School Bus Rescue

By Marie Nordberg

Last October, I was invited by rescue expert Steven L. Taylor to attend a weekend training session in Cedar Falls, IA. Following is my account of an extremely worthwhile experience for me and the 32 Iowa firefighters and EMS providers who took part in the class.

School bus accidents don't happen every day, but when they do, they catch our attention, simply because there are usually multiple victims involved, and many of those victims are children.

On one day last October, local news stations reported three school bus-related accidents in Minnesota, two of which resulted in several injured students. Two years ago, the side arm of a Los Angeles garbage truck penetrated the side of a school bus, decapitated two students, and left a bus filled with traumatized children.

Across the United States, approximately 500,000 school buses transport 22,000,000 students to public and private schools each week. It's estimated that 4.1 billion miles are traveled in one school season.

More often than not, these vehicles travel without mishap; however, when a bus-related accident does occur, local responders may be confronted with a major multi-casualty incident (MCI) for which they are not prepared.

Last October, firefighters and EMS providers from across Iowa gathered in Cedar Falls with Ft. Wayne, IN-based rescue expert Steven Taylor to brush up on what they already knew and to learn new skills in anticipation of having to handle a bus MCI in their own communities.

The weekend began in the classroom, where we learned some startling facts about school bus crashes.

According to 1996 statistics from the Washington, DC-based National Highway Traffic Safety Administration (NHTSA), since 1986, 1,458 people have died in school bus-related crashes. Most of the fatalities (61%) were occupants of other vehicles involved; nonoccupants, such as pedestrians and bicyclists, accounted for 29% of the deaths; and school bus occupants accounted for 10% (drivers 2%, passengers 8%).

Between 1986 and 1996, 95 crashes occurred in which at least one occupant of a school bus or a vehicle functioning as a school bus died. Of those, 48 were single-vehicle crashes involved in the following events: striking a fixed object (28 crashes); the vehicle overturning (6 crashes); a person falling from the vehicle (10 crashes); vehicle colliding with a train (2 crashes); collision with object not fixed (1 crash); and other noncollision (1 crash).

Since 1986, 7 drivers and 48 passengers have died in school buses providing transportation for purposes other than school or school-related activities (churches, civic organizations, etc.). In one such multivehicle crash, 27 occupants, including the driver, died.

Although Taylor concentrated primarily on school buses, he reminded the class that tour buses and other types of motorcoaches carrying large numbers of passengers pass through, or close to, their communities on a daily basis.

If any type of bus accident were to occur in the vicinity, Taylor asked members of the class, how would you answer the following questions:

- Do you have a plan for responding to a large-scale bus MCI?
- Do you have adequate supplies and the right kind of tools?
- Have you had proper training to respond to an incident of this nature?
- Do you have adequate outside resources (mutual aid)?

Bus Classification

Buses are not just large cars, says Taylor. They're constructed very differently, which means that many of your standard rescue tools may not work on certain parts of a bus.

There are four bus classifications: types A, B, C and D. More than 90% of school buses are type C or D.

Type A: Suburban-Type Vehicle. This type has a weight rating of less than 10,000 lbs. It resembles a conventional suburban-type vehicle and has a common capacity of 8 pupils and a driver.

Type B: Standard Van or Chop-Van Chassis. With a weight rating of more than 10,000 lbs., this vehicle is constructed of a standard van or chop-chassis, with a body added by the school bus manufacturer. It has a 16-24 passenger capacity.

Type C: Conventional. This type is identifiable by the engine that protrudes at the front of the vehicle, ahead of the front windshield. It typically weighs 12-15 tons. The driver's seat and main student entrance door are located behind the front axle.

Type D: Flat-Nose. This is identifiable by a body that extends the full length of the chassis, giving it a characteristic "flat-nose" design. The driver's seat and primary entrance door are forward of the front wheels, with the engine located at either the front or rear of the vehicle.

Skeletal System

You need to know about bus structure before you respond to an actual incident. The following information is taken from the Bus Rescue manual that was distributed to the class.

All Type B, C and D school bus body units are comprised of a roof, sidewall, floor, front and rear. The steel skeletal system that forms the basic structure of the vehicle is hidden beneath the interior and exterior metal of the body. The strongest and best reinforced area of the school bus body is the sidewall, which is comprised of load-bearing vertical frame members of angle-iron steel that resemble studs in a wall. These frames become the partitions between windows.

Running horizontally inside each sidewall is an additional structural element, known as the collision beam. This resembles a highway guardrail, and its location limits penetration of objects into the bus's passenger compartment.

The interior and exterior walls of the bus consist of 20-gauge finish panels that are secured directly to the inner skeletal system of the sidewall. To meet requirements for interior noise levels and warmth, fiberglass or styrofoam insulation is sandwiched into the walls. To further impact resistance and structural integrity of the bus sidewall, 16-gauge steel "W"-shaped rub rails are placed the full length of the sidewalls. The rear skeletal system is similar to the sidewall, with additional reinforcement installed to provide protection in rear-end collisions.

The skeletal system of the roof consists of heavy-duty 11-gauge curved steel frame members (roof bows), which are positioned in the roof structure running from side to side.

Emergency escape hatches may be located in the roof structure. These hatches are usually molded fiberglass or other lightweight materials and open by activating a release mechanism located on the hatch inside the bus. During an emergency, simple forcible entry techniques can open the roof hatch from outside the bus. When open, the hatches provide a clearing of at least 14" x 18". On buses used to carry physically disabled passengers, the opening may be as much as 30" x 30".

The floor of the school bus consists of heavy-duty vinyl or rubber applied over thick plywood sheets. Structural steel members acting as floor joists are spaced approximately every 17" along the underside of the floor and support the weight of the floor, seats and occupants. These joists are attached directly to the frame rails of the bus chassis.

Windows/Windshields

The rough openings for the side and rear passenger windows are framed by the vertical wall members, roof edge and top of the sidewall. The window posts are hollow and, when positioned between two passenger side windows, can be removed for extrication with sawing, chiseling or cutting tools. The windows themselves are either laminated or tempered safety glass framed in extruded aluminum.

The windows have a split-sash design and are affixed into the rough openings of the school bus body with rivets or similar securing devices. The windows slide open from the top to provide an opening of approximately 9" x 22", or half the window opening. Selected side windows, which provide a larger opening, are designed as emergency exits

and are labeled as such inside the vehicle. From outside the bus, they are identifiable by hinges along the top of the frame.

Windshields are set into the vehicle body by means of a multipiece rubber mounting gasket. On smaller buses, the windshield is one laminated safety glass pane; full-size buses have two or more sheets of glass. Rescue personnel can easily remove the windshield glass from the inside or outside of the bus by pushing or prying out the glass, or by cutting and peeling off the windshield mounting gasket. This gives rescuers a large access or egress opening into the vehicle.

Seats

Most buses have two types of seats: the driver's bucket seat and the standard three-person passenger seat. The driver's seat is an adjustable unit with a floor-mounted lap-style seat belt or lap-belt/shoulder harness assembly. The seat and pedestal assembly are secured to the floor with four or six bolts.

Student seats are usually framed with 1" tubular steel and secured at each leg to the bus floor and by bolts into the sidewall. The detachable foam rubber seat cushions and backs are covered with vinyl upholstery material.

After 1975, school bus seat backs were changed from low to high-back seats, which is safer for passengers but reduces working room for rescue crews to carry out patient packaging activities.

Aisles

The bus aisle is the lifeline of the vehicle's interior. If the aisle is clear and unobstructed, movement in and out is relatively easy; however, if it becomes congested with rescue and medical crews, movement can be difficult to impossible.

The position of seats establishes the width of the school bus interior. The aisle of the suburban Type A school bus may be as narrow as 10", while a full-size bus aisle is between 12"-14". Since the width of a standard longboard is 16" to 18", rescue personnel quickly discover there are few areas inside the bus where a packaged child on a longboard can be moved.

Interior

Headroom inside school buses, measured at the center aisle, can vary from a minimum of 60" on the small vans to 77" on the full-size bus.

Ceiling and sidewall interior finish panels are of typical 24-gauge sheet metal. Occasionally, the ceiling and sidewall edges separate, exposing occupants to potentially severe lacerations.

Doors

The various types of entrance and emergency exit doors each serve a specific function and are strategically located to maximize exit paths during an accident or fire. The small, suburban van doors are those provided by the original manufacturer; however, the Type B van conversion has three different types of doors:

- The passenger-side, front entrance door is drastically modified to suit special needs.
- The door window glass is typically permanently fixed in the up and closed position and, in some cases, the door handle, window crank and armrest are removed, as are the latch and lock mechanism inside the door itself.
- The sole means of opening or closing this front passenger entrance door is with a manual center pivot control arm installed along the front dashboard area to the right of the driver.

The passenger door on most full-size buses is typically a two-part, split-type door that opens in or out, or a center hinged-type door that folds forward or rearward. Either type may be opened by the manual pivot arm or an air-operated assembly that has a switch located to the driver's left. The air-actuated door also has a back-up emergency release mechanism in the stairwell of the bus near the exit door.

When open, the front door of a full-size school bus affords a horizontal opening of between 22"-24" with a vertical open clearance of 68"-72". Type C and D buses have only one rear door, which opens outwardly with a lever and may be opened from both outside and inside the bus.

The rear exit door is held closed by either a single-point or three-point latch assembly. The single main latch is at the center edge along the side of the door nearest the control handle. With a three-point latch assembly, the door is also secured at the top roofline and bottom floor assembly by a steel bar or rod.

Rear engine buses do not have a rear exit door. Exiting is accomplished by the occupants pushing or kicking out the rear emergency window. Rescue personnel can also remove this rear window to gain access to the vehicle.

Hazards

School bus fuel systems may include gasoline or diesel fuels, as well as propane, butane or natural gas. Gas and diesel fuel tanks, typically with a 60-gallon capacity, are located low along the passenger side of the bus near the front entrance door. Tanks for alternate systems may be on either side of the bus ahead or behind the rear axle.

Batteries

On smaller suburban and van-type buses, the battery is usually under the usually have at least two batteries, either under the hood on each side of the engine or in a battery bank in an exterior compartment on the driver's side of the bus.

At emergency incidents, rescue personnel, once inside, should attempt to turn off the ignition key to minimize the chances of an electrical system malfunction. Emergency personnel on the outside should be able to open the exterior battery compartment door by using the handle or unlatching the wire rods that secure it shut. Another style of battery compartment latching device uses a square-stock hex key that may be found inside the bus instrument panel to the left of the driver's console. If you can't locate it, the doors can be opened by inserting a flat-bladed screwdriver into the keyway.

Although most school buses are Type C units with a carrying capacity of 60-66 seated students, there has been a recent push to the Type D "Super Bus," with a legal standard capacity between 84-90 students, plus the driver. The engine of these buses may be at the front of the chassis, providing for a "forward control" bus or at the back in a rear engine "pusher bus" design. The usable passenger area in these buses has been extended several feet ahead of the front axle to the very front windshield.

Now that you have all of the basics, let's get back to the class.[1-6]

Learning the Ropes

After spending the morning in the classroom, we moved outside to look at different types of buses. At each bus, Taylor explained how to shut off the ignition, how to open the doors and windows, and how to locate the batteries on each type of bus.

Attendees were then divided into groups to go through a rotation that included becoming familiar with the equipment and learning how to use it; learning how to stabilize an overturned bus; patient care; and proper procedures for managing a burning bus.

Like any vehicle rescue, responding to a bus accident means carrying a lot of equipment. For gaining entry through a rear door or for panel removal, rescuers will need a hydraulic cutter, hydraulic spreader, pneumatic impact wrench, reciprocating saw, sledge hammer, Halligan bar and a hydraulic power unit. For stabilizing an overturned bus, you need several boxes of 4x4 wedges, stairsteps, 6' 4 x 4s, Hi-Lift jacks, a low-pressure airbag and a high-pressure airbag.

Side door access will require: a pick head axe, 8 lb. sledge hammer, Halligan bar, pike pole, reciprocating saw, pneumatic impact wrench, utility knife, hydraulic spreader, hydraulic cutter, hydraulic power unit, two #2216 SCBA bottles and an air chisel kit.

For removing the front windshield, you'll need two large, straight blade screwdrivers, a utility knife and two mini firefighter bars. (Taylor adamantly insists that window glass does not have to be broken to gain access to any vehicle; removing the window is always safer and quicker.) Side window removal is somewhat more complicated and will require a cordless drill, mini firefighter bar, hydraulic cutter, hydraulic power unit, air chisel kit, two #2216 SCBA bottles, a reciprocating saw and a tarp or blanket to cover the victims inside.

Helmets, heavy gloves and safety glasses are a must for anyone involved in vehicle rescue. You need both water and fire extinguishers in the event of a fire and/or gasoline

spill. And, it's important to carry back-up tools or know which tools are capable of performing similar functions in the event a tool fails to operate or breaks during use.

Throughout the day, Taylor emphasized one fact: Your rescue tools don't have to be the most expensive on the market, but you need the right tools to do the job. Even a small, rural service can accomplish this by asking local merchants for donations. Which is exactly what Iowa Falls firefighter Kirk Rice did, and he was pleasantly surprised by the positive response he received in the form of donated equipment and tools that would have taken years for his department to buy. His advice to everyone in the class was, "You'll never know whether the merchants will give you equipment if you don't ask."

Teamwork

The afternoon sped by, as EMS providers and firefighters worked side by side through each segment. EMTs and paramedics inflated airbags and adjusted cribbing, while firefighters applied C-collars and secured "victims" to backboards. "It's critical for rescuers and EMS to train together," says Taylor, "so everyone knows and understands the entire process."

After everyone had completed each rotation, we gathered around one of the donated school buses for a chilling experience. Using only a piece of newspaper and a match, Taylor started a fire in one of the seats. Within seconds, the bus was filled with thick smoke and the entire seat was engulfed in flames. Dressed in full turnout gear and SCBA equipment, firefighters and paramedics entered the bus to experience the smoke and heat. Because a bus fire is more confined, it may be more intense than a house fire, Taylor explained, with temperatures reaching 2,000°F.

To knock down a fire inside a burning bus, Taylor suggested standing in the front and aiming the water upward so it deflects off the ceiling and down onto the seats. Make sure the rear window is removed first so steam can escape, he says, and never pick up any broken glass, because it will be so hot it will stick to your skin.

Practice, Practice

On Sunday morning, we reconvened in the classroom for a quick review of the things that had been covered the previous day and to watch a video of some actual bus crashes. Mid-morning, we headed back to the parking lot. Saturday had been warm, sunny and windy; Sunday was cool, with pouring rain and 40+-mph winds. There's nothing like a dose of reality to practice bus extrication.

Dressed in turnout gear, everyone returned to the school buses to review and practice the skills they learned the previous day, with a bit more emphasis on patient care and extrication. On Saturday, firefighters had learned how to apply a C-collar and secure patients to backboards. On Sunday, in addition to reviewing those skills, they worked on removing the windshield and extricating patients.

Taylor's advice to the rescuers was, "If it's a hot day, don't lay a plastic spine board directly on the pavement. Place boards underneath first so the plastic doesn't warp and the

patient doesn't absorb its heat." The same goes in winter, he added, to prevent the board from freezing to the ground. In his opinion, said Taylor, plastic boards work best for sliding patients out and down the fire department ladders.

After lunch, my husband and I were ready to head home, but everyone else suited up and went back out into the rain for a few more hours of practice and instruction.

Was it all worth it? Absolutely! Waterloo firefighter Doug Carter can attest to that. Just one week after the class, he responded to a bus accident in his own community.

"It was a minor accident with no damage to the bus, and we knew that before we got there," he explains. "But having just been through the bus rescue class, I guess my thought process was different than it might have been in the past. The thing that stuck with me most was about establishing flow at the scene: rescuers in one way and patients out another."

Even though the incident didn't allow him to practice his new skills, Carter is confident that he would have known just what to do in a more serious situation.

Conclusion

If a bus accident happens in your community, are you prepared? Since few buses are equipped with seatbelts, most serious crashes involving buses result in major trauma or death. Don't let your community down by not having adequate resources, training and proper equipment.

Special thanks to Steven Taylor for inviting me to participate in his training course; to Lt. Mike Buhrow of the Cedar Falls Fire Department and safety officer Mike Whitson from Cedar Falls Fire/Rescue for their hospitality; and to everyone else in the class who tolerated my questions and let me be "one of the guys."

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