



## ISSUE: PASSENGER VEHICLE DESIGN, EQUIPMENT AND PERFORMANCE IMPROVEMENTS

### Introduction

Passenger vehicle safety is separated into three major areas: pre-crash safety performance (often called crash avoidance); protection of vehicle occupants when crashes occur (usually referred to as crashworthiness); and post-crash integrity of the vehicle and emergency response in the event of a crash.

Performance standards and requirements for crash avoidance and crashworthiness features, as well as post-crash elements of motor vehicles, are contained in the Federal Motor Vehicle Safety Standards (FMVSS), which govern most major safety systems in cars, light trucks, vans, and commercial vehicles.

The National Highway Traffic Safety Administration (NHTSA) has a legislative mandate to issue Federal Motor Vehicle Safety Standards and Regulations to which manufacturers of motor vehicles and items of motor vehicle equipment must conform and certify compliance.



FMVSS 209, Seat Belt Assemblies, was the first standard to become effective on March 1, 1967. Today, there are approximately 140 different federal motor vehicle safety standards and associated regulations. This document describes just a few of those which have made significant strides toward motor vehicle occupant protection.

### Standard No. 201: Occupant Protection In Interior Impact

This standard requires protection for occupants with interior surfaces on the instrument panel (dashboard), seat back, interior compartment doors, sun visors and armrests. The most important of these from the standpoint of injury

causation is the instrument panel and interior surfaces directly ahead of the front passenger seating area. In a crash, unrestrained passengers in the front seat are almost certain to have either their knees, chest, head, or some combination of these body parts contact the instrument panel.

Prior to the establishment of FMVSS 201, instrument panels were made of hard materials, often using metal trim, sharp surfaces and protruding objects, such as knobs or buttons, also made of metal or hard plastic. These objects presented extremely hazardous projections for occupants, especially those unbelted, in a crash and frequently caused serious injuries. Facial lacerations, head injuries and fatalities commonly resulted from contact with these surfaces.

NHTSA has calculated that improvements to the instrument panel, including those required by FMVSS 201 and other changes introduced voluntarily, have reduced fatality and serious injury risk by about 25 percent in current production model passenger vehicles compared to earlier models. The agency estimates that about 700 lives per year are saved in cars alone.

### Standard No. 202: Head Restraints

This standard specifies requirements for head restraints to reduce the frequency and severity of neck injury in rear-end and other collisions.

On Dec. 7, 2004, NHTSA announced a new standard for head restraints to reduce whiplash injuries in rear-end collisions.

More than 270,000 whiplash injuries occur annually in motor vehicle crashes. When all vehicles meet the new requirement, the upgraded head restraint standard is expected to reduce that number by nearly 17,000 annually.

The new standard will require head restraints to be higher and positioned closer to the head. The standard will also, for the first time, require adjustable head restraints to lock in place once properly positioned.

All passenger vehicles, including cars, sport utility vehicles, pickups, and vans that are manufactured on or after Sept. 1, 2008 will be covered under the upgraded standard.

New requirements will apply to front seat head restraints, providing more protection for the driver and the passenger next to the window. Rear seat head restraints, when installed as standard or optional features, will also be subject to a set of new requirements.

#### **Standard No. 203: Impact Protection for the Driver from the Steering Control System**

This standard specifies requirements for steering control systems that will minimize chest, neck, and facial injuries to the driver as a result of impact.



#### **Standard No. 204: Steering Control Rearward Displacement**

This standard specifies requirements limiting the rearward displacement of the steering column into the passenger compartment to

reduce the likelihood of chest, neck or head injuries.

#### **Standard No. 205: Glazing Materials**

This standard specifies requirements for glazing materials for use in motor vehicles and motor vehicle equipment. The purpose of this standard is to reduce injuries resulting from impact to glazing surfaces, to ensure a necessary degree of transparency in motor vehicle windows for driver visibility and to minimize the possibility of occupants being thrown through the vehicle windows in collisions.

About 13,000 people die each year because they are ejected from their vehicles in crashes and more than 8,000 of those killed are entirely or partially ejected through vehicle window openings. Of this number, about two-thirds of the deaths, or 5,350, are ejected through glazed windows.

#### **Standard No. 206: Door Locks and Door Retention Components**

This standard specifies requirements for side and back door locks and door retention components including latches, hinges, and other supporting means, to minimize the likelihood of occupants being thrown from the vehicle as a result of impact.

#### **Standard No. 207: Seating Systems**

This standard establishes requirements for seats, their attachment assemblies, and their installation to minimize the possibility of their failure by forces acting on them as a result of vehicle impact.

#### **Standard No. 208: Occupant Crash Protection**

This standard specifies performance requirements for the protection of vehicle occupants in crashes. The purpose of this standard is to reduce the number of deaths of vehicle occupants, and the severity of injuries, by specifying vehicle crashworthiness requirements in terms of forces and accelerations measured on a variety of anthropomorphic dummies in test crashes, and static airbag deployment tests. This standard also specifies equipment requirements for active and passive restraint systems.

On Dec. 8, 2004, NHTSA announced a final rule amending standard number 208 requiring that rear center seats in all new passenger vehicles be equipped with lap/shoulder safety belts.

All passenger vehicles will be required to comply with the new rule by 2008 when NHTSA estimates that the change will result in 10 to 23 fewer highway fatalities per year, and 245 to 495 fewer injuries. It comes in response to a Congressional mandate, known as "Anton's Law," passed to increase child passenger safety and encourage the use of booster seats by older children.

According to NHTSA, this rule will greatly improve safety for both children and older people. One huge advantage is that lap/shoulder belts can be used with belt-positioning booster seats, making the rear center seat the safest place for older children.

Since 1989, NHTSA has required that all rear window-side seats in new passenger vehicles be equipped with lap/shoulder belts. At this point, 23 percent of new passenger cars, along with

51 percent of new vans and light trucks (SUVs and pickups), are only equipped with lap belts for use by rear center seat passengers.

Besides cars and light trucks, the new rule applies to 12- and 15-passenger vans. Side-facing seats are exempt. The rule will be phased in by manufacturers, with half of model year 2006 passenger vehicles offering the lap/shoulder safety belts; increasing to 80 percent of vehicles in model year 2007 and 100 percent in model year 2008.

#### **Standard No. 209: Seat Belt Assemblies**

This standard specifies requirements for seat belt assemblies. Seat belt assemblies are devices such as straps, webbing, or similar material, as well as to all necessary buckles and other fasteners and all hardware designed for installing the assembly in a motor vehicle, and to the installation, usage, and maintenance instructions for the assembly. The purpose of this standard is to ensure that the hardware of seat belt assemblies shall be designed to prevent attachment bolts and other parts from becoming disengaged from the vehicle while in service.

#### **Standard No. 210: Seat Belt Assembly Anchorages**

This standard establishes requirements for seat belt assembly anchorages to ensure their proper location for effective occupant restraint and to reduce the likelihood of their failure during a vehicle impact.

#### **Standard No. 212: Windshield Mounting**

This standard establishes windshield retention requirements for motor vehicles during crashes. The purpose of this standard is to reduce crash injuries and fatalities by providing for retention of the vehicle windshield during a crash, to keep vehicle occupants within the confines of the passenger compartment.



#### **Standard No. 213: Child Restraint Systems**

This standard specifies requirements for child restraint systems used in motor vehicles and aircraft for the purpose of reducing the number of children killed or injured in

motor vehicle crashes and in aircraft.

#### **Standard No. 214: Side Impact Protection**

This standard specifies dynamic and static performance requirements to assure the crashworthiness of vehicle side structures. The purpose of this standard is to reduce the risk of serious and fatal injury to occupants of vehicles involved in side impact crashes.

#### **Standard No. 216: Roof Crush Resistance**

This standard establishes strength requirements for the passenger compartment roof to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

Roof intrusion and roof contact injury are common factors in rollovers. Based upon crash data in NHTSA's National Automotive Sampling System (NASS) for 1995-1999, rollover crashes are the most dangerous collision type for light duty vehicles, measured by the ratios of fatal and serious injuries to the number of occupants involved in towaway crashes.

Roof contact and the severity of rollover injury is greatly influenced by belt usage. Eighty-nine percent of unbelted ejected occupants receive their most severe injury from ejection (based on NASS annual averages from 1988-1997).

The methods for preventing roof contact, by limiting the occupant's movement or by limiting roof intrusion (through improved roof strength or roof reinforcements), and the predicted benefits (lives saved and injuries prevented), have been debated for many years. In 2004, NHTSA issued a formal "Request for Comments" as part of their rulemaking process. NHTSA will consider all such comments in deciding what regulatory changes, if any, may be appropriate for upgrading the standard.



#### **Standard No. 217: Bus Emergency Exits and Window Retention and Release**

This standard establishes requirements for the retention of windows other than windshields in buses, and establishes operating forces, opening dimensions, and markings for bus emergency exits. The purpose of this standard is to minimize the likelihood of occupants being thrown from the bus and to

provide a means of readily accessible emergency egress.



**Standard No. 218: Motorcycle Helmets**

This standard establishes performance requirements for helmets designed for use by

motorcyclists and other motor vehicle users. The purpose of this standard is to reduce deaths and injuries to motorcyclists and other motor vehicle users resulting from head impacts.

**Standard No. 219: Windshield Zone Intrusion**

This standard specifies limits for the displacement into the windshield area of motor vehicle components during a crash. The purpose of this standard is to reduce crash injuries and fatalities that result from occupants contacting vehicle components displaced near or through the windshield.

**Standard No. 220: School Bus Rollover Protection**

This standard establishes performance requirements for school bus rollover protection. The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from failure of the school bus body structure to withstand forces encountered in rollover crashes.

**Standard No. 221: School Bus Body Joint Strength**

This standard establishes requirements for the strength of the body panel joints in school bus bodies. The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

**Standard No. 222: School Bus Passenger Seating and Crash Protection**

This standard establishes occupant protection requirements for school bus passenger seating, restraining barriers, and wheelchair anchorages. The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from the impact of school bus occupants against structures within the vehicle during crashes and sudden driving maneuvers.

**Standard No. 223: Rear Impact Guards**

This standard specifies requirements for rear impact guards for trailers and semitrailers. The purpose of this standard is to reduce the

number of deaths and serious injuries that occur when light duty vehicles collide with the rear end of trailers and semitrailers.

**Standard No. 224: Rear Impact Protection**

This standard establishes requirements for the installation of rear impact guards on trailers and semitrailers with a GVWR of 4,536 kg (10,000 lb) or more. The purpose of this standard is to reduce the number of deaths and serious injuries occurring when light duty vehicles impact the rear of trailers and semitrailers with a GVWR of 4,536 kg (10,000 lb) or more.

**Standard No. 225: Child Restraint Anchorage Systems**

This standard establishes requirements for child restraint anchorage systems to ensure their proper location and strength for the effective securing of child restraints. The purpose of this standard is to reduce the likelihood of the anchorage systems' failure, and to increase the likelihood that child restraints are properly secured and thus more fully achieve their potential effectiveness in motor vehicles.



**Standard No. 301: Fuel System Integrity**

This standard specifies requirements for the integrity of motor vehicle fuel systems. Its purpose

is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes.

Although vehicle fires are relatively rare events (occurring in less than 1 percent of vehicles in towaway crashes), they tend to be severe in terms of the number of casualties caused. According to NHTSA, 3.5 percent of light vehicle occupant fatalities occurred in crashes involving fire. Overall, the fire itself was deemed to be the most harmful event in the vehicle for about 24 percent of these fatalities.

In 2003, the federal standard was amended establishing a new rear impact test procedure and an upgraded side impact test.

**Standard No. 302: Flammability of Interior Materials**

This standard specifies burn resistance requirements for materials used in the occupant compartments of motor vehicles. Its purpose is to reduce deaths and injuries to motor vehicle

occupants caused by vehicle fires, especially those originating in the interior of the vehicle from sources such as matches or cigarettes.



**Regulation Part No.  
575.105 - Vehicle Rollover**

This section requires manufacturers of utility vehicles to permanently affix to either side of the sun visor a “Rollover

Warning Label” alerting drivers that particular handling and maneuvering characteristics of utility vehicles require special driving practices. The purpose is to inform consumers that utility vehicles have a higher possibility of rollover than other vehicle types and advises consumers of steps that can be taken to reduce the possibility of rollover an/or to reduce the likelihood of injury in a rollover.