**CRASH DATA RESEARCH CENTER**

Calspan Corporation
Buffalo, NY 14225

# CALSPAN ON-SITE MOTORCOACH FIRE INVESTIGATION
**SCI CASE NO.: CA09030**

**VEHICLE: 1995 MOTOR COACH INDUSTRIES (MCI)**
**MODEL: 102-D3**

**LOCATION: PENNSYLVANIA**

**INCIDENT DATE: ARPIL 2009**

Contract No. DTNH22-07-C-00043

Prepared for:

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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 systems.

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## BACKGROUND

This on-site investigation focused on the origin of a fire that consumed an in-transit motorcoach **(Figure 1)** that was occupied by a 46-year old male driver and 46 passengers consisting of 33 females, ages 5-16 years of age and 13 adult chaperones, ages unknown. The fire was determined to have originated in the turbocharger of the rear-mounted diesel engine. The driver of the motorcoach brought the vehicle to a controlled stop on the shoulder of an interstate roadway. The motorcoach was completely destroyed by the fire. All occupants safely exited the motorcoach without injury.

**Figure 1. Front left view of the involved motorcoach.**

The notification of the motorcoach fire was provided by the National Highway Traffic Safety Administration (NHTSA) to the Calspan Special Crash Investigation's (SCI) team on April 30, 2009. Contact with the motorcoach company was initiated and cooperation was gained to conduct an on-site inspection of the motorcoach. The motorcoach was transferred from the initial tow yard to the motorcoach company's facility, a distance of approximately 225 km (140 miles), where it was inspected for this investigation. A fire consultant traveled to the location of the bus and provided fire origin expertise. The inspection was conducted on May 20, 2009. Since there were no injuries associated with this event, occupant data is not included in the Electronic Data System (EDS).

## SUMMARY

### *Incident Site*

This fire incident occurred on an interstate roadway during morning daylight hours. At the time of the incident, the conditions were clear, the temperature was approximately 13 degrees C (56 degrees F) with 75 percent humidity, and the winds were calm. In the vicinity of this incident, the eastbound lanes of the interstate consisted of three concrete surfaced travel lanes with concrete shoulders located immediately adjacent to the travel lanes. The inboard shoulder was bordered by a W-beam guardrail that protected traffic from the natural landscape of the median. The

**Figure 2. Eastbound view of the incident site.**

outboard concrete shoulder was 3.2 m (10.5 ft) in width with a 1.4 m (4.6 ft) asphalt shoulder located outboard of the concrete. A concrete Jersey barrier was located 1.6 m (5.2 ft) outboard of the asphalt shoulder. The overall approach to the incident site consisted of a shallow right curve for the eastbound travel direction with a positive grade of approximately 2-3 percent. The posted speed limit was 105 km/h (65 mph). **Figure 2** is an eastbound view of the incident site. A schematic of the incident site is included as **Figure 18** of this report.

This incident occurred in an active work zone. The outboard travel lane was closed by the placement of plastic traffic barrels that directed traffic flow to the center and inboard lanes. The work zone involved resurfacing of the roadway east of this site. The speed limit in the work zone was reduced to 89 km/h (55 mph). This work zone was still active at the time of the SCI scene inspection.

### *Motorcoach*

#### *Exterior*

The motorcoach involved in this fire related incident was a 1995 MCI, Model 102-D3 with a 47-passenger capacity (exclusive of the driver). The vehicle was manufactured in December 1994 and was identified by Vehicle Identification Number (VIN) 1M8SDMPA3SP (production number deleted). The motorcoach company service records indicated that this vehicle had accumulated approximately 1,548,000 km (962,000 miles).

The motorcoach was a monocoque design with three axles consisting of a front steer axle, a dual-wheel drive axle, and a rear tag axle. The front, side and rear body panels were constructed of sheet metal with rubber and aluminum trim. The front bumper system was comprised of a steel reinforcement beam that was concealed by a rubber fascia. The bumper system was hinged and opened in a downward direction. The spare tire was positioned horizontally behind the front bumper, under the front floor of the motorcoach.

The side body panels incorporated numerous compartments for the stowage of luggage within the wheelbase with access doors to the sides of the engine compartment. The rear of the motorcoach consisted of two center closing doors that provided access to the engine compartment.

#### *Driveline / Service Brakes / Fluids*

The motorcoach was configured with a rear-mounted diesel engine linked to an Allison automatic transmission. The service brakes were air activated drum brakes with DD-3 brake actuators and automatic slack adjusters.

The rear-mounted diesel engine was a Detroit Diesel Series 60 inline six-cylinder with a displacement of 12.7 liters. The engine was equipped with a turbocharger that was mounted on the left (driver's) side of the motorcoach. The oil capacity of the engine (with filters) was listed in a service manual at 36 liters (38 qts). Cooling of the engine was achieved by a rear-mounted copper core radiator that was mounted above and to the right of the engine. The cooling system capacity was 132 liters (140 qts). The onboard

air conditioning system utilized an aluminum condenser that was mounted to the left of the radiator. Both units were fan cooled by individually clutched, thermostatically controlled fans that were driven by a belt off the engine power takeoff. These fans were designed to engage at an engine operating temperature of 92 degrees C (197 degrees F).

The exhaust system utilized a single muffler that was mounted horizontally on the left undercarriage of the motorcoach.

***Tires/Wheels***

The motorcoach was equipped with OEM-style steel wheels at the three axle positions and fitted with Firestone FS400 tires, size 315/80R22.5. The front steer axle tires were identified by Tire Identification Number (TIN) 4D4D 35H 3108. The vehicle manufacturer placard identified the recommended tire size of 12.75 x 22.5 tires. Based on the size of the installed tires, the motorcoach company opted to install larger capacity tires than originally recommended (per placard) by the vehicle manufacturer. The recommended cold tire pressures for the three axles were as follows:

Steer Axle (First) – 724 kPa (105 PSI)
Drive Axle (Second) – 586 kPa (85 PSI)
Tag Axle (Third) – 517 kPa (75 PSI)

The specific tire data documented at the time of the SCI inspection was as follows:

| Position | Measured Pressure | Measured Tread Depth | Damage |
|---|---|---|---|
| Left Front | 714 kPa (103.5 PSI) | 12 mm (15/32”) | None |
| Right Front | 707 kPa (102.5 PSI) | 12 mm (15/32”) | None |
| Left Drive Inboard | Flat | 9 mm (11/32”) | Sidewall burned full thickness |
| Left Drive Outboard | Flat | 12 mm (15/32”) | Sidewall burned full thickness |
| Right Drive Inboard | Unknown | 12 mm (15/32”) | Upper half of sidewall and tread burned, tire inflated |
| Right Drive Outboard | Unknown | 11 mm (14/32”) | Upper half of sidewall and tread burned, tire inflated |
| Left Tag | Flat | 6 mm (7/32”) | Upper half of sidewall was burned full thickness |
| Right Tag | Flat | 6 mm (7/32”) | Upper half of sidewall burned full thickness |

The total Gross Vehicle Weight Rating (GVWR) for this motorcoach was 20,140 kg (44,400 lb). The GVWR ratings at the specific axles were as follows:

Steer axle – 6,532 kg (14,400 lb)
Drive Axle – 10,206 kg (22,500)
Tag Axle – 4,536 kg (10,000 lb)

***Interior***

The interior of the motorcoach was configured for the driver and 47-passengers. The driver's seat and the forward controls were conventionally mounted on the left side of the unit and left of the center aisle, directly opposite of the loading door and the staircase. The driver's seat was mounted on a pneumatic base and was a high-back seat with an integral head restraint. A 3-point lap and shoulder belt system was available and was used by the driver (per interview) at the time of the incident. **Figures 3 and 4** are forward views of the interior of an exemplar motorcoach.

The passenger area of the motorcoach was configured with eleven rows of seats on each side of the center aisle. Each row consisted of two seats with reclining seat backs on each side of the aisle. The seat backs were equipped with padded adjustable head restraints. The rows were offset laterally left to right. An on-board rest room was incorporated into the right rear corner of the passenger compartment and was constructed of plywood walls covered with a carpet material. A three-passenger bench seat was positioned adjacent to the restroom at the end of the center aisle. These seats did not recline as they were positioned against the back wall of the motorcoach.

**Figure 3. Forward view of the interior of an exemplar motorcoach.**

**Figure 4. Interior view of an exemplar motorcoach.**

The seats were constructed of tubular steel frames with foam padding on the cushions and seatbacks. A synthetic blend fabric covered all surfaces of the seats and head restraints. Each seat was equipped with an outboard mounted armrest. The sides of the armrest were clad with a rigid vinyl covering. The top of the armrest was a plastic/vinyl material.

Overhead storage was available on both sides of the motorcoach and consisted of an aircraft-type storage system with top-hinged rigid plastic doors that extended inboard of the roof side rails to facilitate storage of carry-on items (i.e., backpacks, etc.). Reading lights were incorporated into the bottom of the overhead compartments. Video monitors were also mounted to the bottom of the overhead compartments that were used for passenger entertainment. The ceiling of the motorcoach was covered with the same fabric as the seat surfaces.

### *Fuel System*

The motorcoach was configured with a single fuel tank that was mounted to the undercarriage of the vehicle. The filler tube was located on the right side of the motorcoach at the approximate midpoint of the wheelbase. The filler cap was in-place, secure and undamaged at the time of the SCI inspection. The fuel tank had a rated fuel capacity of 727 liters (192 gallons). It was placarded with the following Note: "Section 393.67 of Motor Carrier Safety Regulations requires that this tank not contain more-than 689 liters (182 gallons)." The level of fuel at the time of this fire was unknown; however, the tank was filled at the on-set of this trip. The motorcoach operated on Low-Sulfur Diesel (LSD) fuel.

### *Motorcoach Maintenance*

A representative of the motorcoach operating company stated that the Detroit Diesel engine underwent a major overhaul approximately one-year prior to this incident. The recent service history of this motorcoach provided by the company is summarized in the following table:

| Date | Work Performed | Reported Odometer Reading* |
|---|---|---|
| 1/25/09 | Replaced side marker light bulbs | 93,380 km (58,025 miles) |
| 2/24/09 | Oil change, replaced oil and air filters, greased chassis, replaced instrument panel light, replaced fuel filter, repaired speedometer, adjusted brakes | 97,351 km (60,493 miles) |
| 3/5/09 | Replaced two reading light bulbs and one fluorescent tube | 99,662 km (61,929 miles) |
| 3/20/09 | Brake adjustment | 101,323 km (62,961 miles) |
| 3/26/09 | Replaced wire ends and light bulb socket | 103,052 km (64,035 miles) |
| 3/27/09 | Replaced door hinge bolt | 103,053 km (64,036 miles) |
| 3/30/09 | Changed differential oil (34 liters) | 103,980 km (64,612 miles) |

** The instrument panel-mounted speedometer/odometer unit was replaced as a service repair. The total mileage of this motorcoach was approximately 1,548,000 km (962,000 miles).*

### *Driver/Passenger Data*

The driver of the motorcoach was a 46-year-old male with a stated height of 178 cm (70 in) and weight of 104 kg (220 lb). He wore prescription eyeglasses and stated that he was restrained by the manual safety belt system. He obtained his Commercial Driver's License (CDL) in 2002 and was employed as a part-time driver for this company since that time. The driver received all company sponsored safety and driver-related training.

The motorcoach was occupied by the 33 school-age female passengers (ages 5-16 years of age) and the 13 adult chaperones. The adult Group Leader was seated in the first row right inboard seat, adjacent and to the right of the driver. The remainder of the adult chaperones were seated throughout the motorcoach.

### *Incident*

#### *Pre-Incident*

The driver of the motorcoach departed the bus facility during the morning hours on the day of this incident and traveled approximately 97 km (60 miles) to pickup the tour group for a day trip. All passengers boarded the bus with a small carry-on with most of these carry-ons placed in the overhead storage compartments.

The motorcoach departed the pickup point and the driver traveled in a northeasterly direction on the interstate roadway for a distance of approximately 137 km (85 miles). The average travel speed of the motorcoach was approximately 105 km/h (65 mph) over this distance. The tour group requested a stop at a fast-food restaurant and the driver exited the interstate and parked the motorcoach at a fast-food restaurant that was accessible to large vehicles. The driver stated during the interview that this stop was approximately one-hour in duration. He further stated that several of the passengers remained onboard the motorcoach during this stop and left the vehicle idling for this period of time.

The driver departed the fast-food restaurant and reentered the eastbound travel lanes of the interstate. As he was accelerating up to speed on the on-ramp, another motorcoach from the same company passed the involved coach en route to the same destination. These motorcoaches were not traveling together; it was a coincidence that they traveled together for the next 24 km (15 miles).

The drivers entered the construction zone and apparently slowed to the posted speed of 89 km/h (55 mph). The area leading up to this point involved positive and negative grades of 2-3 percent with left and right curves. This area of the interstate was not a challenging section of roadway for large vehicles.

#### *Incident*

While en route to his destination, the driver of the involved motorcoach detected an audible low air pressure warning alarm in conjunction with a flashing indicator light on the instrument panel. He checked the air pressure gauge and noted that the pressure was in the normal operating range of 827 kPa (120 PSI). This driver radioed the driver of the other motorcoach and reported the low air pressure warnings. (The other motorcoach driver was also a mechanic for the company.) The other driver checked his rearview mirrors and reported back to the driver that he saw flames coming from the rear undercarriage of the motorcoach and advised the driver to pull over and instruct all passengers to exit the motorcoach. The driver checked his left outside mirror and detected smoke coming from the rear of his vehicle.

The driver applied the brakes and steered the vehicle through the construction barriers, onto the outboard shoulder of the interstate. He stated that the vehicle's diesel engine continued to run as the low air pressure warning was initiated. The motorcoach maintained power through his steering maneuver to exit the travel lane. The driver further noted that the engine may have stalled as he brought the motorcoach to a controlled stop.

As he was maneuvering the vehicle to a stop, the tour Group Leader asked the driver if there was a problem. He stated that they had to get everyone off the motorcoach as the vehicle was on fire. The driver unbuckled his safety belt and announced over the onboard public address system that everyone needed to exit the motorcoach immediately and for the passengers to leave their carry-on luggage on the motorcoach. The driver exited his seat and stood at the front of the vehicle to ensure a rapid and safe egress of the passengers through the front right door. During the exit process, the driver stated approximately ten passengers were lagging behind from the back of the motorcoach. He encouraged these passengers to hurry up and exit the vehicle.

Following the safe egress of the passengers, the driver opened the front roof emergency exit as he noted smoke seeping into the back of the motorcoach. He walked to the back of the motorcoach to conduct a final check to ensure that all passengers exited the vehicle. He attempted to open the rear roof emergency exit, but the smoke was too thick. The driver walked to the front of the motorcoach, retrieved the onboard ABC 1.1 kg (2.5 lb) fire extinguisher that was mounted behind the driver's seat and exited the motorcoach, leaving the door in the open position. He called the 9-1-1 emergency response system and attempted to provide the exact location of the incident to the operator.

The other motorcoach driver stopped his vehicle forward of the involved motorcoach, exited the vehicle and attempted to extinguish the fire with his onboard extinguisher. He sprayed the left rear corner area of the motorcoach, exhausting the entire contents of the dry-powder extinguisher without affecting the fire. The driver of the involved motorcoach met the other driver at the back left corner of the vehicle. His intention was to open the rear engine compartment doors and spray the engine compartment. At this point, the heat and fire were too intense for the driver to get close to the burning vehicle. He sprayed his extinquisher on the corner of the vehicle without suppressing the fire.

The driver stated that all passengers were safely positioned away from moving traffic and away from the motorcoach as they waited for the fire department to arrive on-scene. The driver reported that the firefighters arrived on-scene approximately 26 minutes following his call to the 9-1-1 system.

The fire spread and consumed the interior of the motorcoach. The firefighters used water to extinguish the fire.

***Post-Incident***

The passengers decided to cancel the continuation of their trip and another motorcoach was hired to transport the group back to their original starting point. None of the passengers were injured as a result of this incident.

The motorcoach was towed from the scene to a local tow yard. A representative of the insurance company inspected the motorcoach and deemed the vehicle a total loss. The company re-purchased the motorcoach from the insurance company and hired a tow service to transport the motorcoach back to their repair facility where it was held for this SCI investigation.

### *Fire Damage*

#### *Exterior*

The motorcoach sustained major fire-related damage that was confined to the rear third exterior of the vehicle and consumed the majority of the passenger compartment.

#### *Front*

Frontal damage was limited to heat-related cracking of the upper windshields with heavy smoke build-up on the upper interior surfaces of the glazing. The Plexiglas sunshade located above the windshield remained intact, but was deformed by the heat of the fire.

#### *Left Side*

The fire damage to the left side body of the motorcoach extended from the back left corner to the forward aspect of the rear axle positions. The engine compartment door at the left rear lower side of the vehicle displayed evidence of high heat oxidation on the forward upper quadrant. The paint and primer were burned from the sheet metal and the aluminum rub rail that was attached to the lower aspect of the door was melted.

The fire spread forward and involved the left rear drive and tag axle tires. The full circumference of the sidewall of the tag axle tire was burned with the top 30 percent completely burned through with the steel cords exposed. The tire lost air pressure and the sidewall de-beaded from the steel wheel. The tire tread that remained in contact with the pavement was not burned. The drive axle tires were burned in a similar pattern to the tag axle tire. The outer aspect of the upper sidewalls were burned full-thickness, consuming approximately 30 percent of the sidewall surface. The tread was burned with the exception of the tire patch that was in contact with the pavement. Both left side drive axle tires de-beaded from the wheels. During the tow process, these tires rotated on the wheels causing the burned portion of the tires to rotate to the 6 o'clock positions.

The burning tires produced high heat and the resulting fire consumed the rubber deflector shield that was mounted to the top surface of the wheel opening. The sheet metal above the tires was heavily oxidized from the heat with various levels of oxidation radiating from the edges of the burn pattern to the area directly over the tire positions. The fire consumed the air ride suspension bladders and burned the shock absorber bushings from the shock mounts. The aluminum rub rail mounted over the rear axle positions was melted. **Figures 5 and 6** are views of the fire damage to the left drive and tag axle tires.

**Figure 5. Fire damage to the left drive and tag axle tires.**

**Figure 6. Left rear view of the fire damage to the motorcoach.**

***Back Area***

The back of the motorcoach consisted of two vertically hinged sheet metal doors that provided access to the engine compartment. A single fiberglass top hinged door provided access to the radiator and air conditioning condenser. The left engine compartment door displayed an area of high heat oxidation on the lower aspect. The aluminum license plate was partially melted. Painted lettering remained visible on the top surface of the left door. The center area of the right door yielded evidence of high heat oxidation. Paint residue outlined the lower perimeter of the door. The engine compartment doors remained closed during the fire. The rubber bumper fascia, taillight assemblies, and fiberglass corner panels were completely consumed by the fire.

The rear roof structure was fabricated of square stock steel. The left rear vertical upright of the roof structure, located above the engine compartment, displayed high heat oxidation as compared the same component on the right side.

***Engine Compartment***

The engine compartment exhibited severe damage with all rubber, plastic and aluminum components consumed by the fire. The turbocharger was mounted on the left side of the engine (driver's side) and consisted of a cast iron housing on the exhaust side (forward in relation to the motorcoach) with an alloy impeller encased within an aluminum housing. A cast iron body that contained an oil line for lubrication separated these two components. A vacuum operated valve with a synthetic line was mounted to the top of the turbocharger unit that regulated the waste gate via a linkage rod. The aluminum impeller housing and the fins on the impeller were melted. A molten aluminum drip pattern of the impeller hub was present at the 6 o'clock position on the cast iron turbocharger housing. The top left area of this housing displayed high heat oxidation. **Figure 7** is a view of the engine compartment in an exemplar motorcoach. **Figure 8** is the engine compartment in the fire involved motorcoach.

**Figure 7. Engine compartment of the exemplar motorcoach.**

**Figure 8. View of the engine compartment of the involved motorcoach.**

The plumbing located above the turbocharger consisted of large diameter copper tubing with soldered and rubber connector joints. The rubber was burned from the tubing and the band clamps separated resulting in displacement of this tubing.

Located forward and to the left of the engine compartment was the main electrical panel box that contained bundles of wire and connectors. The aluminum cover of this box was consumed and the insulation of the wiring was completely burned.

Serpentine-type belts and large width V-belts powered the compressors, the various pumps and the cooling fans for the air conditioning (AC) condenser and the radiator. These belts were completely consumed. The AC condenser was aluminum and was mounted vertically above the engine, left of the centerline. The majority of the AC condenser was melted and dripped into the engine compartment.

The radiator was copper cored and was not burned in the fire. All hoses associated with the cooling system were consumed in the fire. A reservoir tank for the cooling system was mounted above the AC condenser and the radiator, and was centered over the engine compartment. The lines for this tank were consumed in the fire. **Figures 9 and 10** are of the AC condenser and the radiator and associated components.

**Figure 9. Aluminum AC condenser (left) and radiator (right) of the exemplar motorcoach.**

**Figure 10. View of the same components of the involved motorcoach.**

***Right Side***

The right side of the motorcoach displayed a similar burn pattern to the left side, involving the right lower engine compartment door, the rear right side tires and suspension components, and the painted body panels above the rear axle positions **(Figure 11)**. The painted body panels forward of the axles were intact. Charred paint remained on the perimeter of the right lower access door to the engine compartment. The painted surface of the motorcoach above this door was intact with perimeter fire and smoke damage.

The top 50 percent of the right tag axle tire was burned with the outer (upper) aspect of the sidewall burned full thickness with the steel belts exposed **(Figure 12)**. Air loss was complete, although the tire beads remained engaged to the steel wheel. The upper 50 percent of the right drive axle tires were burned; however, these tires maintained air pressure.

The painted sheet metal above the right rear tires was burned with high heat oxidation present over the tag axle tire. The aluminum trim above the tag axle tire was melted. The rubber spray deflector mounted over the axle positions was burned, but intact at the

forward aspect and totally consumed at the midpoint rearward. The right air bladders for the air ride suspension system were partially burned.

**Figure11. Right rear view of the burned motorcoach.**

**Figure 12. Burned right drive and tag axle tires.**

***Undercarriage***

The fire spread through the arch of the drive axle area into the undercarriage and into the rear area of the plywood floor of the passenger compartment of the motorcoach. The center rear isle area of the floor was completely burned through at the area of seat rows 6-10. A thorough inspection of the undercarriage was not possible due to the flat left side tires and the inability to raise the vehicle.

***Roof***

The roof of the motorcoach was constructed with a series of box beam roof bows that spanned the width of the vehicle at each vertical pillar location. Three rows of longitudinal rails were welded to the lateral bows and extended the length of the roof. The roof surface of the motorcoach was aluminum and was riveted to the roof structure.

The rear 40 percent of the aluminum roof panels were consumed by the fire. This covered the approximate area of passenger seat rows 6-11. The left side roof structure, at the second to last roof bow and the longitudinal roof rail deflected approximately 8 cm (3 in) downward due to heat **(Figure 13)**. The longitudinal rail adjacent to the rear roof emergency exit sagged due to the heat. The oxidation of the roof structure was most prevalent at the rear left aspect of the passenger compartment. The emergency roof exits were completely consumed by the fire.

**Figure 13. Fire related deformation of the left side roof structure.**

***Glazing***

As previously noted, the laminated windshields were smoke and soot covered with the heaviest concentrations occurring at the top surfaces. The upper aspects of the laminated windshields were heat cracked. The windshields remained in place within the gasket mounts.

The left side driver compartment windows were intact with heat cracking at the upper area. The interior surfaces were smoke and soot covered.

The left side contained six large laminated glazing panels along the 11 rows of seats. The most forward glazing panel was in place, cracked at the upper area, and smoke/soot covered on the inside surface. The second left side panel was cracked diagonally with approximately 40 percent of the glazing missing over the aft upper area. The remaining glass was smoke/soot covered. The remaining glazing panels (3-6) were completely consumed by the fire. **Figure 14** is a view of the left side glazing.

The right front door glazing was intact with a light coating of smoke as the door remained open throughout the duration of the fire. There was no damage to the door panel.

The right side of the motorcoach was equipped with seven glazing panels. The forward glazing panel was intact with heat cracking at the upper surface with heavy smoke/soot buildup on the inside surface. The upper rear aspect of the second glazing panel was burned (approximately 25 percent) with the balance of the glass cracked with smoke/soot covering the inside surface. The 3-7 glazing panels were completely consumed by the fire. **Figure 15** is a view of the right side glazing.

**Figure 14. Left side glazing damage.**

**Figure 15. Right side glazing damage.**

***Interior***

The interior surfaces of the motorcoach were covered with a flame-retardant fabric material for the seats, floor, overhead storage compartments, and the ceiling. However; the carry-on items left onboard by the passengers were flammable.

As the fire spread to the passenger compartment through the rear floor and through the side glazing above the rear axles, the interior materials provided additional fuel. The seat fabric and foam cushions were burned from the back of the second row to the rear of the passenger compartment. Rows 4-11 were completely burned with only the tubular steel frames remaining in place. The hard plastic armrests were burned at these rows. The seals in the pneumatic seat back recline mechanisms for rows 4-11 were burned, resulting in the seat backs reclining fully rearward.

The rest room was located in the back right corner of the motorcoach. This facility was partitioned from the passenger compartment with plywood walls surfaced with fabric similar to the seat covers and ceiling material. The fabric was completely consumed and the forward partition was burned to near full-thickness of the plywood. The interior and fixtures within the restroom were completely consumed by the fire.

The overhead storage compartments over rows 4-11 were completely consumed by the fire. The aluminum framework and the bottom portion of the compartments were intact forward of the forth row. The fiberglass doors were completely consumed by the fire. The majority of the passenger's carry-on luggage and personal effects (clothing/food/electronics) were either totally burned or partially burned by the fire. The remaining items fell onto the floor as the overhead compartments collapsed during the fire.

The first two rows of passenger seats sustained minimal damage from the fire. The damage was primarily to the seat backs and the head restraints. The driver's compartment was not consumed by the fire. The pneumatic seat, the safety belt, the controls and the instrument panel were intact and covered with smoke and soot. The instrument panel gauges remained visible behind a light coating of film from the smoke/soot. **Figures 16 and 17** are interiors views of the involved motorcoach.

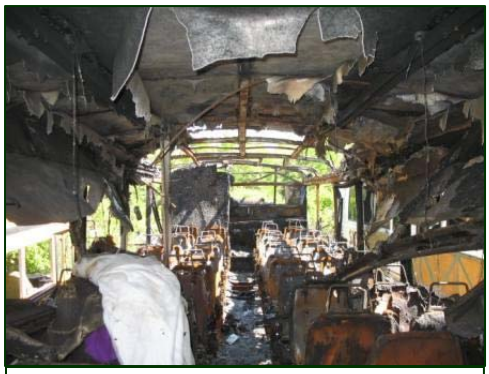

**Figure 16. Rearward view of the interior of the involved motorcoach.**

**Figure 17. View looking forward of the interior of the involved motorcoach.**

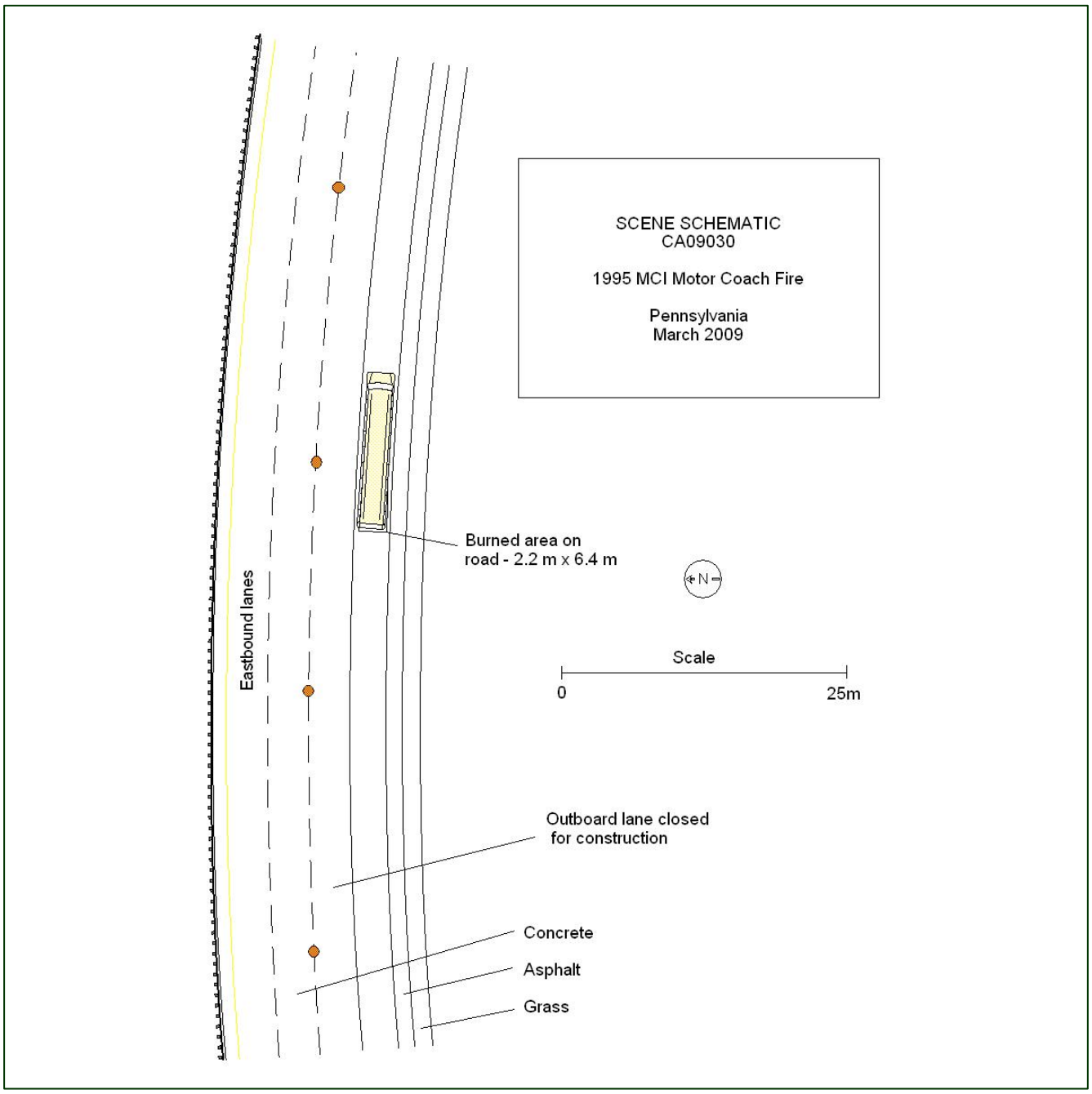


**Figure 18. Incident Schematic**

**ATTACHMENT A**

**FIRE CONSULTANT'S REPORT**

**BACKGROUND**

According to the information that we received, this fire originated in a motorcoach during an in-transit trip that was carrying one driver and 46 passengers. The motorcoach was identified as 1995 MCI, Model 102-D3. The Vehicle Identification Number was 1M8SDMPA3SP(xxxxxx) and the odometer reading was 420,010 km (260,989 miles).

The driver of the vehicle was traveling on an interstate highway when he noticed an audible low pressure warning and a flashing indicator light. He noticed that the air pressure gauge was in the normal operating range. Another motorcoach driver observed fire coming from the rear driver side and notified the driver of the involved motorcoach. He pulled the vehicle to the side of the road and, as he slowed down, the engine seemed to stall.

We were asked to travel to the PA location and examine the remains of the motorcoach and provide a report regarding the origin of this particular fire. At this location, I was accompanied by the SCI investigator and some employees of the motorcoach company.

**ANALYSIS**

During my systematic evaluation of the aforementioned motorcoach, I commenced my visual inspection starting in the front of the motorcoach and traversed around the exterior. During this portion of the examination, I observed smoke, heat, and fire patterns.

In **Figure A-1** (frontal view) attached, I observed smoke staining to the windshield with some heat cracks along the driver side near the top. There was no remarkable fire damage observed, including to the spare tire attached to the undercarriage in the front center. These observations are consistent with a fire originating toward the rear driver side.

The driver side of the motorcoach, **Figures A-2 and A-3** (driver side views) was visually inspected. The fire damage revealed minimal heat damage to the front third of the motorcoach with paint remaining on the surfaces. The front driver side tire still remained intact and was not damaged by the fire. There was some smoke damage to the driver side window with moderate heat damage observed high indicating that the fire progressed from the rear toward the front. As I traversed toward the rear, I observed very heavy heat damage about at the midpoint of the motorcoach where fire patterns had started moving in an upward direction from the rear. The oxidation on the lower surfaces revealed minor blistering with heavier oxidation to the upper portion where the windows had melted away and the roof was missing. The driver side rear of the vehicle revealed the heaviest fire damage with very heavy oxidation to the lower panels where the engine compartment was housed, **Figure A-4** (engine panel view). There was also very heavy oxidation above the rear tire housing **Figure A-5** (wheel well view) where the heat from the burning tires caused an upward intense fire movement. This area appeared to be secondary heat damage and was a by-product of the fire progressing from the underside in the engine compartment, **Figure A-6** (rear of wheel well).

The rear of the motorcoach **(Figure A-7)** revealed very heavy oxidation patterns. The heat and oxidation patterns extended upward from under the vehicle along the driver side.

The heaviest heat damage to the undercarriage was observed on the driver side below the rear bumper. There was also heavy oxidation to the roof structure above the driver side rear. A closer view **Figure A-8** (view of cooling core) revealed heat damage directionally from the engine compartment on the driver side.

The passenger side, **Figures A-9 and A-10** (passenger side view), revealed fire damage from the rear progressing toward the front with less heat and fire damage than the driver side. There was oxidation visible around the engine compartment panel and extension to the wheels, again with less damage than the driver side. This was consistent with the fire origin coming from the driver side through the interior of the engine compartment. As I moved toward the front on the passenger side, the fire and heat damage became less on the exterior. However; there was fire damage observed through the windows and roof line that indicated the fire progressed from the rear toward the front.

As I entered the interior of the motorcoach, **Figures A-11 and A-12** (interior view from front toward the rear), I observed heat and fire damage that was consistent with the fire originating in the right rear driver side. The fire movement was from this corner upward from floor level with heavy damage above this area. The roof system revealed very heavy damage in the right rear corner and the oxidation patterns on the rear of the seats revealed fire progression from the last two seats forward. Each seat ahead of this area became less heat stressed and the fire damage diminished toward the front. The floor was visually examined, **Figures A-13 and A-14** (floor looking from front toward the rear). The fire and heat damage is consistent with the fire progressing from under the plywood flooring from the rear driver side toward the front. The fire traveled via the conduit chase on the floor that was covered with plywood. **Figure A-14** also represents how the fire originated under this area over the engine compartment with heavy oxidation patterns revealed on the metal wall and floor structure in this area.

After making the determination that the fire originated in the engine compartment, **Figure A-15** (view of engine compartment from rear), the fire damage in this area revealed very intense heat and fire damage to the area around the turbocharger **Figure A-16** (view of rear of the turbocharger). The oxidation and melting of the metal products in this area indicated that heat traveled away from this area. The turbocharger had an aluminum housing around an aluminum alloy impeller with both of these items revealing very intense heat stress. This indicated that the fire originated in or near the turbocharger. The heat and oxidation damage observed on the cast iron turbocharger housing is also consistent with the fire originating at this area.

**CONCLUSION**

Based on the evaluation of the motorcoach and the information that was provided, I was able to determine that the origin of the fire was in the engine compartment along the rear driver side. Further, I opine that the ignition source for this fire was directly related to the turbocharger. A more detailed inspection of the engine components by a mechanical engineer may reveal the actual failure or scientific finding regarding the cause.

**FIRE CONSULTANT'S**
**IMAGES**


**Figure A-1. Front view of the motorcoach.**


**Figure A-2. Driver's side view of the motorcoach.**

**Figure A-3. Area over the driver's side rear axles.**

**Figure A-4. Left rear engine compartment panel.**

**Figure A-5. Area over the left rear axles.**

**Figure A-6. Area above the left tag axle.**


**Figure A-7. Rear view of the motorcoach.**

**Figure A-8. Air conditioning condenser (left) and radiator (right).**

**Figure A-9. Left rear view of the passenger's side of the motorcoach.**

**Figure A-10. Closer view of the passenger side of the motorcoach.**

**Figure A-11. Interior view of the motorcoach looking rearward.**

**Figure A-12. Interior view toward the rear of the motorcoach.**

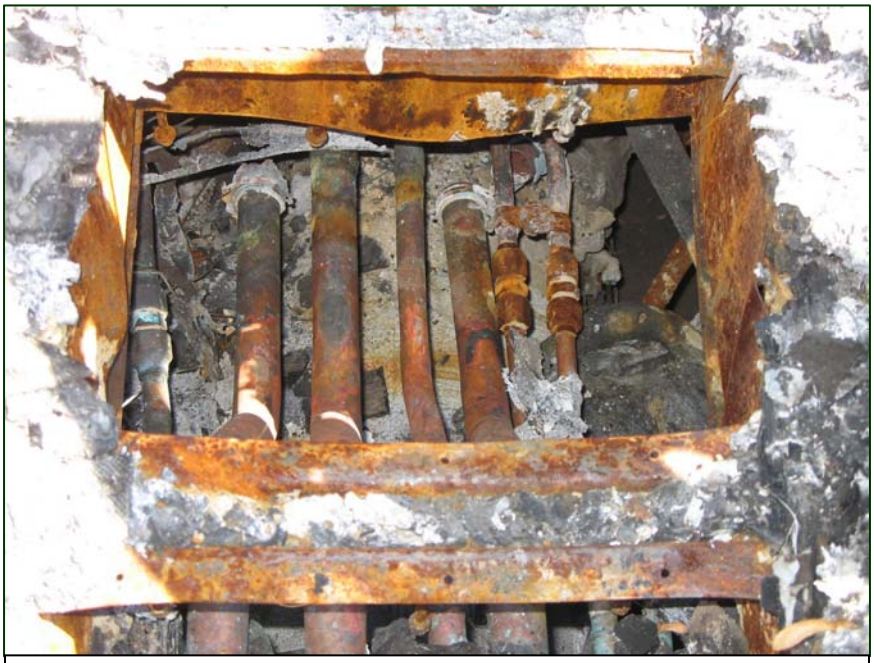

**Figure A-13. View of the rear aisle area looking rearward.**

**Figure A-14. Driver side rear passenger area forward of engine compartment.**

**Figure A-15. Engine compartment of the motorcoach.**

**Figure A-16. Close-up view of the turbocharger.**