CRASH DATA RESEARCH CENTER
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CALSPAN ON-SITE MOTORCOACH FIRE INVESTIGATION

SCI CASE NO.: CA10019

VEHICLE: 2005 MOTOR COACH INDUSTRIES (MCI) MODEL J4500

LOCATION: LOUISIANA

INCIDENT DATE: MAY 2010

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation
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Washington, D.C. 20590

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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 are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order 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 vehicle(s) or their safety system.

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16. Abstract This on-site investigation focused on the origin and severity of a fire that consumed a 2005 Motor Coach Industries (MCI) Model J4500 motorcoach. The vehicle was in-transit, occupied by a 63-year-old male driver and 32 passengers consisting of 26 middle school students and six adult chaperones. The motorcoach was traveling westbound on an interstate roadway and was traversing a high-elevation bridge when an adult passenger heard a loud noise and alerted the driver. The driver stated that he detected a wobble in the right tag axle tire in his right outside mirror. The driver continued for a distance of approximately 0.8 km (0.5 mi) in an attempt to travel over the bridge as there was no safe area to stop the motorcoach. The passengers then detected an odor of smoke. The driver observed smoke in his right outside mirror emanating from the right rear area of the motorcoach. He slowed the vehicle and brought the motorcoach to a controlled stop in the right lane near the high point of the bridge and evacuated all passengers. An adult passenger retrieved the fire extinguisher from the second row right seat area and attempted to suppress the fire without success. A cellular call was placed to the emergency response system to request police and fire department assistance. The motorcoach was completely engulfed in fire prior to the arrival of the fire department. Following their arrival, the firefighters extinguished the fire; however, the fire damage to the bus was extensive**.** There were no injuries associated with this incident. The fire also consumed the majority of all luggage and personal items onboard the motorcoach.			
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BACKGROUND

Figure 1. Left side view of involved motorcoach.

This on-site investigation focused on the origin and severity of a fire that consumed a 2005 Motor Coach Industries (MCI) Model J4500 motorcoach. The vehicle was in-transit, occupied by a 63-year-old male driver and 32 passengers consisting of 26 middle school students and six adult chaperones. The motorcoach was traveling westbound on an interstate roadway and was traversing a high-elevation bridge when an adult passenger heard a loud noise and alerted the driver. The driver stated that he detected a wobble in the right tag axle tire in his right outside mirror. The driver continued for a distance of approximately 0.8 km (0.5 mi) in an attempt to travel over the bridge as there was no safe area to stop the motorcoach. The passengers detected an odor of smoke. The driver observed smoke in his right outside mirror emanating from the right rear area of the motorcoach. He slowed the vehicle and brought the motorcoach to a controlled stop in the right lane near the high point of the bridge and evacuated all passengers. An adult passenger retrieved the fire extinguisher from the second row right seat area and attempted to suppress the fire without success. A cellular call was placed to the emergency response system to request police and fire department assistance. The motorcoach was completely engulfed in fire prior to the arrival of the fire department. Following their arrival, the firefighters extinguished the fire; however, the fire damage to the bus was extensive (**Figure 1).** There were no injuries associated with this incident. The fire also consumed the majority of all luggage and personal items onboard the motorcoach.

Notification of this incident was provided to the Calspan Special Crash Investigations (SCI) team by the Crash Investigations Division (CID) of the National Highway Traffic Safety Administration (NHTSA) on May 12, 2010. The SCI team initiated telephone contact with a staff member of the Federal Motor Carrier Safety Administration (FMCSA) to obtain contact information for the motorcoach company. The Safety Director of the motorcoach company was contacted by the SCI team and cooperation was obtained to inspect the motorcoach and interview the driver. The motorcoach was inspected at the tow facility prior to recycling as it was a total loss. A fire expert reviewed the digital images and the SCI data for this investigation. His review and opinion report relating to fire origin and cause is included as *Attachment A* of this report.

SUMMARY

Incident Scene

This incident occurred on a 3 km (2 mi) long, two-lane, asphalt surfaced interstate bridge that extended over a large waterway. In the motorcoach's direction of travel, the bridge initially extended in a westerly direction, elevated and curved right to the north-northwest direction before straightening out at its crest. The high-elevation bridge then remained straight on its down slope as it transitioned to level ground. The travel lanes were bordered by narrow asphalt shoulders and a concrete bridge rail. At the time of the incident, a construction work zone was established at the beginning of the bridge with concrete barriers reducing the approach to a single lane. The work zone ended at the beginning of the right curve at the base of the bridge. The weather was clear and dry with a temperature of 23.0 degrees C (73.4 degrees F) with a northeasterly wind of 20.4 km/h (12.7 mph) at the time of the incident. The posted speed limit was 89 km/h (55 mph). A schematic of the incident site is included at **Figure 19** on Page 13 of this report.

Figure 2. Westbound approach to the incident site.

Vehicle Data

The motorcoach involved in this incident was a 2005 MCI Model J4500, with a 55-passenger capacity, inclusive of the driver. The motorcoach was identified by the Vehicle Identification Number (VIN): 2M93JMDA15W (production number deleted), and was similar to the exemplar motorcoach shown in **Figure 3**. The motorcoach company reported that the motorcoach was purchased and placed in service on December 9, 2004. The actual mileage is unknown, and no reading could be obtained during the SCI inspection as all components had been consumed by the fire.

Figure 3. Right front oblique view of an exemplar motorcoach.

Figure 4. Exemplar SmarTire installation

The motorcoach was equipped with the SmarTire system, which was installed prior to the vehicle being placed in service in December 2004. An exemplar SmarTire system display is depicted in **Figure 4**. This SmarTire system consisted of a Tire Pressure Monitoring System (TPMS) with digital readout on a Wireless Gateway receiver. A stainless steel band clamp with attached sensor was mounted around each wheel inside the tire. Each TPMS sensor continuously monitored the air pressure and temperature inside the tire and transmitted to the receiver, giving the driver access to a digital readout of current conditions. The system was designed to alert the driver of a change in tire pressure or temperature. The receiver was mounted aft of the left A-pillar outboard of the driver's position. The display was mounted to the instrument panel left of the steering column. Both components were destroyed by the fire.

Exterior

The motorcoach was a monocoque body/frame design. The front, side, and rear body panels were of constructed of stainless steel and fiberglass composite, with trim and fascia consisting of plastic, aluminum, and rubber components. The frame encompassing the passenger compartment was constructed of 5 cm (2 in) square stock. From the belt line to the floor of the passenger compartment, the frame was reinforced with 45 degree gussets. The frame structure of the roof consisted of continuous roof bows that extended from floor-to-floor with longitudinal members in the roof area. Two emergency exits were incorporated into the roof, located at the centerline between the C- and D-pillars and the G- and H-pillars.

The side body panels incorporated three wide compartments for the stowage of luggage within the wheelbase on each side of the motorcoach. There were also several equipment and mechanical maintenance access doors on both sides. A large access door to the engine compartment spanned the rear. A wheelchair access door was located toward the rear corner on the right side, above and aft of the tag axle. The accompanying wheelchair lift stowed directly below access, immediately aft of the tag axle. The battery compartment was also located on the right side, forward of the rear axles and aft of the luggage compartments.

Powertrain

The motorcoach was configured with a rear-mounted diesel engine linked to an Allison automatic transmission. The engine was a Cummins ISM inline 6-cylinder diesel, with a 10.8-liter displacement. This engine was also equipped with a turbocharger. Cooling was achieved by a left rear corner-mounted copper core radiator. There was also an onboard air conditioning system with the condenser mounted forward of the left rear axles. The exhaust system consisted of a single muffler and tailpipe located on the left rear undercarriage.

Undercarriage

The motorcoach was supported by three axles consisting of the front steer axle, the dual-wheel drive axle, and the rear tag axle. As a feature to facilitate passenger access, the right steer axle position was equipped with a kneeling suspension. The total Gross Vehicle Weight Rating (GVWR) of the exemplar motorcoach was 24,494 kg (54,000

lbs). The exemplar motorcoach was also placarded with the following ratings for cold tire pressure of each axle tire and the accompanying Gross Axle Weight Rating (GAWR).

Axle	Cold Tire Pressure	GAWR
Steer (First)	827 kPa (120 psi)	7,485 kg (16,500 lbs)
Drive (Second)	690 kPa (100 psi)	10,432 kg (23,000 lbs)
Tag (Third)	827 kPa (120 psi)	7,485 kg (16,500 lbs)

The fire involved motorcoach was equipped with OEM-style 9.00x22.50 aluminum wheels at all three axle positions. The manufacturer recommended tire size for all eight tires was 315/80R22.5.

Interior

The interior of the motorcoach was configured for the driver and 54 passengers. The driver's seat and the forward controls were conventionally mounted to the left side of the unit and left of the center aisle, directly opposite of the loading door and the curved staircase. The driver's seat was a suspension seat with an integrated head restraint. This seating position was equipped with a 3-point lap and shoulder belt system.

Passenger seating consisted of 14 rows of seats **(Figure 5)**. The forward 13 rows consisted of four seats, laterally offset in groups of two on each side of the center aisle. All seats were of tubular steel construction with foam padding, and covered with a synthetic blend fabric. Each seat was also equipped with a reclining seatback, adjustable head restraint, and a metal foot rest. All seats were configured with outboard and common center armrests. As depicted in **Figure 6**, the back row consisted of only two seats on the left side of the motorcoach, adjacent to a small lavatory. This onboard lavatory was incorporated into the right rear corner of the motorcoach and was constructed of plywood walls. These walls, as well as the ceiling of the motorcoach and other similar areas, were covered with a synthetic carpet material similar to the fabric on the seats.

Figure 5. Exemplar interior

Figure 6. Exemplar rear with lavatory

As seen in the exemplar interior shown in **Figures 5 and 6**, aircraft-style overhead storage compartments extended the length of the ceiling area on both sides of the

motorcoach. The compartments had top-hinged rigid fiberglass doors and were designed to facilitate the storage of carry-on type items and personal belongings. On the underside of these compartments and directly above the passenger seats were courtesy reading lights, accompanied by several staggered video screens for passenger entertainment. A fire extinguisher was located at the second seat on the right side of the motorcoach.

Fuel System

The motorcoach was equipped with a single fuel tank mounted to the undercarriage of the vehicle. The filler tube was located on the right side of the motorcoach, near the midpoint of the wheelbase. At the time of SCI inspection, the cap was intact and in place. A placard declared that the tank was manufactured by MCI in Winnipeg, Canada in December of 2004, and had a rated capacity of 818 liters (222 gallons). The level of Low-Sulfur Diesel fuel in the tank at time of the fire incident was unknown.

Occupant Data

The motorcoach was occupied by the 63-year-old male driver and 32 passengers. The driver was of medium build, with over four years of motorcoach experience with the company. His driving record was clear of previous violations and crashes. The passengers consisted of the 26 male middle school students and the six adult chaperones, strategically positioned throughout the passenger compartment of the motorcoach.

Incident

Pre-Incident

Figure 7. Approach of the motorcoach to the incident site and the right tag axle tire mark.

The motorcoach began its return trip of approximately 1,561 km (970 mi) on the evening prior to this daytime incident. At an average speed of 105 km/h (65 mph), the trip would take approximately 16 hours non-stop. All passengers boarded the motorcoach with small carry-on items and personal belongings, with their larger luggage and musical instruments stowed in the large storage compartments underneath the passenger compartment. After driving approximately 800 km (500 mi) through the night, the motorcoach stopped at a pre-determined location to change drivers. The 63-year-old replacement driver drove the motorcoach approximately 321 km (200 mi) before stopping at a rest/food service area. Following the short duration stop, the driver resumed westbound travel on the interstate roadway. He travelled approximately 206 km (128 mi) and approached the bridge with the construction work zone. The work zone reduced westbound travel to one lane on the approach to the 3 km (2 mi) long high-rise bridge over the waterway. The motorcoach passed through the construction zone and began traveling over the bridge.

While traveling over the bridge, several adult passengers seated toward the rear of the motorcoach were alerted to a loud noise and alerted the driver. The driver detected in his right outside mirror that the right tag axle tire appeared to be wobbling. A dragging tire

mark was present on the outboard travel lane of the asphalt road surface at a location consistent with the position a right side tire **(Figure 7)**. The tire mark extended for an estimated distance of 0.8 km (0.5 mi). The narrow bridge did not have adequate shoulders for the driver to safety stop on the bridge. The driver activated the hazard warning lights and slowed down as he continued to drive with the intent to cross the bridge and safely stop the motorcoach off of the roadway. These actions were in accordance with the motorcoach company's safety procedures. The driver further stated that he did not detect a warning from the SmarTire system.

Incident

The passengers detected the odor of smoke within the motorcoach. The driver observed fire in the right side mirror at the right axle area. The driver slowed the motorcoach to a controlled stop in the right lane beyond the crest of the bridge. The driver ordered the evacuation of the passengers and the adult chaperones aided the driver in safely assisting all child passengers from the vehicle. An adult passenger retrieved the fire extinguisher from the second row right seat area and attempted to extinguish the fire at the right rear area of the motorcoach. Due in part to the location of the motorcoach near the highest point of the bridge and the associated northwesterly crosswinds, this attempt with the 2.2 kg (5.0 lb) ABC extinguisher was unsuccessful. The fire initially involved the right rear axle area, but quickly spread as it was aided by the crosswinds and engulfed the entire motorcoach.

Post-Incident

All passengers safely exited the motorcoach without injury. They were escorted forward of the motorcoach to a safe distance away from the fire. A cellular telephone call was placed to the emergency response system to request police and fire assistance. The local fire department responded to the scene and arrived 22 minutes after the call for assistance and extinguished the fire. It should be noted that the first responders had to approach the incident site in an easterly direction on the westbound travel lanes. For the safety of the passengers, they were transported by multiple vehicles to a local police station. The motorcoach company dispatched a replacement motorcoach to transport the passengers to their final destination. The motorcoach was completely destroyed by the fire and was removed from the scene on a flatbed trailer. Following the SCI inspection, plans were initiated to scrap and recycle the chassis of the motorcoach.

Fire Damage

The entire roof, left side, glazing, undercarriage, floor, and interior of the motorcoach were consumed by the fire. The right front tire and the majority of the right side body panels remained as the only intact portion of the motorcoach. The chassis and the roof structure had heat-related warp and sag, centered near the midpoint of the wheelbase toward the left side. The following describes the motorcoach damage by location.

Front

All frontal components including the windshield glazing, bumper fascia, and painted surfaces were burned by the fire **(Figure 8)**. The upper fiberglass panel above the windshields was burned full-thickness at the center area and had begun to collapse inward. The outer portions remained intact, although the paint had burned off. In the upper right corner, a portion of the identifying motorcoach number remained discernable. Both windshields were completely consumed. The lower portions of the windshield gaskets were charred, but remained in place. All other sections of the gaskets were completed consumed by the fire. The lower 56 cm (22 in) of the extruded aluminum center divider between the two windshields remained intact. The upper aspect of this support was completed melted. All windshield wiper components were melted. The fiberglass paneling below the windshields was charred but intact. The bumper fascia was completely burned. The structural bumper beam remained intact and was soot covered, but void of all paint. The headlamp, turn signal, and marker light assemblies were completely melted. There was no evidence of high heat in the frontal area of the coach.

Figure 8. Frontal view of the MCI motorcoach.

Left Side

The left side of the motorcoach sustained extensive damage with near total consumption of all materials excluding the frame **(Figure 9)**. The majority of the exterior body panels and glazing were completely consumed by the fire. The aluminum window frames and the rubber gaskets were completely consumed. The inner panel of the access door at the lower forward portion of the motorcoach remained intact, located between the lower A and B-pillar. This door provided access to the washer fluid reservoir and the steering system. The outer panel of this door possibly survived the fire; however, it appeared to have been removed by firefighters during the extinguishment of the fire. The compartment located above this access door housed the electrical components and panels for the motorcoach, inclusive of the SmarTire control unit. All wire insulation and non-metallic components in this area were burned.

Figure 9. Left side view of the motorcoach.

Located aft of the steer axle between the wheelbase were three luggage compartments. The doors opened in an upward direction and were framed with tubular steel. Portions of the lower aspect of the fiberglass panel of the forward door remained. The lower half of the door to the second compartment was in a similar condition to the forward door, and the majority of the third door was completely consumed. All of the luggage and

equipment stowed in the center and rear compartments was destroyed. The contents of the forward compartment had been removed.

The air conditioning condenser and its two electric fans were located forward of the left drive axle. The door to this compartment had completely burned away, and the unit itself sustained extensive damage. The composite blades on both fans burned. The copper core to the condenser was intact, but the condenser had dropped out of its mounts. Most of the cooling fins on the core were consumed by the fire.

In the area aft of the tag axle were two radiators for the motorcoach's cooling system. The forward radiator was constructed of copper and was nearly completely disintegrated. The second radiator, located aft of the previously mentioned, was aluminum. This radiator was completely melted by the fire. The cooling fan for these radiators consisted of a shaft driven unit. The gear boxes and drive shaft for the cooling fan unit was charred but intact. The composite fan blades were totally disintegrated. The external louvered door concealing the radiators was completely consumed.

Back

All of the back mounted components were completely burned by the fire **(Figure 10)**. The composite rear bumper fascia was completely consumed as were all taillight and marker light assemblies. The engine compartment door was fiberglass with a steel frame that was top hinged. The external panel was totally consumed and the door framework was in the open position at the time of the SCI inspection. The upper fiberglass panels above the engine compartment were completely burned with exposure of the structural frame of the motorcoach. This framework was minimally distorted by heat; however, there was no evidence of high heat oxidation.

Figure 10. Back plane of the motorcoach.

Engine Compartment

Within the engine compartment, all belts, hoses, wires, connectors, insulation, and other combustible material were completely consumed by the fire. The fiberglass valve cover was charred and burned through at several locations. The majority of the aluminum components were burned and melted. The mounts to the lower of two alternators had melted and separated. The turbocharger was intact and displayed no evidence of high heat, and the exhaust pipe to the muffler was intact and in place. A normal amount of soot was present inside the exhaust tailpipe. Some paint residue remained on the air intake cover over the engine. **Figure 11** is an overall view of the engine compartment.

Figure 11. Overall view of the engine compartment.

Right Side

The right side of the motorcoach sustained extensive damage above the level of the beltline. The body panels below the beltline remained intact with scattered charring and blistering of the painted surfaces **(Figure 12)**. The body panel at the location of the right E-pillar was bowed as a result of partial separation due to heat. All of the glazing panels melted with glass fragments remaining at the corners. The aluminum window frames were predominately intact with scattered melting and distortion of the material. The wheelchair access door to the passenger compartment was completely consumed by the fire. The panel covering the wheelchair lift, that was located below floor level, remained intact. The upper aspect had been broken away by the firefighters during the extinguishment activities. The fiberglass fairing and spray shields above the right rear axle positions were consumed by the fire.

Figure 12. Right side view of the motorcoach.

The door that concealed the fuel filler/tank burned with melted fiberglass and aluminum located at the base of the opening. The batteries and all of the associated connectors and wires were consumed by the fire. The master cutoff switch remained in the On-position.

The fiberglass panels on the two rearward luggage compartment doors had separated from the top of the frames. Though the frames of both doors were closed, the latches at the bottom released. The third and forward luggage compartment door was intact, closed, and operational. The paint on this door was intact with slight scorching on its aft edge.

All body panels surrounding the right side of steer axle were intact up to the level of the beltline. The right front entrance door was burned, but intact. Both glazing panels were melted by the fire. This door was presumed to have been open during the fire following the evacuation of the passengers.

Roof

The exterior roof of the motorcoach was constructed of aluminum panels with overlap riveted joints at each pillar location. The fire consumed the entire roof, exposing the steel framework. The intensity of the fire warped the lateral roof bows and the longitudinal supports. The most notable damage to the lateral bows occurred between the C- and H-pillars. Extensive deflection of the longitudinal supports was most prevalent between the F- and G-pillars, the area over the rear axle locations **(Figure 13)**. The two plastic emergency roof exits were completely burned.

Figure 13. Heat deformation to the lateral and longitudinal roof structure.

Tires / Wheels

The motorcoach was configured with radial tires mounted on aluminum wheels at the eight positions. Of the eight tires, six were completely consumed by the fire and were considered to be a large fuel source for the fire. The right steer axle tire was the only tire that remained undamaged. This tire was a Firestone FS400, size 315/80R22.5 with the following Tire Identification Number (TIN): 4D4D 6SH 4309. The tread and sidewall surfaces of the left steer axle tire were charred; however, the tire maintained air pressure. The tire identifiers were burned beyond recognition. Service records showed that all three left rear tires (two drive and one tag) were replaced in April 2010. Specific tire data, including tire pressure, tire tread depth, and visible damage documented at the time of the SCI inspection, was as follows:

Position	Pressure	Tread	Damage
Left Steer	Unknown	8 mm (10/32 in)	Sidewall burned and cracked, valve cap melted, all identifying markings gone
Right Steer	Unknown	13 mm (16/32 in)	None
Left Drive Inboard	Unknown	Unknown	Fully consumed by fire
Left Drive Outboard	Unknown	Unknown	Fully consumed by fire
Right Drive Inboard	Unknown	Unknown	Fully consumed by fire
Right Drive Outboard	Unknown	Unknown	Fully consumed by fire
Left Tag	Unknown	Unknown	Fully consumed by fire
Right Tag	Unknown	Unknown	Fully consumed by fire

The OEM-style aluminum wheels were equipped with a stainless steel trim ring at the bolt pattern and lug nut caps. The left front wheel was blackened by soot; however, the trim ring and lug caps remained intact. The right front wheel was not damaged.

Figure 14. Tire and wheel remains at the left rear axle positions.

Figure 15. Remaining tire and wheel material at the right rear axle positions.

The outer left drive axle wheel was burned/melted with the bolt pattern area remaining intact. The molten aluminum cooled to a puddle at the bottom aspect of the wheel. Fragments of the tire remained at the bottom of the tread. The inner aluminum wheel at the left drive axle position was completely melted. The inboard left drive axle tire was completely consumed by the fire with the wire bead and steel tread ply remaining. The left tag axle wheel was melted with a minimal amount of wheel reaming at the lower bolt

pattern area. The tire was completely burned with the wire reinforcements remaining at the axle position. **Figure 14** is an overall view of the left rear tires and wheels.

At the right drive axle outboard position, the outboard aluminum wheel was burned through at the 7-9 o'clock position, outboard of the hub. The inner aspect of the wheel was consumed by the fire. The outer sidewall of the outboard right drive tire was burned; however, the bead area was partially intact on the remaining wheel. Fragments of the tire tread remained at the 6 o'clock position. The majority of the inner right drive axle wheel was consumed by the fire with a minimal amount of the wheel remaining at the upper outboard bead area. The inner tire was completely burned. The hubometer was affixed to the right drive axle. The steel housing survived the fire, but the face and odometer reading were destroyed.

The majority of the right tag axle tire was consumed by the fire. The rubber bead area remained at the outer aspect at the 3-5 o'clock position. The inboard aspect of the right tag axle wheel was completely burned. The outer profile of the wheel was intact with melting of the wheel at the 6 o'clock position as viewed at the time of the inspection. **Figure 15** is a view of the right rear tires and wheels.

Undercarriage

The motorcoach was resting on the undercarriage at the tow facility due to the loss of the tires, wheels and air suspension in the fire. Therefore, the undercarriage inspection was limited to the area surrounding the rear axles. There was no means to lift the vehicle to facilitate a more thorough inspection.

The sheet metal panels that were located forward, above, and aft of the tag axle remained intact, thus limiting the spread of the fire through these surfaces. The structural frame of the motorcoach in this area exhibited typical post-fire rusting without specific areas of high heat. All rubber components of the undercarriage were consumed by the fire. These included the air suspension bladders, the shock absorber bushings, the air brake chamber diaphragms, and the plumbing and electrical connectors that were routed through this area. Both the left drive and left tag disc brake rotors exhibited a bluish color associated with heat generated by the fire. The accompanying calipers and brake pads were still in place.

Interior

The fire spread to the interior of the motorcoach and consumed all combustible materials and components **(Figure 16)**. The aircraft-style overhead storage compartments and components were completely burned. The ceiling of the motorcoach was consumed and the plywood floor was completely burned. The seat cushions, fabric and composite armrests were burned. The tubular seat frames remained with all falling rearward as the recline mechanisms released due

Figure 16. Overall view of the burned interior of the motorcoach.

to fire damage. The most extensive damage to the seat frames was noted in the area of the drive axle at rows 10-11 on the right and rows 9-12 on the left side.

SmarTire System

The SmarTire Wireless Gateway receiver was found severely burned among the remnants within the left front electrical panel outboard of the driver's position. The receiver is highlighted in **Figure 17**. The electrical connections remained intact to the receiver, though the unit was burned with probable destruction of the internal circuit board.

The stainless steel band clamps that retained the sensors in the rear wheels were located at the five of the six wheel positions. The left outboard drive wheel band clamp was found within the remnants of the wheel and tire, though much of it had been consumed and the remainder was bluish in color. No remnants of the left inboard drive wheel band clamp or sensor could be found. Similarly, only a small section of the left tag band clamp remained within the remnants of the wheel and tire.

Figure 17. Remnants of the SmarTire receiver

On the right drive axle, both the inboard and outboard drive band clamps were still present, with markings on the outboard wheel indicating the location where it was mounted. Also, the band clamp from the tag axle was found among the tire and wheel remnants.

SCI Fire Source

The dragging tire mark at the scene extended for an estimated distance of 0.8 km (0.5 miles) and terminated at the burn pattern on the road surface that was the point of rest for the motorcoach. The location of the tire mark on the road surface was consistent with the position of the right tag axle tire.

Figure 18. Right tag axle wheel, tire remnants, and the adjacent undercarriage.

The dragging right tag axle tire self-combusted due to increased friction against the road surface. The remote location of the motorcoach prevented disassembly and a thorough inspection of the wheel end to determine if wheel bearing and/or brakes contributed to the dragging tire. Once the fire was detected and the driver slowed the motorcoach to a stop at the high-point of the bridge, the wind aided the fire as it spread to the left side of the motorcoach and forward. The fire burned through the plywood floor forward of the rear axles and entered the interior of the motorcoach. The opened right front door provided venting, drawing the fire forward into the passenger compartment. The wind, directing the fire left, prevented the right side of the motorcoach from becoming totally involved. **Figure 18** is an overall view of the right tag axle tire and wheel.

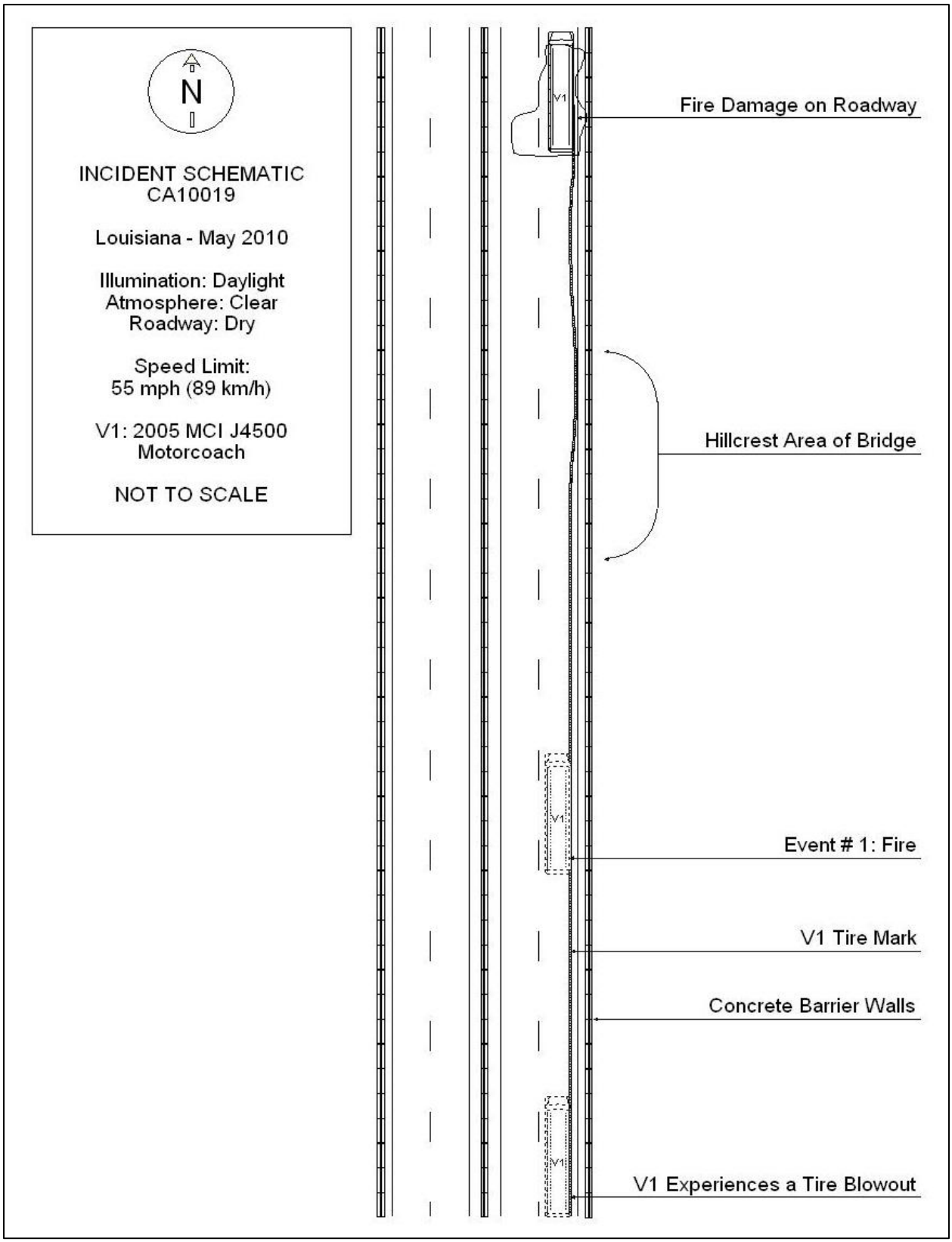

Figure 19. Incident Schematic

ATTACHMENT A:

FIRE EXPERT'S REVIEW AND OPINION REPORT

Independent review and subsequent opinion by a fire origin and cause investigator:
It should be noted that this investigator was not directly involved with the vehicle fire or scene inspections, but rather depended on the photographs and documentations collected by the Calspan SCI team. Whereas this is not the optimal process when conducting an origin and cause investigation, the option of reviewing previous documentation is acceptable methodology according to NFPA 921, "Guide for Fire and Explosion Investigations" (2008 edition), and is adequate for the subject investigations given the scope and purpose of these evaluations.

For each case, photographs and documents were reviewed initially to determine an area or point of origin for the fire. Then this area was analyzed to determine a most probable cause. The area of origin was determined by an interpretation of the fire patterns left by the fire and supporting witness information. Interpreting fire patterns involves assessing the different amounts of damage to the various components involved taking into consideration the progression of the fire which is determined by the various fuel loads involved, the physical properties of the various materials, environmental effects, and the dynamics of the fire itself.

SCI Case Number CA10019

Determination of Origin: The first witnesses to this incident were several passengers at the rear of the coach that reported hearing a loud noise, and verified by the driver who reported seeing a "wobble" in the right tag axle tire. Passengers then detected the odor of smoke and the driver also reported fire visible in his right side mirror. One of the chaperones also tried to extinguish the fire at the right rear of the vehicle. Examination of the exterior of the vehicle shows the coach to be almost completely consumed with the most amount of damage on the left rear side. Since there are multiple witness accounts that the fire started on the right side of the coach, the greatest amount of damage observed is not indicative of the origin, but rather due to the progression of the fire as aided by wind. In addition, the scene also shows a right side rear tire mark extending an estimated half mile. This tire mark agrees with the witness accounts. The area of origin is therefore determined to be at the right rear tag axle wheel end.

Determination of Cause: The cause of this fire is consistent with a tire fire in the right rear tag axle. The root cause of the tire fire cannot be determined as the wheel end was not disassembled and the brakes, wheel seals, and bearings were not inspected.