U.S. Freight Railroads

U.S. freight railroads serve a critical role in the supply chain, accounting for around 40% of long-distance ton-miles — more than any other mode of transportation. These privately owned companies spend billions annually to maintain their networks and offer an environmentally efficient transportation mode. America's freight railroads — the most productive and cost-effective in the world — support job creation, increase our nation's productivity and competitiveness, and combat climate change.

Learn more at AAR.org/Railroad-101

Big Investments

Railroads spend an average of well over $20 billion a year on a nearly 140,000-mile network they almost exclusively own and maintain.

Safe

The last decade was the safest ever for U.S. railroads, with mainline accident rates and hazmat accident rates at an all-time low.

Fuel-efficient

Railroads are the most fuel-efficient way to move freight over land, with 1 train moving 1 ton of freight nearly 500 miles on 1 gallon of fuel, on average.

Economic Engine

Railroads haul one-third of U.S. exports and serve nearly every sector of the economy, from moving the food we eat to the chemicals that treat our water.

Customer-focused

Avg. rail rates (measured by inflation-adjusted revenue per ton-mile) are 44% lower today than in 1981, meaning the typical rail shipper can move much more freight for around the same price as 40 years ago.

Innovative

Employees use technology like trackside smart sensors to predict and prevent problems. Positive Train Control (PTC) automatically stops a train in certain instances to reduce specific types of human-caused errors.

Community Partners

Railroads train thousands of first responders annually and developed the AskRail app to provide railcar information in the event of an incident.

Hiring

Railroads are actively hiring for good, unionized jobs, which have total compensation that ranks within the top 10% of all industries.

Promote a Greener, Less-Congested Future

Greenhouse gas emissions are directly related to fuel consumption. According to EPA data, freight railroads account for just 0.5% of total U.S. greenhouse gas emissions and just 1.9% of transportation-related greenhouse gas emissions.

One train can move one ton of freight nearly 500 miles on one gallon of fuel. Moving freight by rail instead of trucks lowers greenhouse gas emissions by up to 75%, on average. AAR analysis of federal data finds: If 25% of the truck traffic moving at least 750 miles went by rail instead, annual greenhouse gas emissions would fall by approximately 13.1 million tons. A single freight train can replace several hundred trucks, freeing up space on the highway for other motorists.

Maintain Balanced Economic Framework

Thanks to deregulation in 1980, which was founded on strong economic principles and spurred railroads to invest billions into their networks, improving safety and customer reliability and dramatically lowering rates. To meet changing customer demands, railroads need a common-sense regulatory system that provides effective oversight but allows railroads to earn enough to provide the rail system our economy needs to grow. Policymakers must maintain regulatory and legislative policies that allow for innovative solutions, whether it is safety improvements, supporting new markets or evolving to maintain our competitive edge. Rail's role as a transportation solution for tomorrow hinges on these smart policies.

Retain Truck Length & Weight Rules

Any changes overturning current federal law would shift traffic off railroads and onto highways with detrimental impacts on the environment and road infrastructure. According to EPA data, freight rail accounts for 40% of U.S. long-distance freight ton-miles, but just 1.9% of transportation-related emissions. Moving freight by rail instead of truck lowers greenhouse gas (GHG) emissions by up to 75%, on average. Proposals to increase TSW limits have routinely been rejected in bipartisan House and Senate votes.

In 2016, the U.S. Department of Transportation (DOT) recommended to Congress against changing federal TSW limits, concluding that heavier and longer trucks would cause billions of dollars in infrastructure damage. Following a request from the Federal Highway Administration, the Transportation Research Board also released a report in November 2018 identifying 27 research projects focused on pavement, bridges, safety, enforcement, and shipper decisions that need to be completed to evaluate the impacts of heavier or longer trucks more fully on our infrastructure and the safety of other motorists. Since fiscal year 2020, Congress has directed DOT to publish an implementation plan for conducting this research — including timelines for its completion — and has stated that the research results should be reviewed before any changes in TSW limits are considered.

Freight Railroads Move America Safely

Freight railroads are the safest way to move goods over land. The last decade was the safest ever for U.S. railroads, with mainline and hazmat accident rates at an all-time low.

Railroads work with their employees, suppliers and customers, and federal, state and local officials to safeguard the rail network. Railroads' holistic approach to rail safety focuses on four key areas: infrastructure and equipment investment; training and operational improvement; technology deployment; and community outreach and preparedness. The high standard railroads apply to every aspect of operations underpins this approach. Railroads often exceed federal inspection regulations while also advocating for tougher safety standards.

In March 2023, freight railroads announced seven key safety measures to help drive accidents to zero, including installing approximately 1,000 new detectors.

Key Takeaways

- Railroads are a very safe way to move freight and are working hard to improve infrastructure and equipment safety, reduce human error and protect the rail network every day.
- The last decade was the safest ever for U.S. railroads, with mainline accident rates and hazmat accident rates at an all-time low.

Employee Safety

The employee casualty rate is at an all-time low.

The rail industry has lower employee injury rates than most other sectors, including trucking, airlines, anufacturing and construction. State-of-the-art training centers with simulators and virtual reality enable employees to practice real-life skills in a controlled environment. Daily employee meetings emphasize teamwork and continual learning on the job. New technologies, like drone-based bridge inspections, help keep employees out of harm's way while giving them the tools to excel at their jobs.

Network Safety

In recent years, America's freight railroads have been pouring record amounts back into their infrastructure and equipment, which has helped improve safety.

The American Society of Civil Engineers (ASCE) awarded America's rail network the highest grade in its most recent Infrastructure Report Card, a B. Thanks in part to rail's investments and multi-layered inspection practices, FRA data show that the last decade has been the safest ever for railroads, with the Class I railroads' mainline train accident rate at an all-time low and down 49% since 2000.

Technology

Innovations have driven safety gains over the last two decades.

Today's highly skilled rail workforce uses technology — from new design specifications for rail cars and track components to smart sensors to big data and drones — to monitor network and equipment health n real time. These technologies help guide maintenance planning, which has led to greater safety, accuracy and productivity than ever before. Automated technologies will allow further progress in challenging areas like reducing human error and improving grade crossing safety. Many of these rail-related technological advancements are developed at MxV Rail (formerly the Transportation Technology Center, Inc. or TTCI) in Pueblo, Colorado, a subsidiary of the AAR that is widely considered the best rail research facility in the world.

For example, Positive Train Control (PTC) is technology that reduces the number of human error-caused accidents by automatically stopping or slowing a train to prevent four specific types of accidents. These include train-to-train collisions; derailments caused by excessive speed; accidents that can occur if trains are routed down the wrong track; and unauthorized train movements on tracks undergoing maintenance. Today, PTC is fully implemented and in operation on 100% of Class I PTC route-miles network-wide.

Preparedness & Response

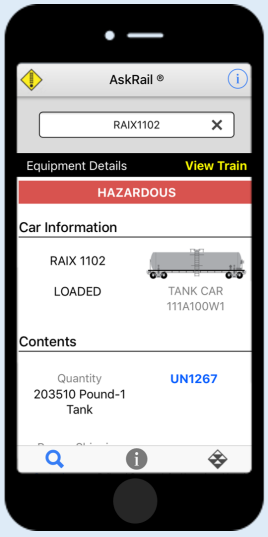
Railroads work with public and private partners daily to monitor and protect the nearly 140,000-mile freight rail network.

Natural disasters, physical and cybersecurity threats, and pandemics can disrupt railroad operations and hamper federal and state response and recovery efforts. To help ensure continued operations, railroads employ cyber and physical security experts, police officers, and intelligence professionals to monitor, identify and respond to threats. Railroads maintain and implement comprehensive response plans with federal, state, local, and industry partners based on past experiences, such as the COVID-19 pandemic and 9/11. Through collaboration and daily intelligence sharing, railroads stay ahead of emerging threats.

Hazardous Materials Safety

More than 99.9% of all hazmat moved by rail reaches its destination without a release caused by a train accident.

Railroads work with customers, suppliers, communities and federal regulators to safely move hazardous materials and mitigate the rare accidents that occur. Along with calling for rigorous tank car design standards, railroads train more than 20,000 first responders each year; created the AskRail mobile app that gives emergency responders immediate access to information on what is in a particular rail car and how to respond to it; and developed software with the FRA that determines the safest rail routes for hazmat. These efforts — coupled with ongoing investment, technology, employee training, improved operating practices and community outreach efforts — have lowered hazmat accident rates by 78% since 2000.



Railroads worked with the International Association of Fire Chiefs to develop the AskRail app, which provides immediate access to timely data about what type of hazmat a railcar is carrying so first responders can make an informed decision about how to respond to a rail emergency.

Pedestrians & Motorists

Railroads work with state, local and federal officials, safety organizations, technology companies and the public to reduce accidents and injuries at highway-rail grade crossings and along railroad tracks.

Collisions at grade crossings and incidents involving trespassers on railroad property account for well over 95% of rail-related fatalities. These incidents usually arise from factors outside railroad control, but railroads are committed to reducing their frequency.

Railroads invest heavily in grade crossing safety, spending hundreds of millions of dollars each year to close, improve and maintain crossings and millions more on educational programs, including Operation Lifesaver, a non-profit dedicated to improving safe behavior at grade crossings. Grade crossing collisions were down 23% last year compared to 2000, but along with trespass incidents, these preventable accidents remain persistent challenges across the rail industry. Over 95% of rail-related fatalities are trespassers or grade crossing users. The combined total of trespasser and suicide fatalities for 2022 increased by 4% from 2021.

Performance-based Regulations

Forward-thinking regulations allow railroads to use technology to achieve shared safety goals better.

The FRA oversees virtually every aspect of freight rail operations, including track and equipment inspections, employee certification, operating speeds and signaling systems. Freight railroads often exceed FRA regulations while advocating for even tougher safety standards. In the years to come, new regulations should be performance-based rather than prescriptive. This will focus industry attention and effort on the outcome rather than on how that outcome is achieved, allowing railroads to innovate with the latest technologies that will bring them closer to an accident-free future.

Freight Rail Safety Inspections

Across the network, railroads employ thousands of well-trained inspectors — qualified per Federal Railroad Administration (FRA) regulations — who monitor and assess the health and safety of the equipment that moves essential goods and materials and the track that spans nearly 140,000 miles.

There are prescribed training standards for any employee who inspects or performs tasks covered by a federal rule, including those who inspect such things as signals, tracks, railcars, locomotives and bridges. In addition to conducting the various inspections required by FRA, railroads have — for decades — voluntarily invested in testing, implementing and advocating for advanced inspection technology to supplement manual inspections.

Every day, around the clock, thousands of sensors throughout the rail network collect billions of data points that generate alerts for issues that require immediate attention.

Furthermore, advanced computer programs, machine learning and AI analyze the data, identifying patterns and predicting what network elements may soon need to repair or replaced days or even months in advance. These elements include tracks, wheels, bearings, locomotive components and more. This information helps give railroads lead time to proactively schedule maintenance and fix issues before they become dangerous.

Key Takeaway

Thanks in part to rail's multi-layered inspection practices, FRA data show that the last decade has been the safest ever for railroads, with the Class I railroads' mainline train accident rate at an all-time low and down 49% since 2000.

Track Inspections

Track inspection technologies have helped railroads achieve substantial safety gains in recent years, with 2022 marking the lowest-ever rate of track-related accidents.

Freight Train & Equipment Inspections

Railroads have significantly invested in testing and deploying equipment inspection technologies without federal requirements. FRA research shows these devices help enhance safety. Since 2000, the equipment-caused accident rate is down 21%.

DEEP DIVE

Track Inspections

The American Society of Civil Engineers (ASCE) has repeatedly awarded railroads the highest grade in their Infrastructure Report Card. ASCE cited sustained private investments by the nation's freight railroads as the primary reason for the network's good condition. From 1980 to 2021, America's privately owned freight railroads spent about $760 billion — averaging well over $20 billion per year — to maintain and improve their network. That investment breaks down to more than $260,000 spent on average per mile of the freight rail network. Inspections and maintenance make up a significant amount of that spending.

All disciplines perform, at a minimum, the federally required inspections as well as additional inspections as called for in each railroad's maintenance rules. On top of these federally required visual inspections, there are also federally mandated internal rail inspections, bridge inspections, signal, crossing and geometry inspections. Many railroads do each of these at a higher frequency than prescribed by the regulations, and advanced technologies increase the speed of these inspections while improving their quality.

For example, track geometry and ultrasonic track inspections help pinpoint defects that are usually not visible to the human eye or can only be identified when the track is in use. They also allow railroads to inspect more track in less time and provide data to schedule maintenance proactively.

ATI technologies measure how the track structure performs under the weight of a train. Automated Track Inspection (ATI) systems use lasers and cameras mounted onto locomotives or railcars to inspect track as the train travels across the network. Track inspection vehicles, or "track geometry cars," can measure hundreds of thousands of track miles yearly. An advanced algorithm can analyze track alignment of more than 1,500 curves in track in just a few hours, whereas it would have taken a team of four people 10 months to complete the same task manually.

Ultrasound looks for flaws inside tracks and ties. As a train travels over any track segment, energy is transmitted through the track and into the ground below. This energy can be measured as a series of sound waves, collectively called an acoustic signature. The acoustic signature of a track is different depending on the health of the track. Going further down, ground-penetrating radar looks inside track foundation — known as ballast — to see water damage or deterioration.

Drones inspect tracks and ballast. Loose or missing fasteners in track, for example, or soft spots in ballast could cause more stress on the track structure and lead to signal problems. Railroads use drones most frequently after weather events to look for washouts, downed trees, misaligned track and other conditions caused by weather. Drones can also look at areas of track affected by severe weather. This technology provides trending data because railroads can analyze older snapshots with newer ones.

Signal inspectors inspect active grade crossing devices. Railroad employees also help ensure safety at the points where trains cross roads. Inspectors climb up on the lights to ensure they are pointed in the right direction, open the bungalow and check everything in the case, and look at the timing and distance between the train coming into the crossing circuit and the crossing protection coming down.

Bridge inspectors and sonar technology help safeguard bridges. Regular inspections of railroad bridges by inspectors or drones are vital for trains safely transporting goods across bodies of water. More frequent inspections occur for bridges with more intensive traffic or whose conditions may warrant closer monitoring. Railroads follow an aggressive "safety first" policy and immediately alter or suspend service on any bridge until all concerns are addressed, and repairs are made if necessary. Railroads use drones to inspect bridges and to take video and pictures of hard-to-reach areas within the bridge. Sonar identifies increased erosion around the piers, which can compromise a bridge's integrity.

DEEP DIVE

Train & Equipment Inspections

FRA regulations and AAR interchange standards establish stringent thresholds to ensure the health and safety of the more than 1.6 million railcars (and 12 million wheels) traveling across the country daily. Rail employees visually inspect each train before departure in accordance with those standards. If a car does not meet those standards, railroads make appropriate repairs to ensure safety. The customer owns more than 99.9% of all tank cars, while entities other than railroads own more than 80% of all covered hopper cars, such as all cars that carry plastic pellets.

Some defects can only be identified when the asset moves, which only technology can accomplish. This technology also helps increase the safety of the inspector. To ascertain the equipment's current condition, wayside detectors use various technologies — such as infrared and lasers — to assess the health and safety of locomotives and railcars traveling along the national network. They alert railroads to anomalies or troubles with locomotive or railcar components that could affect their performance, damage track or become a safety hazard. The Asset Health Strategic Initiative, a program developed in the mid-2000s and led by AAR and its data management subsidiary, Railinc, maintains the "Equipment Health Management System (EHMS). Through the EHMS, Railinc collects and centralizes detector-generated data to help car owners and railroads see alerts and proactively repair equipment based on AAR or FRA rules. Here are just a few examples of the wayside detectors railroads use:

While a train is on the move, hundreds of sensors throughout the locomotive continually gather data on the performance of individual components. Sensors transmit the data to analysts using real-time software to identify equipment needing maintenance. Locomotives also have fuel management systems that use sensors that provide engineers with real-time recommendations on how to operate the train to maximize fuel efficiency, but also sense when an engine is getting too hot or when oil is contaminated.

Machine visioning inspects passing trains. Machine visioning technology uses cameras that collect 40,000 images per second of trains as they pass by at up to 60 MPH. This technology reduces inspection times to mere seconds. A series of algorithms then analyze the images to identify any anomalies, allowing railroads to resolve issues faster than they could with manual inspections alone. The technology helps railroads look at many elements simultaneously, providing a comprehensive view of locomotives, trains and their components.

Lasers and scanners measure the wheel profiles of moving trains. Wheel Profile Detectors (WPDs) measure wheel profiles of moving trains using laser and optical scanning devices to take images of the flange, tread and other aspects of the wheel. The WPD data summary aims to get an aggregate view of these measurements. The data summary can be used to analyze wheel trends and determine wheel wear and condition. This data can alert railroads when immediate action must be taken to remove a car from service or if a wheel is worn beyond the FRA and AAR thresholds.

Hot bearing detectors sense overheating bearings. Railroads monitor bearing temperatures using heat-sensing detectors placed at intervals along the right-of-way to notify the engineer if it is necessary to stop a train due to an overheated bearing. Some hot bearing detectors (also known as hot box detectors) transmit bearing temperature data so that bearings that are warmer than average but still safe to operate can be tracked and replaced before they reach the end of their useful life.

Wheel impact load detectors reduce broken rails and wheel and bearing failures. These detectors identify wheels that are heavily pounding on the tracks and cull them out of service if they are reaching the end of their useful life.