

**CRASH DATA RESEARCH CENTER**

Calspan Corporation  
Buffalo, NY 14225

**CALSPAN REMOTE SCHOOL BUS ROLLOVER CRASH INVESTIGATION**

**CASE NO: CA03-062**

**VEHICLE: 1993 BLUE BIRD 3800-SERIES SCHOOL BUS**

**LOCATION: OHIO**

**CRASH DATE: SEPTEMBER 2003**

Contract No. DTNH22-01-C-17002

Prepared for:

U.S. Department of Transportation  
National Highway Traffic Safety Administration  
Washington, D.C. 20590

## **DISCLAIMER**

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

## TECHNICAL REPORT STANDARD TITLE PAGE

|  |   |   |                         |
|--|---|---|-------------------------|
| <p>1. <i>Report No.</i><br/>CA03-062</p>   | <p>2. <i>Government Accession No.</i></p>                           | <p>3. <i>Recipient's Catalog No.</i></p>  |                         |
| <p>4. <i>Title and Subtitle</i><br/>Calspan Remote School Bus Rollover Crash Investigation<br/>Vehicle: 1993 Blue Bird 3800-Series School Bus<br/>Location: State of Ohio</p>  |   | <p>5. <i>Report Date:</i><br/>August 2006</p>   |                         |
|  |   | <p>6. <i>Performing Organization Code</i></p>   |                         |
| <p>7. <i>Author(s)</i><br/>Crash Data Research Center</p>  |   | <p>8. <i>Performing Organization Report No.</i></p>   |                         |
| <p>9. <i>Performing Organization Name and Address</i><br/>Crash Data Research Center<br/>Calspan Corporation<br/>P.O. Box 400<br/>Buffalo, New York 14225</p>  |   | <p>10. <i>Work Unit No.</i><br/>C00410.0000.0165</p>  |                         |
|  |   | <p>11. <i>Contract or Grant No.</i><br/>DTNH22-01-C-17002</p>   |                         |
| <p>12. <i>Sponsoring Agency Name and Address</i><br/>U.S. Department of Transportation<br/>National Highway Traffic Safety Administration<br/>Washington, D.C. 20590</p>   |   | <p>13. <i>Type of Report and Period Covered</i><br/>Technical Report<br/>Crash Date: September 2003</p> |                         |
|  |   | <p>14. <i>Sponsoring Agency Code</i></p>  |                         |
| <p>15. <i>Supplementary Note</i><br/>This remote investigation focused on the performance of the passenger compartment, the integrity of the body panels, the compartmentalization of the interior, and the vehicle dynamics of a 1993 full-size, Blue Bird 3800 school bus involved in a quarter-turn rollover crash.</p>   |   |   |                         |
| <p>16. <i>Abstract</i><br/>This remote investigation focused on the performance of the passenger compartment, the integrity of the body panels, the compartmentalization of the interior, and the vehicle dynamics of a 1993 full-size, Blue Bird 3800 school bus involved in a quarter-turn rollover crash. At the time of the crash, the bus was in the middle of its morning route transporting middle and high school age students to school. The bus was operated by a 45-year old female driver and was occupied by 31 students ranging in age between 12 and 17 years old. The bus was traveling southbound on a two-lane rural roadway when the driver steered right to avoid a northbound vehicle and partially dropped off the right roadside. The driver overcorrected by steering left, crossed the centerline of the roadway, and departed the left roadside. As she departed the left roadside, the driver initiated a right steering input while the left side tires had entered a roadside ditch. The combination of the listing of the bus to the left due to the ditch and the right steering input induced a left-side-leading one-quarter turn rollover onto its left side. The bus came to rest off the left roadside in a soybean field. An on-board (rearward looking) video camera captured the occupant kinematics of the crash; the 3-second video tape indicated the students were distributed evenly throughout the bus. The dynamics of the left side roll displaced the unrestrained passengers laterally to the left. All the passengers seated on the right side of the bus came to rest on the left side and in some cases on top of the left side passengers. The 32 bus occupants were transported to two area hospitals for treatment and observation. The occupants on the bus sustained only minor soft-tissue injuries.</p> |   |   |                         |
| <p>17. <i>Key Words</i><br/>School bus rollover.<br/>Driver and occupant injuries.</p>   |   | <p>18. <i>Distribution Statement</i><br/>General Public</p>   |                         |
| <p>19. <i>Security Classif. (of this report)</i><br/>Unclassified</p>  | <p>20. <i>Security Classif. (of this page)</i><br/>Unclassified</p> | <p>21. <i>No. of Pages</i><br/>7</p>  | <p>22. <i>Price</i></p> |

**TABLE OF CONTENTS**

**BACKGROUND ..... 1**

**SUMMARY ..... 1**

    CRASH SITE ..... 1

    VEHICLE DATA – 1993 BLUE BIRD 3800 SCHOOL BUS ..... 2

    CRASH SEQUENCE ..... 2

    PRE-CRASH ..... 2

    CRASH ..... 2

    POST-CRASH..... 2

    VEHICLE DAMAGE..... 3

    EXTERIOR - 1993 BLUE BIRD 3800 SCHOOL BUS ..... 3

    INTERIOR - 1993 BLUE BIRD 3800 SCHOOL BUS ..... 4

    MANUAL RESTRAINT SYSTEMS - 1993 BLUE BIRD 3800 SCHOOL BUS..... 4

    OCCUPANT DEMOGRAPHICS - 1993 BLUE BIRD 3800 SCHOOL BUS ..... 4

    DRIVER..... 4

    DRIVER AND OCCUPANT KINEMATICS ..... 4

    TABLE OF OCCUPANTS: ..... 5

**FIGURE 8 –SCENE SCHEMATIC ..... 7**

**CALSPAN REMOTE SCHOOL BUS ROLLOVER CRASH INVESTIGATION**  
**SCI CASE NO: CA03-062**  
**LOCATION: OHIO**  
**VEHICLE: 1993 BLUE BIRD 3800 SERIES SCHOOL BUS**  
**CRASH DATE: SEPTEMBER 2003**

**BACKGROUND**

This remote investigation focused on the performance of the passenger compartment, the integrity of the body panels, the compartmentalization of the interior, and the vehicle dynamics of a 1993 full-size, Blue Bird 3800 school bus involved in a quarter-turn rollover crash. At the time of the crash, the bus was in the middle of its morning route transporting middle and high school age students to school. The bus was operated by a 45-year old female driver and was occupied by 31 students ranging in age between 12 and 17 years old. The bus was traveling southbound on a two-lane rural roadway when the driver steered right to avoid a northbound vehicle and partially dropped off the right roadside.



**Figure 1 - Overhead image of crash scene.**

The driver overcorrected by steering left, crossed the centerline of the roadway, and departed the left roadside. As she departed the left roadside, the driver initiated a right steering input while the left side tires had entered a roadside ditch. The combination of the listing of the bus to the left due to the ditch and the right steering input induced a left-side-leading one-quarter turn rollover onto its left side. The bus came to rest off the left roadside in a soybean field. An on-board (rearward looking) video camera captured the occupant kinematics of the crash; the 3-second video tape indicated the students were distributed evenly throughout the bus. The dynamics of the left side roll displaced the unrestrained passengers laterally to the left. All the passengers seated on the right side of the bus came to rest on the left side and in some cases on top of the left side passengers. The 32 bus occupants were transported to two area hospitals for treatment and observation. The occupants on the bus sustained only minor soft-tissue injuries. **Figure 1** is an overhead image of the crash scene.

The Crash Investigation Division of the National Highway Traffic Safety Administration received notification of this crash and assigned a remote crash investigation to the Calspan Special Crash Investigations team. The crash was of interest due to the agency's ongoing research into school buses crashes. A copy of the Police Accident Report (PAR) and 18 photographs were obtained to aid in the completion of this narrative report.

**SUMMARY**

***Crash Site***

The crash occurred on a rural two lane north/south road. At the time of the crash, it was daylight and there were no adverse weather conditions. The asphalt roadway contained no lane markings; however, since the crash date a double-yellow painted centerline has been applied. The roadway was curved slightly left in the southbound direction and contained a negative southbound grade exceeding 2 percent. The roadway was bordered by natural growth and a ditch approximately 30

cm (12”) in depth was present on the east roadside. The posted speed limit for the north/south roadway was 89 km/h (55 mph). A conceptual scene schematic is included as **Figure 8** at the end of this narrative report.

### ***Vehicle Data – 1993 Blue Bird 3800 School Bus***

The 1993 Blue Bird 3800 school bus was a conventional design and was configured on an International 3800 series chassis. The Vehicle Identification Number (VIN) was not reported. The passenger seating consisted of bench seats with high backs on steel framework, designed for compartmentalization. The number of rows in the bus is unknown; however, the bus was designed to accommodate up to 77 passengers. Safety features included split-sash windows with a 23 cm (9”) opening; a 133 x 96 cm (52.5 x 37.7”) rear emergency door opening with reflective tape applied at the emergency exits; and a full-view outward opening entrance door with 3429 sq. cm (1350 sq.”) of tempered safety glass. The bus was also configured with 188 cm (74”) of headroom and interior width of 231 cm (90.75”).

### ***Crash Sequence***

#### ***Pre-Crash***

The 45-year old driver of the 1993 Blue Bird 3800 school bus was operating the vehicle in a southbound direction on a two-lane rural roadway and was negotiating a slight left curve (**Figure 2**). The driver, believing that she was partially in the northbound lane, steered right allowing a northbound vehicle to pass. As the driver steered right, she straddled the road edge until the front right wheel dropped off and crushed the unsupported asphalt road edge (**Figure 3**). Realizing that a right side road departure was occurring, the driver overcorrected by steering left and crossed the roadway’s centerline and then departed the left roadside (**Figure 4**).



**Figure 2 - southbound approach of 1993 Blue Bird**



**Figure 3 - Fractured road edge.**



**Figure 4 - Area of left roadside departure and rollover.**

#### ***Crash***

As the vehicle departed the left roadside, the left side wheels entered a ditch approximately 30 cm (12”) in depth and the driver applied a right steering input. The combination of the steering input and the listing of the bus to the left led to a left side leading one-quarter turn rollover. The vehicle came to rest on its left side in a soybean field facing in a southwest direction.

#### ***Post-Crash***

Immediately following the crash, the driver radioed a school official who in turn contacted rescue personnel. Emergency personnel from 10 area EMS squads arrived on scene and assisted

in the removal of the injured occupants from the bus. The driver was removed from the vehicle and transported to a local hospital with moderate injuries. Among the students, 20 were transported by ambulance to a local hospital where they were treated and released with police-reported minor injuries. The remaining 11 students were transported to a separate local hospital by another school bus for observation.

### ***Vehicle Damage***

#### ***Exterior - 1993 Blue Bird 3800 School Bus***

The 1993 Blue Bird 3800 school bus sustained minor structural damage to its left side due to the crash (**Figure 5**). There was no formal SCI inspection on the bus and this report is based mostly on 18 photographs taken by the school district following the crash. Damage is present on the front left roof area above the driver's window and side rail. This damage is approximately 50 cm (20") in length and the crush is approximately 10 cm (4") in depth. The side rail was bowed from the A- to C-pillars on the left side and the entire roof shifted to the right approximately 8 cm (3"). An 8 cm (3") gap is present separating the left aspect of the gasket-style windshield from the left A-pillar (**Figure 6**). The two warning lamps on the front right roof area were also displaced from their housing. Stress cracks were also present on the right aspect of the windshield caused by a translation of force from the roof shift.



**Figure 5 - Left roof area of 1993 Blue Bird 3800.**

Minor damage was present on the left rear corner of the roof area above the exit row window frame at the K-pillar (**Figure 7**). The damage was approximately 25 cm (10") in length and the crush was approximately 8 cm (3") in depth. The left extending stop arm was also deformed due to impacting the ground during the rollover.



**Figure 6 - Gap between windshield and A-pillar.**



**Figure 7 - Damage to the left rear of 1993 Blue Bird 3800.**

The Ohio Department of Public Safety and Ohio Highway Patrol conducted an internal post-crash investigation of the vehicle and furnished the Calspan SCI team with a condensed copy of their findings. The information they provided discussed the post-crash condition of the brake

lines, brakes, body condition, doors, glazing, stop arm, bumper, and exterior mirrors. They found the brake lines and brakes to be in working order. The report indicated that the top of the entire body shifted to the right. The entry door was jammed and the windshield was both shifted to the right and fractured on the right aspect. The report further stated that the extending stop arm sustained heavy damage, the left side of the front bumper was deformed rearward, and that the left side rear view mirror and its bracket had been fractured.

#### ***Interior - 1993 Blue Bird 3800 School Bus***

The interior of the 1993 Blue Bird 3800 school bus appeared to have sustained minor damage during the crash. The district provided photographs of the interior consisted only of three grainy images; therefore analysis of the interior was limited in scope. A possible body fluid transfer was present in the vicinity of the fourth and fifth rows on the roof panel above the side rail (**Figure 8**). Also, what appears to be a clump of hair is present fixed to the fourth bolt along the roof (**Figure 8**). No further discernable contact points or intrusions could be identified.



**Figure 8 - Possible interior contact evidence.**

#### ***Manual Restraint Systems - 1993 Blue Bird 3800 School Bus***

The 1993 Blue Bird 3800 school bus was configured with a 3-point manual lap and shoulder belt for the driver's position. The police reported that the driver was restrained; however, no photographic evidence was provided for substantiation. There were no restraints available for the balance of the occupants.

#### ***Occupant Demographics - 1993 Blue Bird 3800 School Bus***

##### ***Driver***

|                            |   |
|----------------------------|---|
| Age/Sex:                   | 45-year old/Female  |
| Height:                    | Not reported  |
| Weight:                    | Not reported  |
| Seat Track Position:       | Not reported  |
| Manual Restraint Use:      | 3-point lap and shoulder restraint  |
| Usage Source:              | Police report   |
| Eyewear:                   | Not reported  |
| Type of Medical Treatment: | Transported to a local hospital by ambulance – unknown level of treatment |

##### ***Driver and Occupant Kinematics***

Specific injury information is not known for either the driver or the 31 student occupants. The driver probably initiated a lateral trajectory to the left and contacted the left side interior components during the crash sequence. Based on a 3-second video from a camera mounted to the front bulkhead of the bus, as the vehicle overturned onto its left side the students seated on the right side were displaced laterally to the left where they contacted left side seated students as well the roof area above the side rail. The absence of specific medical data limits the

information contained within this narrative report. There was no documentation of the students seating positions; however, the school district Transportation Director indicated in an interview that the student’s injuries consisted of minor contusions and abrasions. Removal from the scene consisted of 20 students being transported by ambulance to a local hospital where they were treated and released. The remaining 11 students were transported to a separate hospital by another district school bus for observation and released. What has been ascertained pertaining to the student passengers is contained within the following table:

***Table of Occupants:***

| <b>Age</b> | <b>Sex</b> | <b>Injury Severity</b>    | <b>Mode of Transport</b> |
|------------|------------|---------------------------|--------------------------|
| 12         | Female     | Possible injury           | Ambulance                |
| 13         | Male       | Possible injury           | School bus               |
| 15         | Male       | Possible injury           | School bus               |
| 15         | Male       | Non-incapacitating injury | Ambulance                |
| 17         | Female     | Non-incapacitating injury | Ambulance                |
| 13         | Female     | Possible injury           | School bus               |
| 17         | Female     | Non-incapacitating injury | Ambulance                |
| 14         | Male       | Possible injury           | School bus               |
| 13         | Male       | Possible injury           | School bus               |
| 14         | Male       | Possible injury           | School bus               |
| 16         | Male       | Non-incapacitating injury | Ambulance                |
| 15         | Male       | Non-incapacitating injury | Ambulance                |
| 15         | Male       | Non-incapacitating injury | Ambulance                |
| 15         | Male       | Possible injury           | School bus               |
| 17         | Male       | Possible injury           | School bus               |
| 15         | Male       | Not reported              | Ambulance                |
| 14         | Female     | Possible injury           | School bus               |
| 13         | Female     | Non-incapacitating injury | Ambulance                |
| 13         | Female     | Possible injury           | School bus               |
| 15         | Male       | Non-incapacitating injury | Ambulance                |
| 12         | Male       | Possible injury           | School bus               |
| 12         | Female     | Non-incapacitating injury | Ambulance                |
| 14         | Male       | Non-incapacitating injury | Ambulance                |
| 14         | Female     | Non-incapacitating injury | Ambulance                |
| 13         | Male       | Non-incapacitating injury | Ambulance                |
| 15         | Female     | Non-incapacitating injury | Ambulance                |
| 16         | Female     | Non-incapacitating injury | Ambulance                |
| 13         | Female     | Non-incapacitating injury | Ambulance                |
| 12         | Female     | Non-incapacitating injury | Ambulance                |

|    |      |                           |           |
|----|------|---------------------------|-----------|
| 14 | Male | Non-incapacitating injury | Ambulance |
| 13 | Male | Non-incapacitating injury | Ambulance |

*Source: Police report.*

**Figure 8 – Scene Schematic**

