Top 100 Safety Innovations, Chronological Order			
Year	Innovation	Agency/Company/Location	Detailed Description
1872	Closed Track Circuit	Philadelphia and Erie Railroad, Erie Pa., Kinzua, Pennsylvania	Dr. William Robinson, after designing and installing the first "open track circuit," realized that although the system worked perfectly it could fail in and unsafe manner-- i.e. display a "clear" signal when in fact the block was occupied by a train or portion of train. He then developed the closed track circuit, where presence of a locomotive or cars would cut the power energizing the relays that would cause a "clear" signal to be displayed. Only when the block was completely cleared of the train would energy be restored to the relays and the signal display other than "danger" or "occupied." This is the basis for automatic block signal systems; the fail-safe detection of track occupancy through changes in electrical current. Without this invention, the safety and efficiency of railroads would never have progressed to the level it has achieved today.
1872	Automatic Air Brake System for Railcars	Pennsylvania Railroad, Pittsburgh, Pennsylvania	Westinghouse developed the first automatic air brake system, which had a built-in safeguard whereby the brakes on the entire train would apply automatically if the train should separate or if air pressure should escape due to leakage in the system. This design set the stage for future air brake systems for the rail and bus industries.
1890	Streetcar Fender	Various Cities	Attached to the front of electric streetcars, the fender would "scoop up" inattentive pedestrians and keep them from being swept under the wheels and crushed. Numerous manufactures supplied them as OEM equipment, among them Providence, Parmenter, Universal and Berg.
1892	Amalgamated Transit Union (predecessor) Founded	Indianapolis, indiana	The Amalgamated Association of Street and Electric Railway Employees, now named the Amalgamated Transit Union (ATU), was founded. The ATU has the largest membership among unions that represent transit workers throughout the United States and Canada. The union has its origins in a meeting of the American Federation of Labor in 1891 at which president Samuel Gompers was asked to invite the local street railway associations to form an international union. Gompers sent out a letter to the local street railway unions in April 1892, and based on the positive response arranged for a convention of street railway workers. The convention began on 12 September 1892 in Indianapolis, Indiana, attended by fifty delegates from twenty-two locals. Many of the smaller unions were affiliated with the AFL, while four larger locals were affiliated with the Knights of Labor and two were independent.
1903	Laminated Glass, First Discovery of Benefits	France	Laminated glass is invented as a measure to reduce injuries in automobile accidents by Edouard Benedictus. It is actually first “discovered” in a laboratory accident. By 1930, safety glass became standard for all Ford vehicles in the U.S.
1904	First All Steel Passenger Car	American Car and Foundry, New York	ACF built the first all-steel passenger car in the world for Interborough Rapid Transit in 1904, and then built the first steel cars used on the London Underground in the following year. This was a much safer carbody material than the combustible wood cars operating in subway service. It was referred to as the "Gibb's Car" after IRT Chief Engineer George Gibbs who designed and built the first prototype after manufacturers refused to build a steel car. Car manufacturers of the time were unwilling to undertake such an experimental proposition. Steel was deemed too heavy for any practical applications. Conventional wisdom of the day (since proven to be false) held that an all steel car would vibrate itself to pieces, for wood was "necessary" for its damping effects on the car's vibration. It was also widely believed that a steel car would be very loud, and poorly insulated from temperature extremes such as heat and cold. With a large backlog of orders for wooden cars, manufacturers had no incentive to explore the new technology as there was still plenty of demand for wooden railcars.
1904	Windshield Wipers	New York	In 1904, Mary Anderson applied for a patent for a swinging arm with a rubber blade following a road trip to New York in which she witnessed streetcar operators stop to remove ice and water from their windshields. The device consisted of a lever that could be operated from inside a car. The lever caused a spring-loaded arm with a rubber blade to swing across the windshield and then back again to their original position, thus removing droplets of rain or flakes of snow from the windshield's surface. At the time she applied for her patent, cars were not very popular. Henry Ford's Model A automobile had not even been manufactured yet, and he would not create his famed Model T vehicle until 1908. Anderson, meanwhile, was teased and laughed at by many people because of her idea for the windshield wipers. Many felt the movement of the windshield wipers would distract the drivers. By 1913, however, thousands of Americans were driving their own cars, and mechanical windshield wipers were standard equipment.

1911	Center Line Safety Stripe	Trenton, Michigan	The first white center line to safely divide a road surface was introduced by Edward N. Hines, road commissioner for wayne County, Michigan. His "center line safety stripe" is painted on River Road near Trenton, Michigan.
1911	SAE Handbook on Standardization	US Society of Automotive Engineers	The US Society of Automotive Engineers published its first SAE Handbook on Standardization. It issued standards and specifications for spark plugs and carburetor parts, and eventually standardizes all automobile parts. Standards are essential for interchangeability, reliability, and quality control.
1911	Speedometer and Odometer	Germany	A mechanical speedometer that not only measures but indicates an automobile's speed is built by German W.H. Grossman. Speedometers work by measuring the rotation speed of the vehicle's transmission, and use a flexible cable that is attached to a pointer on an indicator display. The odometer is then connected by gears to the speedometer spindle and measures distance travelled.
1913	Electric Interlocking Machine	Grand Central Terminal, New York	In 1913, a brand new Grand Central Terminal in New York City opened for service utilizing the latest in state-of-the art electric interlocking equipment. This largest of North American passenger terminals utilized this equipment until 1993 when the latest state-of-the art processor based central control systems teamed with a geograpically distributed system of 17 VPI Interlocking Control systems were placed in service as part of major terminal refurbishment project.
1914	Anthony N. Brady Memorial Awards	American Electric Railway Association	The family of Anthony N. Brady authorized the American Museum of Safety to establish safety awards program for American electric railway industry, in partnership with APTA's predecessor association, the American Electric Railway Association.
1914	City-wide Safety Awareness Campaign	Boston Elevated Railway and Boston Chamber of Commerce, Boston, Massachusetts	Boston Chamber of Commerce, Boston Elevated Railway, and other smaller railway companies, run one of the largest and most carefully planned safety awareness campaigns to date, which initially focus on school children in response to 25,000 school children being killed on tracks in the preceding 20 year period. The broader “safety first” message was posted on more than 1,000 storefronts, at stations, in newspapers, and on trolley cars (including large, illuminated signs on Boston Elevated cars). (Source: Cambridge Tribune, 4 July 1914)
1914	Laminated Glass, Process	Safetee Glass Company	Frank Shuman invents a process for making laminated safety glass, called safetee glass, and soon to be manufactured by the Safetee Glass Company.
1914	First Use of Radio in Railroad Communication	Scranton, Pennsylvania	Technical World Magazine described the scene when wireless two-way radio was first successfully used onboard a moving train. “One of the passengers peeked into the cubby-hole, then exclaimed in tones of amazement: ‘Wireless, by jinks!’ Then the amazed traveler rushed back through the length of the train, spreading the incredible information that a wireless operator was on board receiving news bulletins just as was done on ocean liners.” (“Getting the Wireless Onboard Train”, Technical World Magazine, February, 1914, pages 914-918)
1915	Federal Aid Road Act	Washington, DC	January 15, 1915: Joint US Congressional committee reports that federal aid for road improvements is consistent with several constitutional objectives. Roads regulate commerce, provide for the common defense and promote the general welfare. This Congressional report leads to the Federal Aid Road Act of 1916.
1915	Largest Reinforced Concrete Bridge in North America	Nicholson, Pennsylvania	The bridge is 245 feet high, 2375 feet long, 186 feet high at the arches, and contains over 163,000 yards of concrete and 2,275,000 pounds of reinforcing steel, utilizing the innovative engineering practice which set a precedence for large-scale concrete construction.
1916	Dead-Man Control Safety Feature	Birney Safety Car, Multiple Cities	Part of the equipment first introduced by the Briney Safety Car, the "deadman" would bring the streetcar to a stop automatically in the event of incapacitation of the operator. This device removed power from the car's motors if the controller handle was released for any reason. The car would then coast to a stop, or could be braked to a stop by the motorman. Also see "Birney Safety Car" (1916).

1916	Birney Safety Car	Birney Safety Car, Multiple Cities	A lightweight street rail car was introduced by Charles Birney, known as a “safety car,” or the “Birney Safety Car.” It was designed to be operated by one man instead of a two-man crew. It is considered to be the first mass-produced standard streetcar (albeit with minor variations) in North America. In addition to the Dead-Man Control Safety Feature which removed power from the car's motors if the controller handle was released for any reason, bringing the car to a stop, the Birney Car also introduced the use of pneumatically balanced and interlocked doors. If a door was stuck open, or a passenger or other object blocked the door, the motors could not be started. These safety features, among others introduced by this model, are standard today. See also "Dead-Man Control Safety Feature" (1916); and "Sensitive-Edge Seals on Bus Exit Doors" (1974).
1917	Electric Coupler System	Ohio Brass (now Wabtec)	Ohio Brass (now Wabtec) patent US 1,353,557 was a patent on the development of electric coupler portions. The use of electric couplers eliminated the need for brake-men to get in between cars to make up trainline cables. A related patent by Ohio Brass was for a safety uncoupling device for isolation of electric circuits prior to uncoupling cars for the worker's safety.
1918	Removal of Wooden Equipment From Subway Routes	Brooklyn Rapid Transit Company (BRT), Brooklyn, New York	The “Malbone Street Wreck” in the Brooklyn Rapid Transit Company (BRT) system was a catastrophic subway accident that led to two important safety improvements. First, the accident put additional pressures on BRT to remove wooden equipment from routes that operated in subways. Secondly, safety devices were designed and implemented including the “dead-man’s switch” in the cab and “trippers” on the trackside.
1918	"Trippers" on Trackside	Brooklyn Rapid Transit Company (BRT), Brooklyn, New York	The “Malbone Street Wreck” in the Brooklyn Rapid Transit Company (BRT) system was a catastrophic subway accident that led to two important safety improvements. First, the accident put additional pressures on BRT to remove wooden equipment from routes that operated in subways. Secondly, safety devices were designed and implemented including the “dead-man’s switch” in the cab and, for the first time on such a large scale, “trippers” on the trackside to serve as an emergency means for stopping trains.
1920	Fageol Safety Coach	Fageol Safety Coach, Multiple Cities	The Fageol Safety Coach was the first bus not based on a heavy truck chassis. Poor riding quality, high centers of gravity, and low performance engines made converted motor trucks unsatisfactory for transit use. The Fageol Safety Coach, built by Frank and William Fageol, was the first bus with a lower center of gravity, better springs, and more powerful engine.
1920	Highway Research Program Created, Focuses on Deteriorating Roads	Washington, DC	The US government creates a national program of highway research to solve the deteriorating road problems created by heavy use. The highway research is part of the National Research Council and is organized as a clearinghouse and forum for all branches of highway engineering.
1921	Hydraulic Four-Wheel Brakes	Nationwide	Hydraulic Four-Wheel Brakes are invented by Malcolm Loughhead (later changed his name to Lockheed and became famous in Aeronautics). The first automobile to offer four-wheel hydraulic brakes was the Duesdenburg Model A in 1922.
1921	Vacuum-Operated Windshield Wiper	Buffalo, New York	First vacuum-operated windshield wiper developed by Tri-Continental corporation, Buffalo, NY. These replaced hand operated wipers. Also see "Windshield Wipers".
1923	First Patented Traffic Signal	Cleveland, Ohio	In 1920, Garrett Augustus Morgan went into the newspaper business, starting the "Cleveland Call." While he was driving along the streets of Cleveland, he realized how unsafe intersections were, and was determined to make driving safer. Morgan patented a traffic signal on November 20, 1923 (U.S. patent No. 1,475,024, issued in 1923) - this was the first traffic signal patented, but not the first invented. His traffic signal was a T-shaped pole with arms (but with no lights) that has three signs, one or more of which popped out at a time: a red "stop," a green "go," and another red "stop in all directions." This last signal let pedestrians cross the street. It was controlled by an electric clock mechanism. This device became very popular, and was used all around the USA. Morgan sold his device to the General Electric Corporation for $40,000 (a huge sum at that time). His device was used until the three-light traffic light was developed.

1924	First Signal Command System for Elevators	New York	Otis company develops the first signal command system for elevators and installs it in the Standard Oil Company building in New York. It is the first step towards fully automatic elevator controls.
1925	Uniform Road Signs Adopted by US	Washington, DC	March 2, 1925: Uniform road signs are adopted by the US Joint Board of State and Federal Highway Officials. Standard shape and color schemes for certain categories of road signs are adopted, such as stop signs became octagonal and caution signs required to have black letters on yellow backgrounds.
1926	First Cars With Safety Glass Windows as Standard Equipment	Nationwide	Safety glass was first offered as standard equipment by Cadillac. The transit industry followed suit with bus and rapid transit rolling stock designs.
1926	Antifreeze for Internal Combustion Automobile Engines	Union Carbide Company	First anti=freeze for automobile engines is introduced by Union Carbide company, called Prestone. It sells for five dollars a gallon.
1926	First Designated Pedestrian Crossing	London	The first designated pedestrian crossing is installed at Parliament Square, London. It consists of two parallel white lines across the road.
1927	The Twin Coach	Oakland, California	The "Twin Coach" was a revolutionary bus design by the Fageol brothers of Oakland, California. was released. It was the first use of the entrance door placed in advance of the front axle and also featured the use of driver-controlled, pneumatic doors.
1927	Centralized Traffic Control System (Rail)	General Railway Signal Company / New York Central Railroad	On July 25, 1927, the first centralized traffic control system in the world went in service between Stanley and Berwick, Ohio, on the Ohio Division of the New York Central Railroad. An account from that date by J.J. Brinkworth of the New York Central Railroad illustrates the groundbreaking achievement: "The dispatcher was there and he was just filled up with enthusiasm on this new gadget called centralized traffic control... Along about 10 o'clock, he just yelled right out loud, 'Here comes a non-stop meet.' We all gathered around the machine and watched the lights that you know all about, watched the lights come towards each other and pass each other without stopping. That, to me... was history on American railroads, the first non-stop meet on single track without train orders... and you never saw such enthusiasm in your life as was in the minds and hearts of that crew."
1929	Brill Bullet Car Design	Philadelphia, Pennsylvania	To address stability and smoothness concerns of contemporary designs, Brill, in conjunction with Westinghouse and General Electric, worked on a new rail car design. The result was the 1929 aluminum and steel wind-tunnel-developed slope roof Bullet cars. Trucks were able to handle rough track, improving smoothness. The first order was placed by the Philadelphia and Western Railroad, a third rail line running from 69th Street Upper Darby to Norristown in the Philadelphia region.
1929	First Air-Condidtioned Rail Car	Chicago, Illinois	September 9, 1929: The first air-conditioned Pullman rail car is operated between Chicago, Illinois and Los Angeles, California.
1930	Continuous Welded Rail	Central of Georgia Railroad	In 1893 Hans Goldschmidt of Germany began to experiment with aluminothermic reactions for the production of high purity chromium and manganese. This work led to a patent application for the Thermit process in 1895. A detailed investigation on Thermite welding was carried out in the United States by the Committee On Welded Rail Joints which was composed of members from the American Bureau of Welding and the American Electric Railway Engineering Association. This group had the cooperation of the National Bureau of Standards. The goals of the work were to improve and standardize the making of welded rail joints. In the United States, the Central of Georgia Railroad was first to use welded rail for tunnel trackage in 1930 and the Delaware and Hudson Railroad is credited with the first open-track installation of thermite rail welds in 1933. These efforts lead to the development of Continuous Welded Rail which has become common on main lines since the 1950s. Also see "Modern Railroad Track Structure Design" (1950).

1933	Cat's Eye Road Reflector	Yorkshire, England	The cat's eye road reflector invented by Percy Shaw, Yorkshire, England, is a simple device that has saved countless lives. These inexpensive glass and rubber reflectors are set on the roadway at regular intervals, and help motorists see where the road is at night. Each of the cat's eyes reflects oncoming light, acting like lights set into the road. Shaw invented it after he had been driving on a dark, winding road on a foggy night; he was saved from going off the side of the hill by a cat, whose eyes reflected his car's lights. Shaw's invention mimicked the reflectivity of a cat's eyes. Because of his invention, Shaw was awarded the Order of the British Empire ("OBE") by Queen Elizabeth of England in 1965.
1935	Manual on Uniform Traffic Control Devices (MUTCD) is Introduced	Joint Committee composed of AASHO and NCSHS	The 1935 MUTCD established the need for a manual that standardized the use and design of traffic control devices. In November 1935, the first edition of MUTCD was approved as an American Standard. As the Nation grew and changed, the MUTCD has grown and changed. The manual has been revised approximately every decade to reflect that growth and change. The 1935 edition set the standard for types of signs by classifying them as regulatory, warning, or guide signs. Regulatory signs were black on white rectangles (except the STOP sign was black on yellow or yellow on a red octagon); diamond-shaped slow-type signs warned drivers to slow down; signs that cautioned were square. The manual also promoted using symbols on signs because nighttime roadway illumination was becoming more common. The 3-color signal was also adopted as the standard for signal lenses.
1935	Grade Separated Highway-Rail Crossings	Nationwide	One of the earliest grade separated railroad junctions was a portion of the Nickel Plate Road in Cleveland, Ohio, United States which was completed in 1910. Beginning in 1935, US road builders and city planners adopted viaducts for cars as a solution to the increasingly hazardous at-grade, highway-rail crossings. In this example, cars drive under the Pacific Electric railroad tracks crossing Fletcher Drive, Los Angeles, California.
1936	Automatically Actuated Crossing Gate Signal	Western-Cullen-Hayes, Inc.	Western-Cullen-Hayes, Inc. and its predecessor companies have been serving the railroad industry with crossing warning equipment for over 100 years. Among the company's many "firsts", it provided the first automatically actuated crossing gate signal installed in North America in 1936.
1936	Standard Bus Design	New York	To respond to Mayor Fiorello LaGuardia's order that motorbuses replace electric-traction vehicles, more than 700 buses were purchased in New York City, and a standard was established in bus design (i.e. two doors,a rear-mounted engine and transmission, and a hoodless front end).
1936	First Industry-Developed Standardized Street Railway Car (P.C.C. Car)	Brooklyn & Queens Transit System, New York	The first delivery of an Electric Railway Presidents' Conference Committee (PCC) streetcar was made to the Pittsburgh Railways. The PCC was a light-weight, streamlined streetcar with significantly advanced design and technology compared to older vehicles. They were designed to reduce costs and help stem ridership declines on street railways. Nearly 5,000 were built in the United States and Canada, with the last deliveries in 1952. About 20,000 vehicles based on the standard PCC design were also built in Belgium, Italy, Spain, Czechoslovakia, and Poland.
1939	Flashing Turn Signal Lamps	General Motors	Flashing turn signal lamps were first developed by the Guide Lamp Division of General Motors.
1939	First Street with a Designated Bus Lane	Chicago, Illinois	Chicago city code incorporated bus lanes as early as 1863: "When a bus lane is designated and indicated by appropriate signs or markings, it shall be unlawful for any vehicleoth er than a bus or a vehicle servicing a bus to enter or use such lane, except when making a right hand turn." The first designated bus-only lane was built in 1939.
1940	Two-Way Mobile FM Radio	Hartford, Connecticut	A major advance in police radio occurred in 1940 when the Connecticut state police began operating a two-way, frequency modulated (FM) system in Hartford. The statewide system developed by Daniel E. Noble of the University of Connecticut and engineers at the Fred M. Link Company greatly reduced static, the main problem of the amplitude modulated (AM) system. FM mobile radio became standard throughout the country following the success of the Connecticut system.

1942	Major Changes in Fire Codes, Including Emergency Lighting and Occupant Capacity Placards	Boston, Massachusetts	On November 28, 1942, Boston's packed Cocoanut Grove nightclub burns after a patron accidentally ignites artificial palm fronds in a downstairs lounge. Possible exit doors are sealed or swing inward, and the main entrance is a revolving glass door. With 492 deaths, Cocoanut Grove is the deadliest nightclub fire in U.S. history and the cause of major changes in fire codes and laws, including emergency lighting and occupant capacity placards in nightclubs and other meeting places.
1942	DECELOSTAT Wheel-Slip Prevention	WABCO	WABCO Passenger Transit patented the DECELOSTAT Controller in 1942 to prevent loss of braking due to slippery rail conditions. This wheel slip prevention equipment was an important safety improvement and has been improved many times over the years since.
1950	MacPherson Strut Front Suspension System	Earle S. MacPherson	The MacPherson system has the shock absorber, suspension spring, and wheel spindle (shaft) assembly mounted on each front wheel, and became the standard for most automobiles.
1950	Tinted Glass for Automobiles	Buick	Tinted glass automobile windows first became available on Buick models. The product was designed initially to reduce glare and aid vision for the driver.
1950	Modern Railroad Track Structure Design	Nationwide	Modern Track Structure is composed of three major technology innovations-- pandrol clip, concrete ties, and thermite welding-- in component design, implemented independently of each other over the last hundred years. Adopted by industry since the 1950s, together they have contributed to a substantial decline of track related train accidents. The development of the concrete tie was patented in 1877 by Joseph Monier and first used on the Alford and Sutton Tramway in 1884, followed by the Reading Railway in 1896 but proved unsuccessful and was not revisited until after WWII when modern pre-stressed concrete tie methods were developed to rebuild French and European railroads. While the thermite welding process had existed since the late 1890s, it took the research carried out by a Joint Committee On Welded Rail Joints-- which included representatives of the American Electric Railway Engineering Association-- to standardize its application for rail installation in the U.S. The Central of Georgia Railroad was first to use welded rail for tunnel trackage in 1930 and the Delaware and Hudson Railroad is credited with the first open-track installation of thermite rail welds in 1933. These efforts lead to the development of Continuous Welded Rail which has become common on main lines since the 1950s. Also see "Pandrol Clip" (1957) and "Continuous Welded Rail" (1930).
1951	Automobile Power Steering	Chrysler	First offered on the Chrysler Imperial models, the system uses hydraulic pressure to minimize the effort required to turn the steering wheel. The technology would transfer over to transit bus design in the coming years.
1955	First Use of Remote Control to Move Multiple Unit Railroad Passenger Cars	New York	December 1, 1955: Demonstrated between New Rochelle and Rye, NY, controlled from Larchmont, NY. This innovative practice greatly reduced the risks of worker injury associated with the tasks of repositioning cars in the yard. It is common practice today.
1957	Pandrol Clip Invented as Means of Fastening Rails to Ties	Norway	The Pandrol clip was patented in 1957 by a Norwegian railroad engineer, Per Pande Rolfsen. The resilient design provides greater stabilization of the lateral and longitudinal forces acting on the rail. The design worked especially well in restraining continuous welded rail and was suitable for use on wood or concrete ties.
1959	GM's "New Look" Coach Introduced	General Motors	The bus revolutionized the field with advanced stress-skin aluminum construction and virtually indestructible build quality, along with the Allison V-Series automatic transmission and air suspension. With this model, GM pioneered its standard, and now famous, "fishbowl" windshield design which reduced glare and improved visibility for the operator. GM continued to produce the highly successful model until 1986, with only some modifications.
1959	Federally Mandated Safety Standards in Automobiles	Washington, DC	Congress passed legislation requiring all automobiles to comply with new safety standards, including seat (lap) belts. The shoulder harness requirement came in 1968.

1965	Advances in Computer-Controlled Train Operations	Various	Use of computers to augment train movement and signalization progress rapidly during the last half of the 20th century as speed and power of processors, software, and peripheral devices expanded the use and reliability of automated systems. Beginning in 1965 on the Westinghouse-developed "Sky Bus" automated people mover system in Pittsburgh, the concept of automated control was augmented by programmable logic controllers (PLC) for larger Automated Guideway Transit (AGT) applications-- exemplified by Vancouver's SkyTrain and Toronto Transit Commission's Scarborough Line. The use of computer controls adapted to even more complex system applications in heavy rail environments, with the opening of the Bay Area Rapid Transit District (BART) Automatic Train Operations (ATO) system in 1972. In 2006, the Canarsie Line of New York City Transit demonstrated further capabilities as a Communications-Based Train Control (CBTC) system by modern-day standards. See also "First Application of Communications Based Train Control (CBTC)" (1985); "CBTC-People Mover" (2003); and "CBTC-Transit Rail" (2006). Related: "Positive Train Control (Demonstrated Successfully in Commuter Rail Revenue Service)" (2014).
1965	Pneumatic Differential Engine for Actuation of Passenger Doors on Buses	Vapor	In 1965, Vapor introduced the pneumatic differential engine for actuation of passenger doors on transit buses. It provided maximum velocity and minimum force in the mid-point of its range of motion. This was a safety improvement over conventional door design.
1966	Grade Crossing Predictor	Stanford Research Institute	Grade crossing predictor is patented (Stanford Research Institute), which is the current standard for newly constructed grade crossings. It is a component within the grade crossing active warning system, connected to the rails, and activates the crossing's warning devices (lights, bells, gates, etc.) at a consistent interval prior to the arrival of a train at a grade crossing.
1967	National Transportation Safety Board (NTSB) Established	Washington, DC	In 1967, Congress consolidated all transportation agencies into a new U.S. Department of Transportation (DOT) and established the NTSB as an independent agency placed within the DOT for administrative purposes. In creating the NTSB, Congress envisioned that a single organization with a clearly defined mission could more effectively promote a higher level of safety in the transportation system than the individual modal agencies working separately.
1967	Air Open-Spring Close Door System for Bus Exit Doors	Vapor	Vapor offers the "Air Open-Spring Close" door system for bus exit doors. This most popular exit door design allows the door panels to gently close once the passengers have alighted safely. This is a feature still ordered by many transit agencies on new buses.
1969	Exact Fare Required On Buses	New York	On August 31, 1969, New York City buses began requiring exact change. Before the MetroCard, before the old two-tone token, when fares were just 20 cents, New York City bus drivers did something that today seems almost remarkable. They gave change. City officials praised the policy change for speeding up service and preventing robberies. One driver called it the “best thing” since air-conditioning on buses. Bolting a heavy-duty, locked fare box to the bus floor had pretty much ended robbery attempts. Transit officials cited additional benefits: faster rides, less risk of fare money “disappearing” and fewer accidents caused by distracted drivers.
1970	Automatic Slack Adjuster	Chicago RTA, Chicago, Illinois	The automatic slack adjuster was introduced in 1970 for bus and railcar air brakes, greatly reducing incidents caused by severely worn or "soft" brakes.
1970	Laser-Guided Drilling Techniques Used for Rail Tunnelling	Flathead Tunnel, Northwest Montana	November 7, 1970: Second longest tunnel at the time in the United States, the Flathead Tunnel opens. Workers use new laser beam technology to guide drilling. It is approximately seven miles long.
1974	Sensitive-Edge Seals on Bus Exit Doors	Vapor	Vapor develops and provides "sensitive edge" seals on bus exit doors. The air-wave and sealed cavity design detects passengers or objects obstructing the path of the door, and automatically re-opens the doors for increased passenger protection.
1975	Electronic Alertness System for Locomotive Engineers	Vapor	In 1975, Vapor introduced Plus 1, an electronic alertness system for locomotive engineers that monitors multiple controls and sounds an audible alarm if no actions are detected within a prest time interval.

1977	First Wheelchair-Lift-Equipped Fixed-Route Bus	San Diego, California	Upon initial fitting of wheelchair lifts on transit buses, they were only available in few cities, San Diego being the first to do so. Today, and since the passing of the Americans with Disabilities Act in 1990, all new bus models are required to be fully accessible and over 98% of buses operating in the U.S. are wheelchair accessible (source: Public Transportation Fact Book).
1978	Large Bus System Commits to Fully Accessible Fleet	Seattle Metro, Seattle, Washington	In 1978, Metro Council voted to make Seattle Metro Transit the first large transit system committed to a fully accessible bus fleet. An order of 143 Flyer buses with wheelchair lifts was placed. Today, it's fleet of 1,400 buses is 100% equipped with wheelchair lifts.
1983	NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems	National Fire Protection Agency, Washington, DC	Prior to 1983, there was no national standard for fire-life-safety in transit systems. Standards available for buildings were not always appropriate and needed to be modified by individual agencies. Recognizing the gap, the Fixed Guideway Transit Systems Technical Committee was formed in 1975 and immediately began work on the development of NFPA 130. One of the primary concerns of the committee in the preparation of this document centered on the potential for entrapment and injury of large numbers of people who routinely use these types of mass transportation facilities. During the preparation of the first edition of this document, several significant fires occurred in fixed guideway systems, but fortunately the loss of life was limited. The committee noted that the minimal loss of life was due primarily to chance events more than any preconceived plan or the operation of protective systems.
1983	Hazard Communicatio n Standard	OSHA, Washington, DC	OSHA issues its Hazard Communication Standard, which requires employers to inform and train millions of workers who are exposed to or handle toxic substances.
1985	First Application of Communicatio ns Based Train Control (CBTC)	Toronto Transit Commission, Toronto, Ontario, Canada	The Scarborough RT was the first implementation of the Intermediate Capacity Transit System (ICTS) technology developed by the Urban Transportation Development Corporation (UTDC). Rather than the standard and relatively larger subway cars used by the other lines of the Toronto subway, the Scarborough RT rolling stock consisted of smaller vehicles with steerable trucks, powered by linear induction motors. The Scarborough RT was also the first application of a moving block, communications-based train control (CBTC) system for automatic train protection (ATP). The characteristics of the system included: High-resolution train location determination, independent of track circuits; Continuous, high capacity, bidirectional train-to-wayside data communications; and Train-borne and wayside processors performing vital functions.
1986	Rail Safety Audit Program	APTA, Washington, DC	APTA initiated the Rail Safety Audit Program (RSAP) and developed the Manual for the Development of Rail Transit System Safety Program Plans which formed the basis of APTA's modal safety management programs, currently for Rail, Commuter Rail and Bus transportation systems. The program was subsequently adopted in 1996 by the Federal Transit Administration as the base guideline for its state safety oversight (Part 659) requirements.
1986	Computerized Safety Information and Data Analysis System (SIDAS)	Washington Metropolitan Area Transit Authority (WMATA), Washington, DC	After an in-depth study conducted by WMATA's Office of Safety and Fire Protection, an immediate need for 'computerizing' safety data was found. WMATA presented its efforts at the 1987 APTA Annual Rapid Transit Conference, June 14-18, 1987. Innovative at its time, the data analysis system contained bus and rail accident/incident databases to more effectively capture contributing factors and potentially unsafe conditions. In addition, the system allowed analysis of occupational safety & health data, material safety data sheets (MSDS) and chemical information, safety and fire protection inspections, safety and fire protection training records, and accident/incident recommendation follow-up.
1986	First Driverless Application of Communicatio ns Based Train Control	SkyTrain, Vancouver, British Columbia, Canada	The Intermediate Capacity Transit System (ICTS) was developed by Ontario's Urban Transit Development Corporation (UTDC) as a transit system that was lighter and smaller, and therefore cheaper to build and run than a full-fledged heavy-rail subway, but capable of higher capacities and shorter headways than a streetcar line. The Vancouver SkyTrain was the first major deployment of this technology which included short-headway, fully automated (driverless) operation utilizing moving-block, communications-based train control (CBTC) technology providing automatic train protection (ATP), automatic train operation (ATO) and automatic train supervision (ATS) functions.
1987	Introduction of Random Drug and Alcohol Testing	Federal Railroad Administration, Washington, DC	The horrific Amtrak/Conrail rail accident at Chase Maryland in Janaury 1987 forever changed the public perception of substance abuse in the workplace with the FRA introducing random drug and alcohol testing for train operating employees. Later in the same year, USDOT followed suit for its safety sensitive employees. These moves led to transportation industry-wide rules in 1990 for drug and alcohol free workplaces.

1987	Altoona Bus Research and Testing Center	Pennsylvania Transportation Institute (State College, PA) and Federal Transit Administration	Originating at a bus testing facility in Altoona, Pennsylvania, the FTA New Model Bus Testing Program at the Altoona Bus Research and Testing Center (Altoona Center) in Duncansville, Pennsylvania, is designed to promote the production of better transit vehicles and components, and ensure that transit customers purchase safe vehicles able to withstand the rigors of transit service. The Bus Testing Program of the Federal Transit Administration was established in response to the requirements of the Surface Transportation and Uniform Relocation Assistance Act (STURAA) of 1987. Under the program, testing was required on all new model buses before they can be purchased with federal funds. Vehicle testing and minimum safety standards for FTA-funded vehicles were also mandated more recently by the signing into law of the Moving Ahead for Progress in the 21st Century Act (MAP-21) in 2012.
1989	First Prototype Ergonomically Designed Bus Operator Workstation	BC Transit, Vancouver, British Columbia, Canada	Leading the movement to design a modern ergonomic driver workstation to reduce musculetal and soft tissue repetitive motion injury, Dale Laird of BC Transit retrofitted a trolley bus based upon ergonomic principles designed to fit the 95th percentile driver. This effort was quickly adopted by Bus operations in Seattle, Portland and Sacramento. In 1991 the Canadian Urban Transit Association commissioned an Ergronomic Study of the Bus Driver's Workstation and in the same year, New Flyer Industries produced the first OEM production bus with designed ergonomic features which then swept the industry.
1991	Priority Alarm System for Bus Operators	Bach-Simpson, GO Transit, Toronto, Ontario, Canada	Bach-Simpson provided the first Priority Alarm System to Toronto GO Transit in 1991. The system allowed operators to send a priority signal to the dispatcher or control center in the event of an emergency. It also included a "passenger assist" feature for passengers to press in an emergency.
1991	Bloodborne Pathogens Standard	OSHA, Washington, DC	OSHA protects 5.6 million workers exposed to the hazards of HIV/AIDS and hepatitis B with this standard.
1991	Tilt-train Technology Tested; Later Implemented on Northeast Corridor	Amtrak	Tilt-train technology tested and implemented on Northeast Corridor (Amtrak's Acela Express) between Washington and Boston beginning in 2000. The new train is designed to allow higher speeds on existing tracks, for it automatically tilts as it enters curves and counters the centrifugal force passengers would normally feel. Its computer automatically turns the wheel and axle assembly to follow the curve, making for a smoother ride and safer passenger compartment.
1993	Confined Spaces Standard	OSHA, Washington, DC	OSHA issues a standard requiring safe procedures and permits for entry into confined spaces, including underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines. The standard prevents more than 50 deaths and more than 5,000 serious injuries annually for the 1.6 million workers who enter confined spaces.
1995	APTA Becomes Standard Development Organization, Releases Passenger Rail Equipment Safety Standards (PRESS)	Washington, DC	After serious rail accidents in Silver Spring, MD and Secaucus, NJ the lack of US passenger car construction standards was identified in the accident investigations as an urgent need. APTA, at the urging of FRA, established the PRESS Task Force to assume responsibility for the developing new and updating old AAR standards for commuter and intercity rail passenger cars. APTA organized a multi-disciplined task force of industry volunteers that produced the first volume of standards in a year's time. These standards became the nucleus of the 49CFR Part 238 regulations. The PRESS documents spearheaded APTA's standards program and continue to provide a high level of safety and survivabilty in new rail passenger car structure and systems.
1998	Video-Based Driver Risk Management	DriveCam	In 1998, the DriveCam(R) Program was created using a patented video event recorder and software interface to capture driving behavior to improve fleet safety, identify passenger issues and understand crash causation. Initially adopted in the transit industry by Laidlaw Transit in 2004, video-based driver risk management has subsequently become a standard of the industry and is used by transit operators such as SFMTA, WAMTA, New Jersey Transit, First Transit, MV Transit and many other agencies throughout the country.

1999	Bus Simulator for Transit Bus Applications	New York City Transit, New York	The FAAC MB-2000 bus simulator offered a variety of visual display options (with varying horizontal fields of view) and real mirrors—depending on the customer's training requirements. It featured a fully enclosed bus cab, authentic bus dash, side instrument panel, and seating configuration, and TrueFeel Steering providing a more realistic "feel" for force feedback, camber recovery, tire scrub, curb strikes and road vibration. It also included a feature allowing instructors or students to switch to an overhead view and review street-level situations.
2000	Advanced Civil Speed Enforcement System (ACSES II)	Alstom	Alstom's Advanced Civil Speed Enforcement System (ACSES II) is a continuous speed control system with transmission of data from transponders and radios. ACSES II core functionality utilizes Alstom's worldwide products for PTC systems. ACSES II is in operation on the Northeast Corridor (NEC), the busiest rail segment in North America, currently allowing high-speed train travel up to 150 mph. It is the first fully functional PTC solution with FRA Type Approval (49CFR236 subpart I) and System Certification in revenue service since 2000.
2001	Lane Departure Warning System	Nissan, Japan	Nissan became the first automaker to offer a lane departure warning system in an automobile. Toyota followed suit in 2002, and improved it further in 2004 to include the capability for the system to apply a small counter-steering force to avoid lane departure. Among other Intelligent Transportation Systems (ITS) being evaluated, several efforts are currently underway to investigate and develop applications for the public transit industry.
2002	FTA Handbook for Transit Safety & Security Certification	Federal Transit Administration, Washington, DC	A Joint Task Force on Safety and Security Certification comprising FTA, APTA and industry stakeholders, prepared this handbook to support efforts of the industry to achieve continuous improvement in safety and security performance. It provides a guide for establishing a certification program that identifies key activities, incorporates safety and security more fully into transit projects, highlights resources necessary to develop and implement a certification program, and provides tools and sample forms for the user. "Application of safety and security certification promotes an informed management decision-making process in project design, construction, testing, and initiation into revenue service" - Handbook, pg. 1
2003	Communications-Based Train Control (CBTC) - People Mover	Bombardier, San Francisco, California	Bombardier introduces the first radio-based communications-based train control system (CBTC) on the airport Automated People Mover
2006	Communcations-Based Train Control (CBTC) - Transit Rail	New York City Transit, New York	In 2006, New York City Transit completed a CBTC installation on its Canarsie Line and became the first transit property in the US to implement CBTC technology in a heavy rail environment (modern day standard application). The Canarsie Line was NYCT's "pilot project" for CBTC, prior to rolling out the technology system-wide. NYCT's goals for CBTC are to increase capacity, enhance safety and improve the availability and maintainability of the signaling system. The Canarsie Line CBTC system was supplied by Siemens and was designed for semi-automatic train operations. While a train operator is retained in the lead cab of the train, train movements between stations are automatic under the control and protection of the CBTC system.
2008	Rail Safety Improvement Act of 2008	Washington, DC	The Rail Safety Improvement Act of 2008 is enacted by Congress to improve railroad safety, in which among its provisions, was the mandate for positive train control (PTC) developed in response to the Chatsworth train collision that same year
2009	Health, Safety & Environment Self Certification for Contractors and Visitors	Bombardier Transportation	Bombardier built a computer-based training program (CBT) that certifies contractors and visitors prior to being on-site, reducing the overhead required to organize and schedule typical instructor-led training programs. Using Bombardier's Operations & Maintenance site HSE policies, a matrix was built detailing which policies are 'site unique' and which policies apply to all sites. Instructional designers and Subject Matter Experts then developed a storyboard breaking the content down into smaller modules and applying visual and interactive learning concepts. The storyboards were then given to the designers and programmers to develop a highly visual and interactive training program in a modular way that can be altered to accommodate future changes. To date, over 1000 contractors and site visitors have taken the courses across six sites in English and French.

2011	Mirror Awareness Guide (MAG) Device	Capital Metropolitan Transportation Authority, Austin, Texas	One of Capital Metro's most common type of collisions was mirror-to-mirror. Surprisingly, more collisions occurred from vehicles overtaking buses rather than from oncoming traffic. To counter this problem, the agency developed its Mirror Awareness Guide (MAG) devices and affixed them to the street-side rear section of its buses. The MAG device is the width of a bus mirror and set to the center height of the street-side exterior mirror. The premise is simple: when an overtaking vehicle approaches the bus and begins to pass, the driver should notice the protruding MAG device, which focuses their attention on the bus, causing them to pass with a wider safety cushion. If they fail to notice the device and travel too closely to the bus, their mirror will hit the device producing a loud noise without harming their mirror or the flexible MAG. The key benefits are inexpensive design, quick-and-easy installation and a reduction of mirror-to-mirror accidents.
2012	Alternating Blank-Out Signs at Rail Grade Crossings	Regional Transportation District, Denver, Colorado	In 2012 the new blank-out signs were installed at the five crossings on the Denver Regional Transportation District (RTD) light rail area known as the Cascades. This is the part of the Central Light Rail Corridor adjacent to and near the Auraria Campus, which houses the University of Colorado Denver, Metropolitan State University, and the Community College of Denver. Cascades crossings experience high traffic and have historically shown some of the higher crash volumes of the entire RTD LRT system. The new blank-out signs include the W10-7 “Light Rail Transit Approaching” symbol sign that alternate with either the R3-1 “No Right Turn” symbol sign or the R3-2 “No Left Turn” symbol sign, depending to the posted location. These alternating blank-out signs both regulate the motorist by prohibiting left-turn or right-turn movements across the tracks while at the same time warning them of approaching LRT trains. The “before” and “after” statistical analysis and safety study was conducted in 2014. It shows that the new alternating blank-out signs are effective in decreasing the frequency of violations and risky behaviors at at-grade crossings as they provide a clearer message to motorists of the risk of making a turn while providing an explanation of that risk.
2012	Rail Activation "Hold Point" process	Utah Transit Authority, Salt Lake City, Utah	New, deliberate activation process put into place at UTA which facilitated the successful openings of 4 new rail lines (67 miles) in a one year period. The Hold Points separate the phases of a rail project, especially in the final year of activation. Phases included construction & stand alone testing, system integration, pre-revenue operations and revenue operations. Each hold point required specified Certifiable Items Lists and processes to be signed off by the Chief Safety Officer and others before proceeding to the following phase. It is currently promoted as a FTA "best practice" for the transit industry.
2013	Display of Safety Messages on Destination Signs	Capital Metropolitan Transportation Authority, Austin, Texas	Capital Metro in Austin, Texas imlemented safety messages displayed on outside destination signs, in an effort to reduce collisions, injuries and damage to property. These safety messages also include warnings for distracted driving and impaired driving. While many transit agencies include safety messaging in their public relations materials, Capital Metro is among the first agencies to utilize the scrolling LED destination signs for this distinct purpose. The messages include: Drive Friendly Drive Safely Don't TXT N DRV Talk Text CRASH Share the Road Sober Ride Pass With Care
2013	Enhanced Visibility of Bus Fleet With Retro-Reflective Tape	Capital Metropolitan Transportation Authority, Austin, Texas	Capital Metro incorporated high-visibility (retro-reflective) conspicuity tape into its bus livery for enhanced visibility, which is in line with the standard safety requirement of public school bus fleets. No such standard currently exists for transit buses.
2013	Confidential Close-Call Reporting for Rail Transit	Washington Metropolitan Area Transit Authority (WMATA), Washington, DC	In 2013 WMATA's General Manager / CEO and ATU Local 689 signed an MOU to implement a non-punitive confidential close call reporting program to encourage employees to report events that would not have been identified otherwise. Similar programs have been adopted by other-- primarily commuter and inter-city rail-- operators.

2013	Fatigue Risk Management Program	Washington Metropolitan Area Transit Authority (WMATA), Washington, DC	From 2011 to 2013, WMATA worked on developing and implementing its' Fatigue Risk Management System (FRMS) program to ensure employees have adequate rest to help ensure fitness for duty. November 14, 2013 WMATA's GM/CEO signed WMATA Policy/Instruction establishing a Fatigue Management Program. For this and other important policy and procedural changes, WMATA earned the Gold Award for Safety Excellence in 2014. Confidential Close Call Reporting has been implemented primarily by the Class 1 Freight Railroads and Amtrak, in partnership with the Federal Railroad Administration. It is currently being introduced in a variety of formats for the Rail Transit environment.
2013	Emergency Training Facility With Advanced Technology Built in Re-purposed Subway Station	Massachusetts Bay Transportation Authority	The MBTA Emergency Training Center is a state-of-the-art public transit emergency training facility located in Boston, Massachusetts. The facility opened in June 2013 and offers advanced training, exercise, and simulation capabilities in a realistic tunnel environment. The facility consists of multiple training areas, each dedicated to different transit modes or response functions, including heavy rail, light rail, bus, power, evacuation, as well as both law enforcement and fire response. The space that is now occupied by the MBTA Emergency Training Center began life in 1917 as an underground streetcar station. Only two years later, on October 14, 1919, the station was closed after being made redundant. In the years since, the abandoned space saw a variety of uses, including storing material and testing station accessibility enhancements. In 2009, MBTA officials began exploring the feasibility of converting the space into a state-of-the-art emergency training facility for transit. Through a grant from the Department of Homeland Security, this vision was fulfilled in 2013. For their efforts, MBTA won the 2014 APTA Rail Security Excellence Award presented by APTA at the 2014 Rail Conference.
2014	Positive Train Control (Demonstrated Successfully in Commuter Rail Revenue Service)	Metrolink, Los Angeles, California	In February 2014, Metrolink unveiled Positive Train Control (PTC) in Revenue Service Demonstration, becoming the first commuter rail service in the U.S. to rollout PTC. PTC is a set of highly advanced technologies designed to automatically stop or slow a train before certain types of accidents occur, and its implementation is mandatory for railroads-- including commuter railroads-- in the United Staters (with passage of the Rail Safety Improvement Act of 2008) which are regulated by the Federal Railroad Administration.