMOTE VEHICLE FIRE CHILD RESTRAINT SYSTEM INVESTIGATION

CASE NUMBER - IN17007
LOCATION - KANSAS
VEHICLE - 1995 CHEVROLET BLAZER
CRASH DATE - JULY 2013

BACKGROUND

This report documents the remote investigation of a crash-related fire in a 1995 Chevrolet Blazer (**Figure 1**) in which a 19-month-old male was seated in a child restraint system (CRS) located in the second row center seating position. This investigation was initiated by the National Highway Traffic Safety Administration and assigned to the Special Crash Investigation team at the Indiana University Transportation Research Center in January 2018. This single-vehicle rollover crash occurred in Kansas in July 2013 during early morning and was investigated by a local police agency. Photographs of the crash scene and vehicle were obtained in February 2017. A telephone interview was conducted with the investigating police officer in August 2017. A telephone interview was conducted with the fire chief of the responding fire department in September 2017 and a copy of the fire incident report was obtained.

Figure 1: The damaged 1995 Chevrolet Blazer; police photo, view southwest

This crash occurred on a four-lane, divided interstate highway. The Chevrolet was a 4-door SUV equipped with a driver's frontal air bag. A belted 21-year-old female driver and a 19-month-old male second row center passenger occupied the vehicle. The child was seated in forward-facing CRS of unknown make and model, which was destroyed in the fire. The Chevrolet was traveling northwest approaching an acceleration lane from an interchange. A non-contact vehicle merged from the acceleration lane into the Chevrolet's lane. The driver of the Chevrolet steered left to avoid hitting the back plane of the non-contact vehicle and then overcorrected right. The Blazer began to rotate clockwise, and rolled over (event 1) an estimated 16 quarter turns, left side leading. The vehicle came to final rest upright and caught fire (event 2). Passersby removed the driver and the second row passenger from the vehicle. The fire then fully engulfed the vehicle. A fire department responded to the crash scene and extinguished the fire. The Chevrolet's driver sustained critical injuries and was transported by ambulance to a hospital where she was pronounced deceased. The second row center passenger sustained police-reported "C" (possible) injuries and was transported by ambulance to a hospital where he was treated in the emergency room and then transferred by helicopter to a second hospital where he was treated in the emergency room and released. The vehicle was towed from the crash scene due to damage.

CRASH SUMMARY

Crash Site: This crash occurred during dark early morning hours on the northwest-bound lanes of a four-lane, divided, interstate highway. The weather conditions were dry and cloudy with 16 kilometers (10 miles) visibility, easterly winds at 15 km/h (9 mph), a temperature of 24.4 °C (76 °F), and a dew point of 17.2 °C (63 °F), according to local weather reports. The interstate traversed in a southeast/northwest direction and had two bituminous lanes in each direction divided by a grass median. Each side of each roadway was bordered by bituminous shoulders. The roadway pavement markings consisted of solid white edge lines, broken white center lines, and solid yellow median edge lines. Rumble strips were located on each shoulder. The speed limit was 121 km/h (75 mph). A crash diagram is included at the end of this report.

Figure 2: Police photo of northwest-bound approach of Chevrolet and non-contact vehicle

Figure 3: Police photo of Chevrolet's tire marks from driver's left steering maneuver, view west

Figure 4: Police photo of Chevrolet's tire marks from driver's right steering maneuver and path to rollover, view northwest

Pre-Crash: The Chevrolet was traveling west in the right northwest-bound through lane approaching an acceleration lane from an interchange area (**Figure 2**). A non-contact vehicle had merged from the acceleration lane into the right northwest-bound through lane and continued northwest-bound for approximately 275 m (900 ft). The driver of the non-contact vehicle told police that she was traveling 97 to 105 km/h (60 to 65 mph) when suddenly the Chevrolet approached her vehicle from behind at a high rate of speed. The Chevrolet's driver then suddenly swerved to the left (**Figure 3**) into the left northwest-bound through lane to avoid striking the back plane of the non-contact vehicle. The police crash scene photographs of the Chevrolet's tire marks on the roadway showed that the vehicle began to rotate counterclockwise as result of the left steering maneuver (**Figure 4**). The driver then initiated a hard right steering maneuver as the vehicle approached the median shoulder and the vehicle began to rotate clockwise on the shoulder.

Crash: The Chevrolet rolled over (event 1), left side leading, on the median shoulder and continued rolling over on the shoulder and then in a northwesterly direction across both northwest-bound lanes across a police-reported distance of 67.4 m (221 ft). The vehicle came to final rest upright in the right northwest-bound through lane heading northeast and caught fire (event 2). The reported rollover distance suggested that the vehicle rolled over an estimated 16 quarter turns.

Post-Crash and Fire-Related Discussion: The driver of the non-contact vehicle called 911 and reported the crash. She stated to police that the fire had begun and that the flames emanated from the "passenger wheel." Several passersby stopped and assisted in the removal of the child from the CRS in the second row. Police had then arrived and were assisted by other passersby in the removal of the driver. The police reported that the safety belt webbing was cut to free the driver. Shortly after her removal, the vehicle was engulfed in flames.

The fire incident report from the responding fire department indicated that notification of the crash and fire was received at 0245 hours and fire responders arrived on-scene at 0255 hours. The fire incident report indicated that the fire was extinguished and the responding units cleared the crash scene at 0331 hours. Three fire suppression units and five personnel were involved. No other details regarding the fire and post-fire activities were provided.

The Chevrolet's driver sustained critical injuries and was transported by ambulance to a hospital where she was pronounced deceased at 0339 hours. The second row center passenger sustained police-reported "C" (possible) injuries and was transported by ambulance to a hospital and treated in the emergency room, then transferred by helicopter to a second hospital where he was treated in the emergency room and released. The vehicle was towed from the crash scene due to damage.

1995 CHEVROLET BLAZER DESCRIPTION

The Chevrolet was a 4-wheel drive, 5-occupant, 4-door SUV with the VIN: 1GNDT13W4S2xxxxxx equipped with a 4.3-liter, V-6 engine, 5-speed automatic transmission, and 4-wheel antilock brakes. The vehicle was also equipped with a driver's frontal air bag. The specified wheelbase was 272 cm (107.0 in).

EXTERIOR DAMAGE

Exterior Damage Events 1: The Chevrolet sustained damage to both side planes and the top plane during the rollover. It appeared that the direct damage extended down the majority of the length of both sides. However, most of the paint was burned off the vehicle so minor scratches from ground contact could not be discerned. The damage to the top plane resided primarily on the roof. The hood also appeared to have some direct damage scratches related to rollover. Both left side wheels and the right rear wheel were displaced from the vehicle during the rollover. The right front wheel remained on the vehicle

Damage Classification Event 1: The Collision Deformation Classifications (CDC) was 00TDDO3. The severity of the damage was moderate based on the extent of the roof crush.

Exterior Damage Event 2: The vehicle sustained major fire damage to the entire vehicle. Some paint remained on the lower portions of both right-side doors and quarter panel. The fire damage was severe since most of the combustible material was consumed in the fire. The source of the fire is not known.

INTERIOR DAMAGE

The interior of the Chevrolet sustained moderate damage from intrusion of the right A-pillar, roof, and roof side rail during the rollover. Most of the combustible material in the vehicle's interior was consumed in the fire.

MANUAL RESTRAINT SYSTEMS

The front and second rows of a 1995 Chevrolet Blazer were typically equipped with three- point lap and shoulder safety belts. The status of the safety belts in the subject vehicle could not be determined due to the extent of damage from the fire and the lack of sufficient photographic coverage of the vehicle's interior. The driver was belted at the time of the crash since the police crash report stated that the driver's safety belt was cut by passersby to remove her from the vehicle.

SUPPLEMENTAL RESTRAINT SYSTEMS

A 1995 Chevrolet Blazer Chevrolet was typically equipped with a driver's frontal air bag. If the air bag was in fact present in the vehicle, it was consumed during the fire.

CHILD RESTRAINT SYSTEM

The child was seated in an unknown make/model forward-facing CRS. The child was secured in the CRS by a five-point harness according to the investigating police officer. The CRS was consumed in the fire according to the police crash report.

1995 CHEVROLET BLAZER OCCUPANTS DRIVER DEMOGRAPHICS

Age/Sex:	21 years/female
Height:	173 cm (68 in)
Weight:	73 kg (160 lbs)
Eyewear:	Unknown
Seat Type:	Bucket
Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Police crash report
Air Bags	Frontal; if present, destroyed in fire and unknown if deployed
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Removed by passersby
Transport From Scene:	Ambulance
Medical Treatment:	Pronounced deceased at hospital at 0339 hours

DRIVER INJURIES

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Laceration descending thoracic aorta at its junction with the diaphragm, with retroperitoneal hematoma in thoracic region[1], not further specified	420218.6	Left front door panel, forward upper quadrant	Probable
2	Laceration inferior (thoracic) vena cava near diaphragm, with retroperitoneal hematoma in abdominal re- gion[1], not further specified	421802.3	Left front door panel, forward upper quadrant	Probable
3	Fracture (distortion) of ribs in left chest, not further specified	450210.2	Left front door panel, forward upper quadrant	Probable
4	Laceration (punctures) left lung (un- derlying pulmonary tissue[2]), not further specified	441430.3	Left front door panel, forward upper quadrant	Probable
5	Hemopneumothorax of left pleural cavity with displacement of left lung and mediastinum toward right	442205.3	Left front door panel, forward upper quadrant	Probable

[1] On its face this doesn't make sense because the retroperitoneum occurs only in the abdominal cavity; however, the phrase was stated in the autopsy. The paramedics reported blood coming from the ears, nose, and mouth and there was significant blood in the oropharynx.

[2] There was possible contusion as well with tearing of the pulmonary tissue; however, this tearing could have resulted from resuscitation attempts. Police performed cardiac compressions at the scene.

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
6 7	Fracture neck with hypermobility[3] at C_2 left, consistent with cervical fracture, not further specified	650228.3 650206.3	Critical IPC con figuration Roof Noncontact injury: impact forces[4]	Possible Possible
8	Laceration (tear) left lobe of hemidiaphragm with extrusion (partially) of stomach, spleen, and liver into the chest cavity	440610.4	Left front door panel, forward upper quadrant	Probable
9	Contusion liver (hemorrhage in the capsule consistent with traumatic injury), not further specified	541812.2	Critical IPC con figuration Left front door panel, forward upper quadrant Steering wheel rim	Possible Possible
10 11	Contusion and laceration (tear) of spleen (hemorrhage in the capsule consistent with traumatic injury), not further specified	544212.2 544222.2	Left front door panel, forward upper quadrant	Probable
12 13	Laceration, 10 cm (3.9 in) and contusion (discoloration) at base of left neck, not further specified	310402.1 310602.1	Torso portion of safety belt system	Probable
14	Abrasions, numerous, left side of face, not further specified	210202.1	Noncontact injury: flying glass, unknown source	Probable
15	Abrasions, numerous, left side of chest, not further specified	410202.1	Noncontact injury: flying glass, unknown source	Probable
16	Contusion, large, left anterior chest wall with discoloration (hemorrhage between muscle fibers and into adipose tissues), not further specified	410402.1	Left front door panel, forward upper quadrant	Probable
17	Abrasion to back along spine, not further specified	410202.1	Noncontact injury: flying glass, unknown source	Probable
18	Contusion, large, back with discoloration, not further specified	410402.1	Left front door panel, rear upper quadrant	Possible
19	Abrasions, numerous, left side of abdomen (hip), not further specified	510202.1	Lap portion of safety belt system	Probable
20 21 22 23	Abrasions, numerous linear, on left shoulder, left upper arm, left posterior distal forearm, and left hand, not further specified	710202.1 710202.1 710202.1 710202.1	Noncontact injury: flying glass, unknown source	Probable
24	Fracture (deformity/distortion[5]) of left (upper) arm, not further specified	751100.2	Left front door panel, forward upper quadrant	Probable

[3] The head twists freely to the left.

[4] Two important factors must be considered. First, there are no reported lesions to the scalp or head and, second, the driver's seat belt was reported as being "very tight" upon arrival of rescue personnel.

[5] Suggestive of fracture

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
25	Abrasions, numerous, left leg, not further specified	810202.1	Noncontact injury: flying glass, unknown source	Probable
26	Injury soft tissue (possible seat belt[6] mark) over right upper thigh, not further specified	810402.1	Steering wheel rim	Probable
27 28	Abrasions and contusion (bruising) on plantar and dorsal surfaces of right foot, not further specified	810202.1 810402.1	Floor, foot controls	Probable

Sources: Autopsy records, emergency room records, and EMS treatment Record. Injury Number 17 came only from EMS Treatment Records. Injury Numbers 1 to 12, 15, 16, 18, and 23 to 28 came only from Autopsy Records. Injury Numbers 14 and 19 came from a combination of Emergency Room and Autopsy Records. Finally, Injury Numbers 13 and 20 to 22 came from a combination of all three sources.

DRIVER KINEMATICS

The driver was restrained by the lap and shoulder safety belt. The adjustment of her seat track is not known. The driver was initially likely displaced to the right in the safety belt when she steered left and the vehicle began to rotate counterclockwise and decelerate. She was likely redirected to the left when she steered right and the vehicle rotated clockwise and decelerated. The driver was then likely redirected in multiple directions when the vehicle rolled over, left side leading. She probably contacted the left front door during the rollover which resulted in a thoracic aorta laceration, laceration of the inferior vena cava, and a laceration of the left lobe of the hemidiaphragm. This injury resulted in the extrusion of the stomach, spleen, and liver into the chest cavity. The driver also sustained a contusion and laceration of the spleen, fracture of the left upper arm, and a large contusion on the left anterior chest, probably from contacting the left front door. She sustained fractures of an unspecified number of left ribs and a laceration of the left lung with hemopneumothorax of the left pleural cavity from contact with the left front door. The driver sustained a fractured neck at C_2, possibly from contact with the roof or left roof side rail as well as impact forces during the rollover. Possible contact with the left front door and steering wheel rim caused a contusion of the liver. The driver also sustained multiple lacerations, abrasions, and contusions. The driver was removed from the vehicle by passers-by and transported by ambulance to a hospital where she was pronounced deceased at 0339 hours.

[6] No marks were seen on her chest nor were there marks on or between her iliac crests.

SECOND ROW CENTER OCCUPANT DEMOGRAPHICS

Age/Sex:	19 months/male
Height:	99 cm (39 in)
Weight:	15 kg (34 lbs)
Eyewear:	None
Seat Type:	Split bench with folding backs
Seat Track Position:	Fixed
Manual Restraint Usage:	Child restraint system
Usage Source:	Police crash report
Air Bags	None
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Removed by passerby
Transport From Scene:	Ambulance
Medical Treatment:	Treated in hospital emergency room, then transferred by helicopter to a second hospital; treated in emergency room and released

SECOND ROW CENTER OCCUPANT INJURIES

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1 2	Abrasions, minor, and contusion (hematoma) on right posterior (back of) scalp, not further specified	110202.1 110402.1	Other interior loose object: wooden board from baby bed[7]	Probable
3 4	Abrasion and contusion (hematoma), 25 cm (9.8 in) circular area, on right forehead, not further specified	210202.1 210402.1	Other interior loose object: wooden board from baby bed	Probable
5 6 7	Abrasions (petechial hemorrhage) over all face, bilateral neck, and chest, not further specified	210202.1 310202.1 410202.1	Noncontact injury: flying glass, unknown source	Probable
8 9	Abrasion and contusion right anterior shoulder, not further specified	710202.1 710402.1	Child restraint system's harness straps	Certain

Sources: Emergency room records (initial and "transferred to") and EMS treatment records. Injury Number 9 came only from emergency room records. Injury Numbers 1 to 8 came from a combination of EMS treatment and emergency room records.

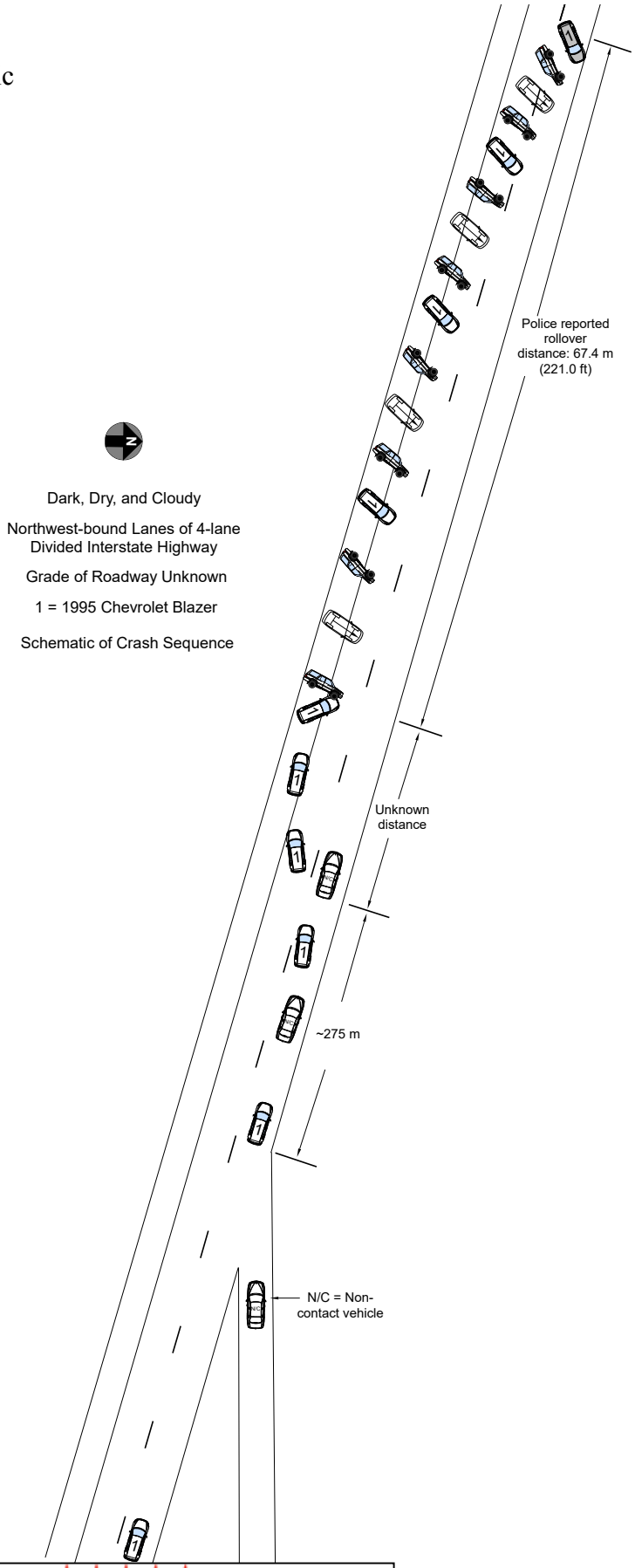
SECOND ROW CENTER OCCUPANT KINEMATICS

The second row right occupant was likely restrained in an unknown make/model forward-facing CRS. The second row right occupant was likely displaced to the right in the CRS when the driver

[7] Medical records report that passersby heard a baby crying and removed patient from vehicle, which was on fire. Passersby reported that a wooden board from a baby bed was found near the patient's head covering the patient.

steered left and the vehicle rotated counterclockwise and decelerated. He was then probably redirected to the left when the driver steered right and the vehicle rotated clockwise and decelerated. The occupant was then likely displaced in multiple directions in the CRS during the rollover and was probably struck in the head by a loose piece of cargo (wooden board from a baby bed according to the medical records), which caused abrasions and contusions to his posterior scalp and right forehead. Loading the CRS harness straps caused an abrasion and contusion to his right shoulder. The occupant also sustained abrasions to the face, neck and chest, probably from flying glass fragments. Passersby removed the occupant from the vehicle following the crash. He was transported by ambulance to a hospital where he was treated in the emergency room and then transferred by helicopter to a second hospital where he was treated in the emergency room and released.

Crash Schematic



Dark, Dry, and Cloudy

Northwest-bound Lanes of 4-lane Divided Interstate Highway

Grade of Roadway Unknown

1 = 1995 Chevrolet Blazer

Schematic of Crash Sequence

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