Transportation of LNG and Other Hazmat by Rail

Committee for the Safe Transportation of Liquefied Natural Gas by Railroad Tank Car – Phase 2 Information-Gathering Meeting

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ASSOCIATION OF AMERICAN RAILROADS

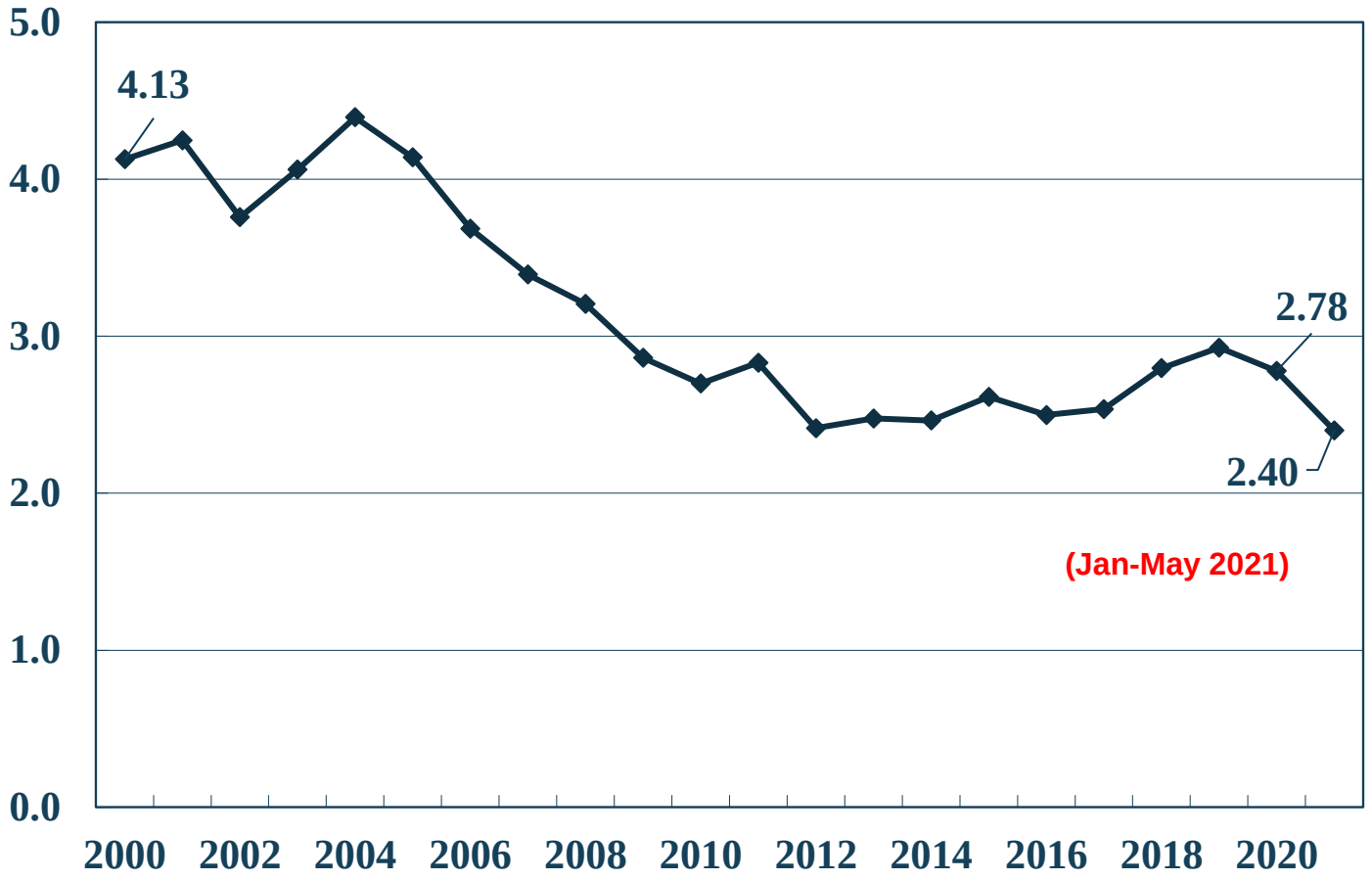
Railroad Safety 2020

The Train Accident Rate Change Since…

	2000	2011	2019
Train Accidents	**-33%**	**-2%**	**-5%**
...Human Factors-Caused	-27%	+11%	-2%
...Track-Caused	-52%	-29%	-12%
...Equipment-Caused	-22%	+22%	-1%
...Derailments	-35%	-7%	-4%

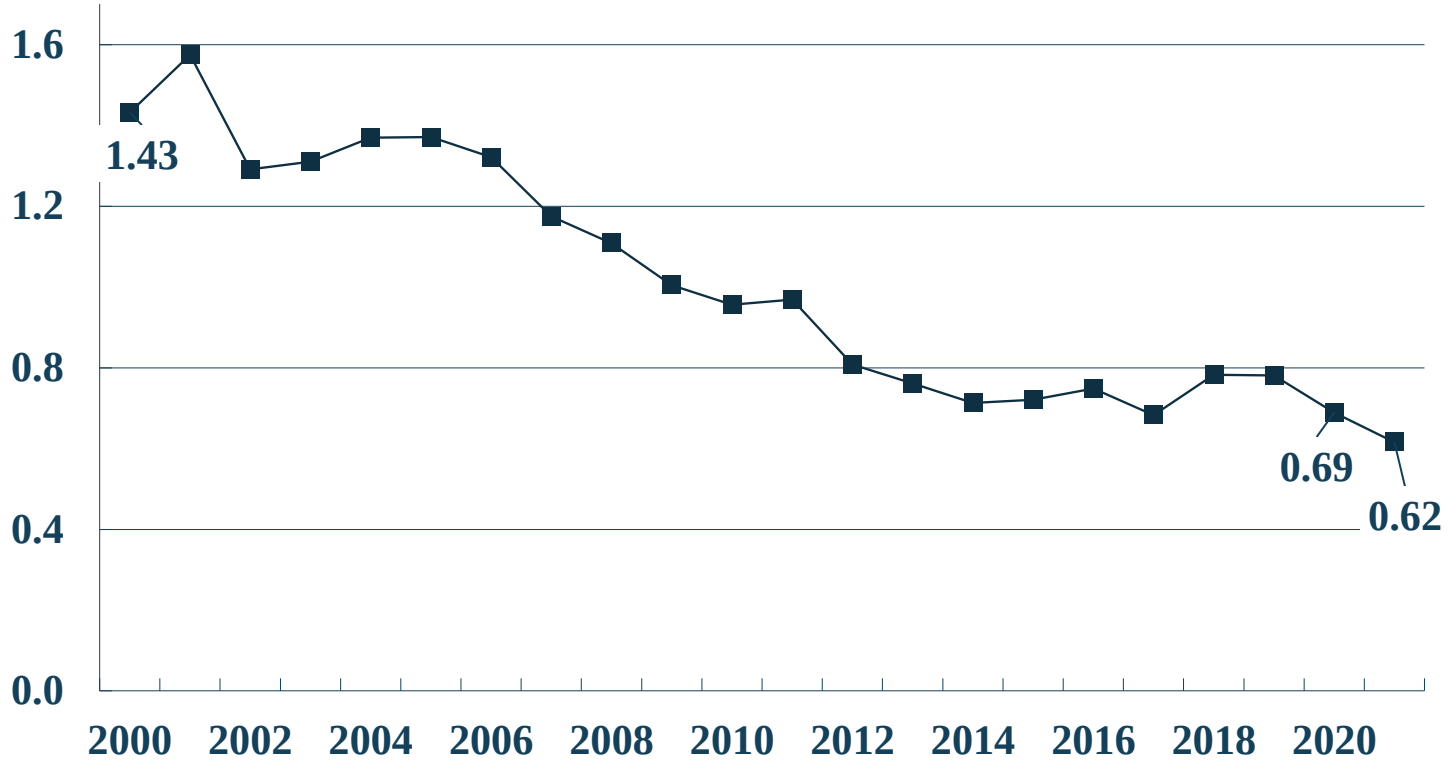
Source: FRA data as of Aug 2021.

In 2020. Train Accidents / Million Train-Miles Dropped 33% Since 2000 & 2% Since 2011



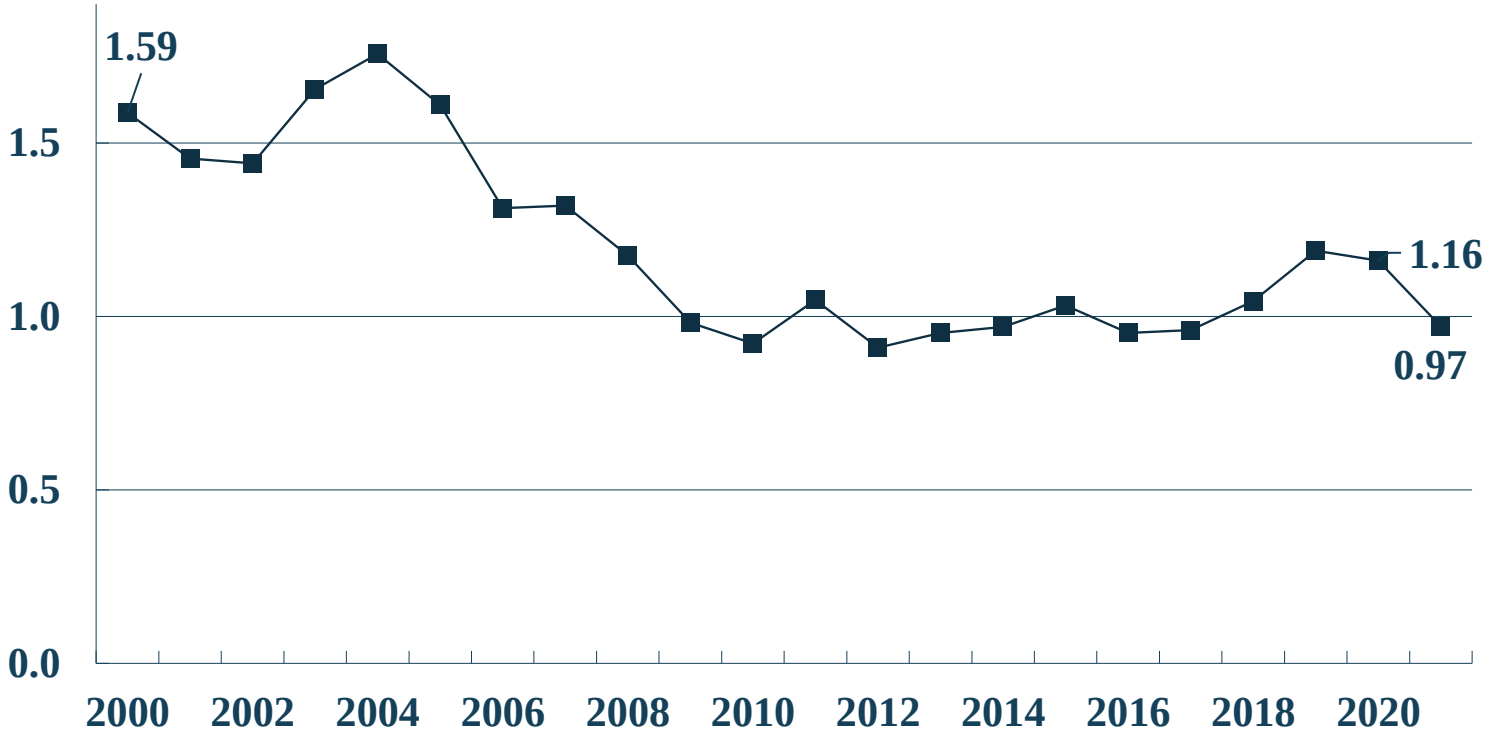
Sources: http://safetydata.fra.dot.gov/officeofsafety/publicsite/summary.aspx.
Note: Excludes grade crossing accidents. Data for 2020 and Jan-May 2021 are preliminary, as of August 2021.

In 2020, Track-Caused accidents / Million Train-Miles Dropped 52% Since 2000 & 29% Since 2011



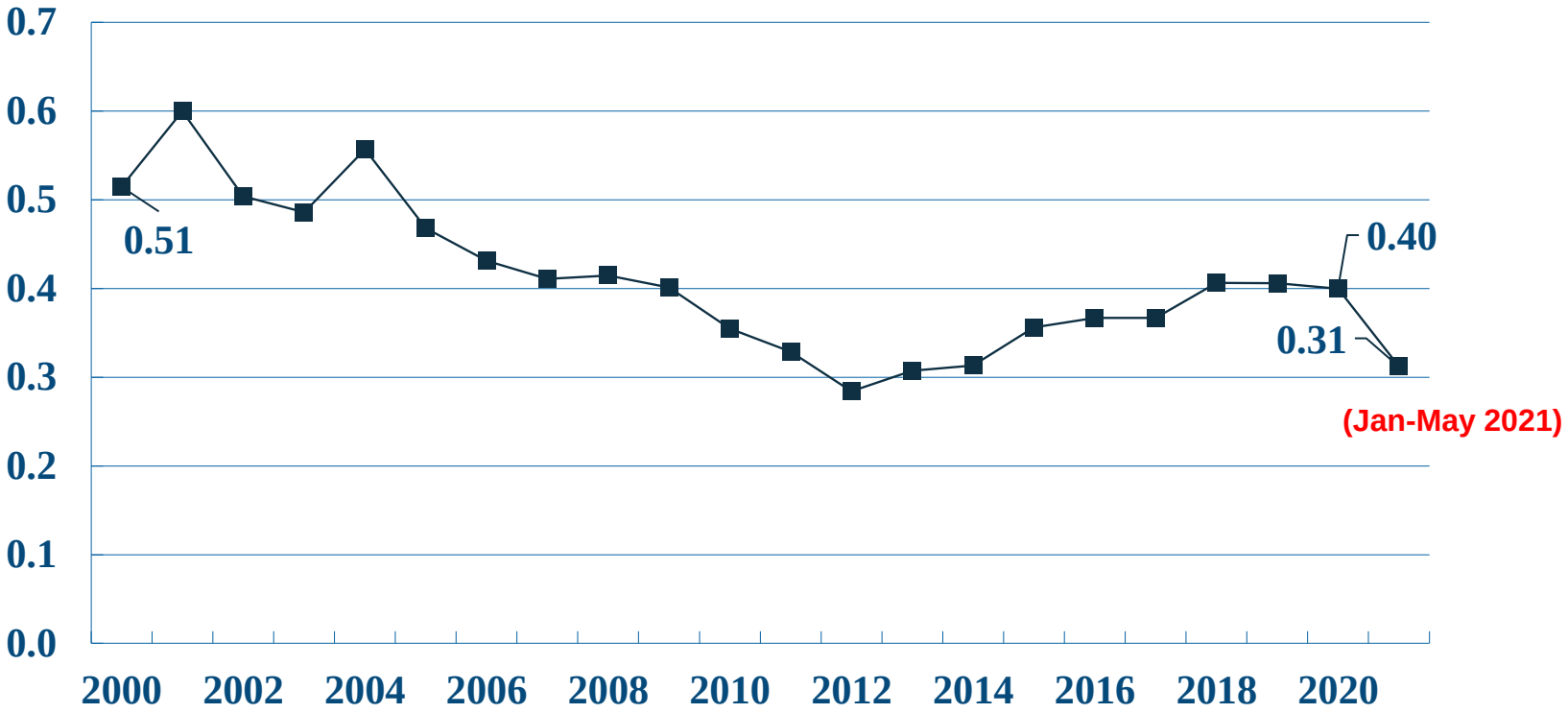
Sources: http://safetydata.fra.dot.gov/officeofsafety/publicsite/summary.aspx
Note: Excludes grade crossing accidents. Data for 2020 and 2021 are preliminary, as of August 2021.

In 2020, Human Factors Accidents / Million Train-Miles Dropped 27% Since 2000



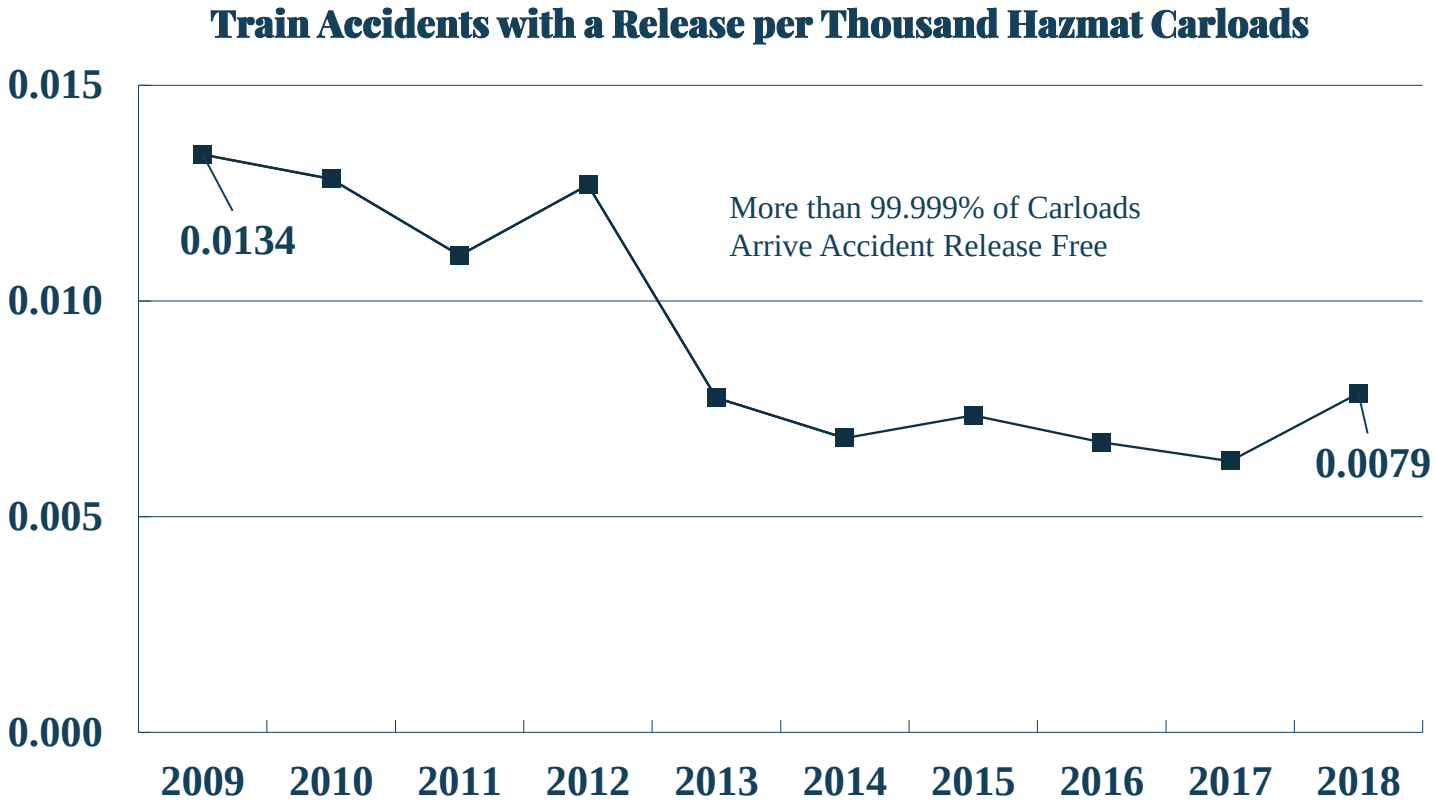
Sources: http://safetydata.fra.dot.gov/officeofsafety/publicsite/summary.
Note: Excludes grade crossing accidents. Data for 2020 and 2021 are preliminary as of August 2021.

Equipment-Caused Accidents / Million Train-Miles Dropped 22% Since 2000



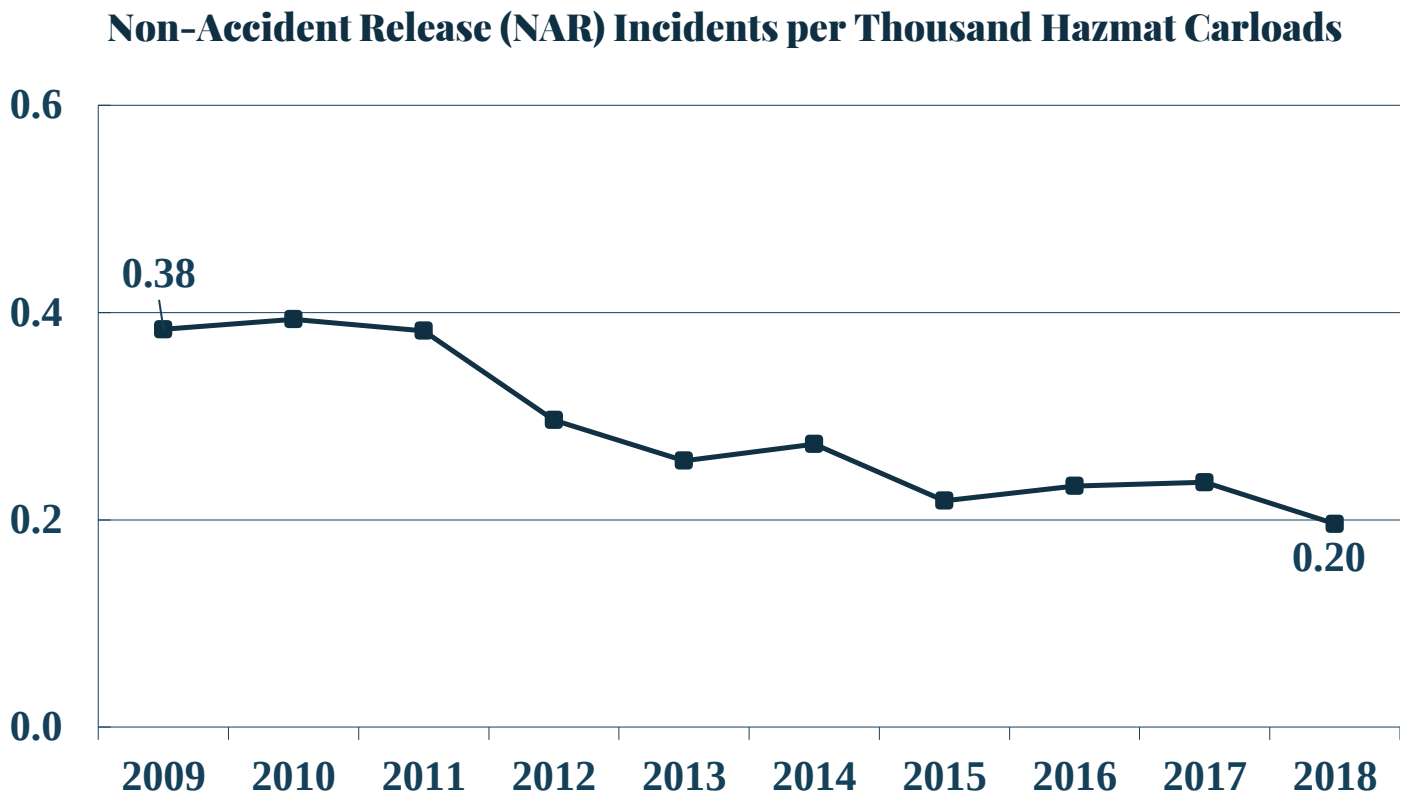
Sources: http://safetydata.fra.dot.gov/officeofsafety/publicsite/summary.aspx
Note: Excludes grade crossing accidents. Data for 2020 and 2021 are preliminary, as of August 2021.

Hazmat Accident Rates Declined 41% Since 2009



Sources: AAR Analysis of FRA Train Accident Database and PHMSA Hazardous Materials Incident Database, as of June 2020.
Notes: Carloads terminated are from the ICC/STB Waybill Sample, 2009-2018. STB Waybill data not available for 2019 as of March 2021.

Hazmat Non-Accident Release (NAR) Rates Declined 49% Since 2009.



Sources: AAR analysis of PHMSA Hazmat database for 2009-2018, as of April 2020. Hazmat carloads of all car types terminated in the U.S., from ICC/STB Waybill Sample, 2009-2018. STB Waybill data not available for 2019 as of March 2021.

Employee Qualifications

- Specific Training Requirements
- Alcohol / Drug Testing
- Certification of Locomotive Engineers / Conductors
- Operational Testing of Crews

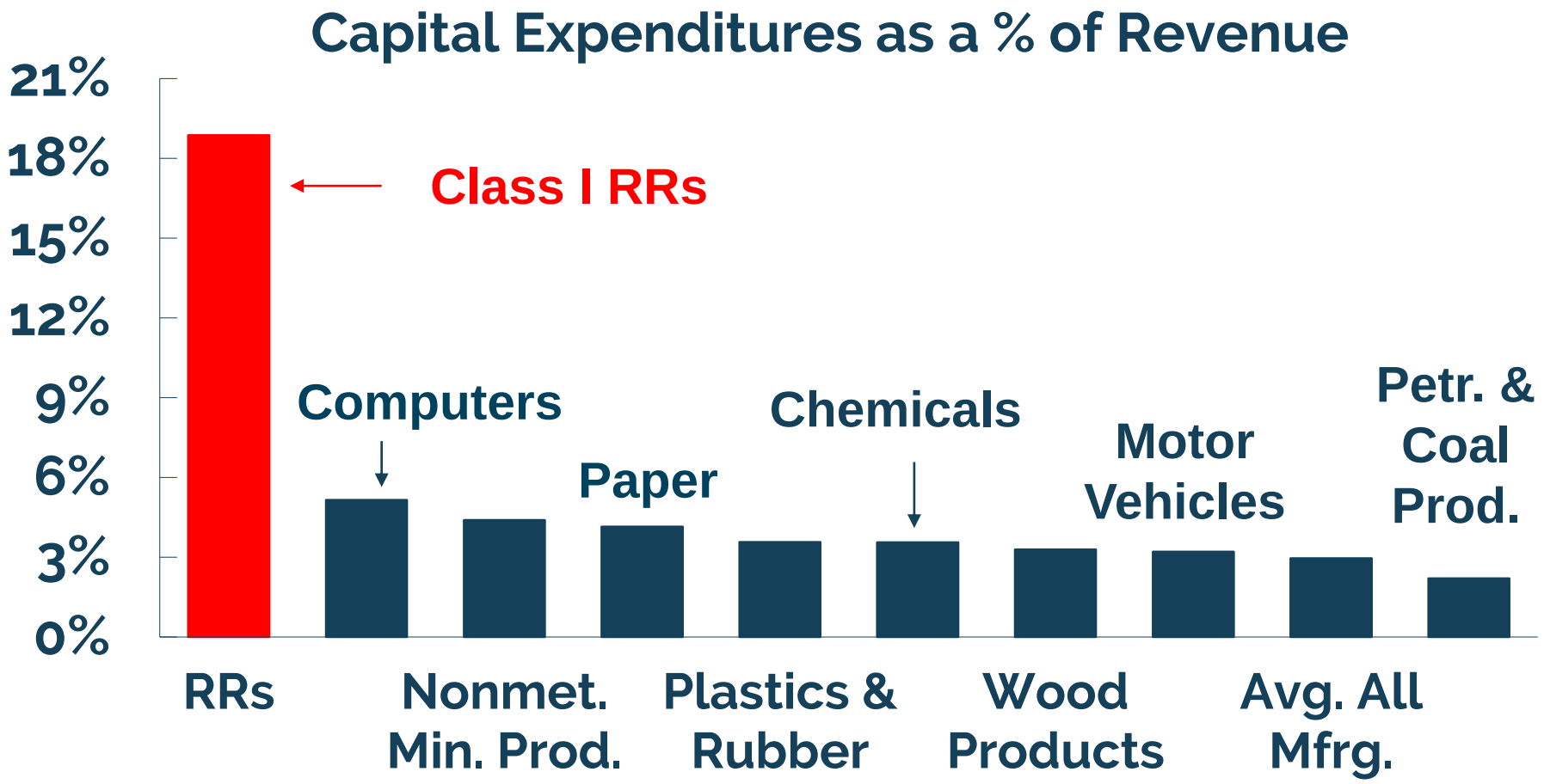
Investments

Railroads have privately invested more than $740 billion since 1980 to create the world's best rail transportation network.

Positive Train Control; Largest Combined Effort in U. S. Transportation History

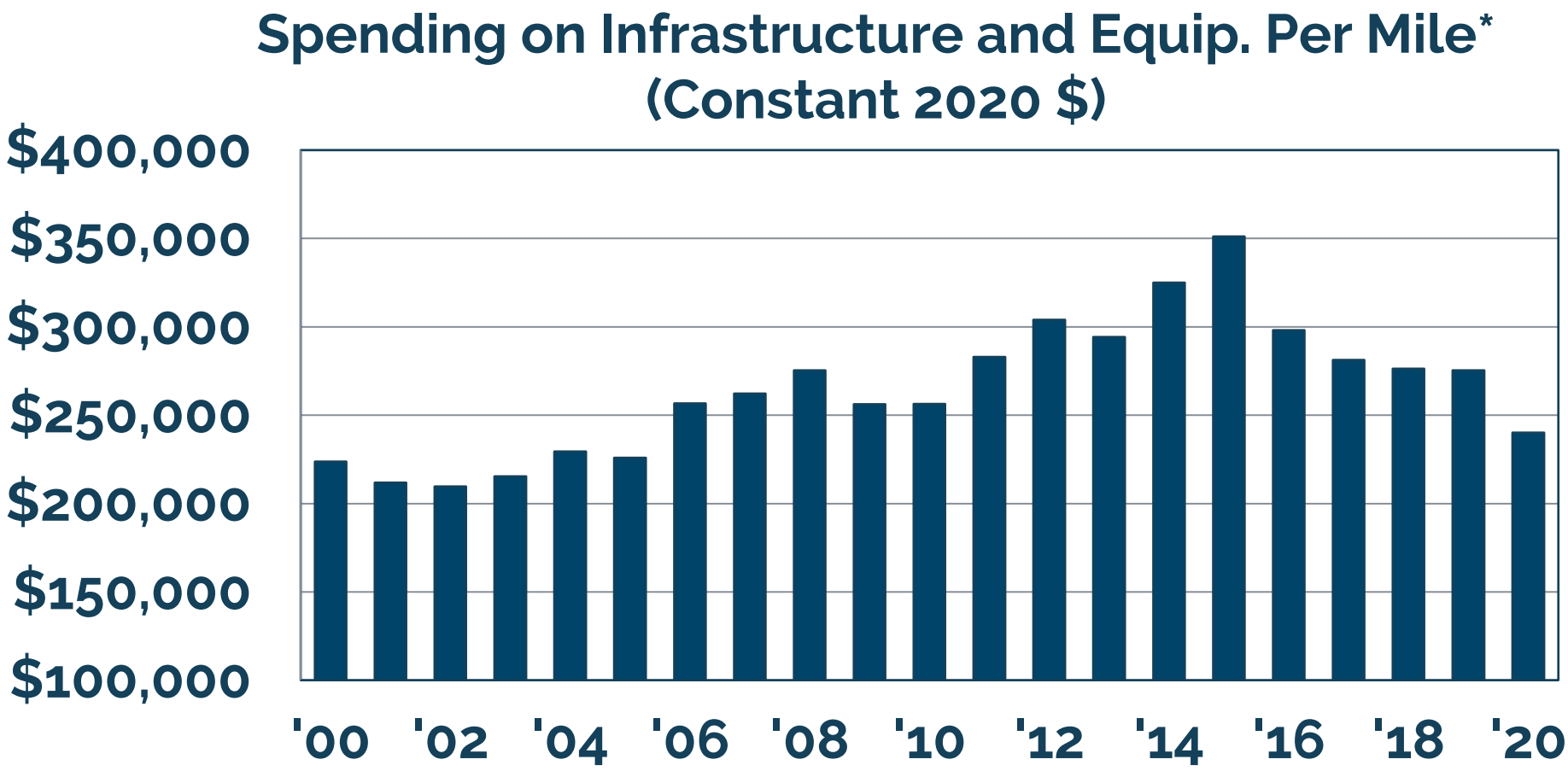
- Highly precise geo-mapping of ~82,000 track miles (~60,000 route-miles)
- Install PTC on more than ~18,500 locomotives
- Install ~29,500 “wayside interface units”
- Installing PTC on ~1,900 switches in non-signaled territory
- ~14,500 signal replacement projects
- Develop, produce, and deploy new radio system and new radios at ~4,000 base stations, ~32,600 trackside locations, and on ~18,500 locomotives
- Development of back office systems and upgrade dispatching software

RRs Are Far More Capital Intensive Than Other Industries



Figures are average 2010-2019 Sources: Census Bureau, AAR

Higher Spending on Infrastructure & Equipment*



*Capital spending plus maintenance expenses per route-mile owned. Figures are for Class I railroads. Source: AAR

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

A COMPREHENSIVE ASSESSMENT OF AMERICA'S INFRASTRUCTURE

RAIL B

Rail received the *highest* ranking of the 17 categories – the only one to receive "B"

Industry Research

AAR Strategic Research Initiatives Program

- **SRI Vision**:

The SRI vision for North America's railways is a future without train derailments or train accidents.

- **SRI Mission**:

The SRI mission for North America's railways is to create and transfer knowledge, to innovate, to support functional and technological development, and to support ***IMPLEMENTATION***.

SRI Objectives

Infrastructure Systems / Inspection / Cross-Cutting

Facility for Accelerated Service Testing and Engineering Research (FASTER)
- Provide controlled testing of track components and structures under a 114-car, 18,000-ton train on a closed loop of test track.

Revenue Service Testing
- Provide real-world testing and evaluation of new technology and maintenance practices on Class-1 railroad property, under scientific control, following successful controlled testing at FASTER.

Bridge Systems
- Develop, evaluate, and implement new bridge design, bridge fitness for service assessments and maintenance strategies through computational modeling and in-track testing.

Rail Performance and Integrity
- Identify root causes of rail failure, evaluate mitigation strategies, and evaluate performance of new rail materials and maintenance practices through computational modeling, laboratory testing, and in-track testing.

Weld Performance
- Identify root causes of weld failure, evaluate mitigation strategies, evaluate performance of new weld materials and maintenance practices through modeling, laboratory testing, and in-track testing.

Rail Inspection Technology
- Develop, evaluate, and implement improved methods for detecting and quantifying defects on the surface and within rails and rail welds

Tie and Fastener Systems
- Assesses current and new track system designs including tie/fastener life extension studies

Special Trackwork
- Develop and evaluate longer lasting and lower maintenance special trackwork designs and components for implementation in revenue service.

Substructure Systems
- Evaluate the effects of increased loads and traffic on ballast and subgrade and evaluate improved substructure maintenance practices and technologies.

Substructure Inspection Technology
- Develop and evaluate new technologies for inspecting ballast and subgrade.

Track Buckling Prevention
- Mitigate the effects of longitudinal forces in continuous welded rail due to temperature and other factors.

Track Inspection Technology
- Investigate and evaluate non-traditional track inspection technologies such as autonomous systems

Operations Systems / Universities / Technology Transfer

Automated Train Operations

- Develop, evaluate, and implement operational concepts for enhanced train control and communication.

Positive Train Control Interoperable Lifecycle Management

- Develop, evaluate, and implement operational concepts to support continuous innovation and ensure interoperability of PTC systems.

Train System Dynamics and Energy Management

- Examine the causes and control measures for in-train forces and their effects on rolling stock and track structure. Evaluate potential means to reduce the energy input to move trains.

University Programs

Support and oversee fundamental research at academic research institutions aimed toward development of new technologies for the rail industry.

Technology Transfer and Implementation

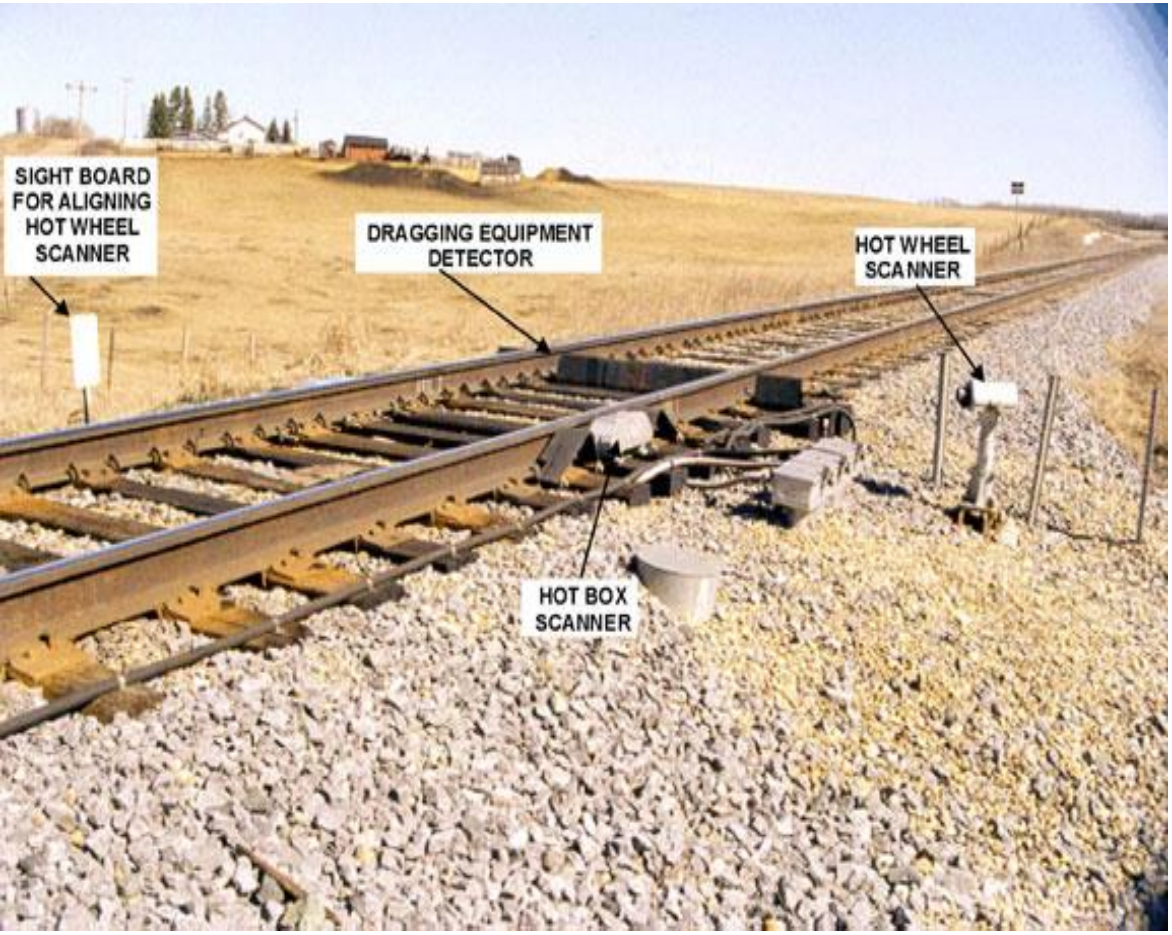
- Participate in global research knowledge transfer, access new and emerging technologies from rail transportation research organizations around the world and facilitate implementation of new technologies into revenue service.

Track Inspections

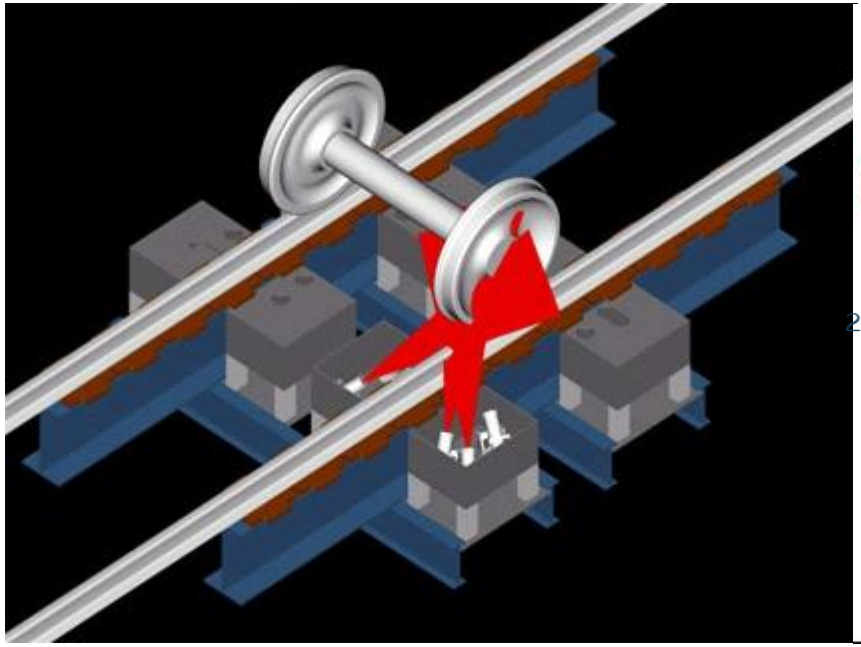
Autonomous Track Inspection

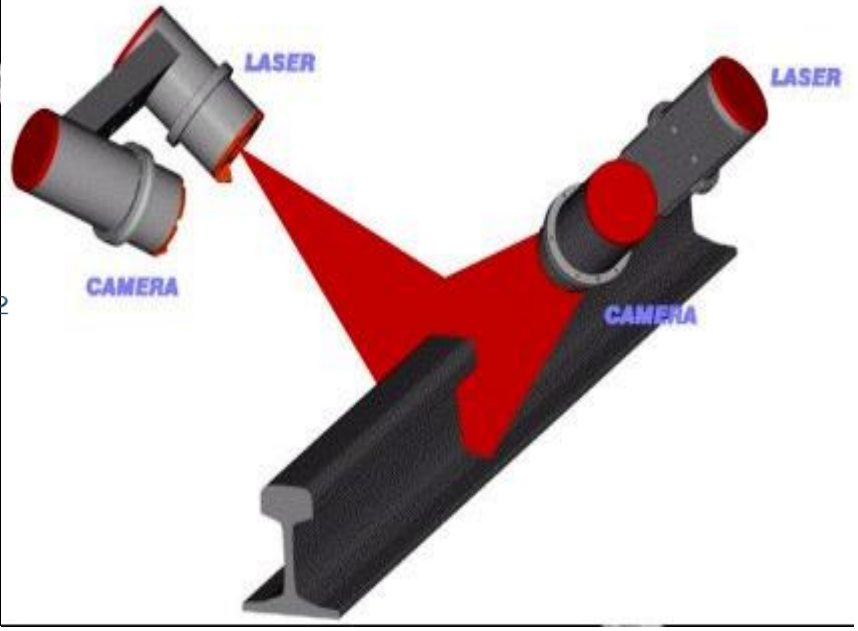
CN AITP car at MacMillan Yard, Toronto. Bentley Systems photo.

Other Wayside Detectors

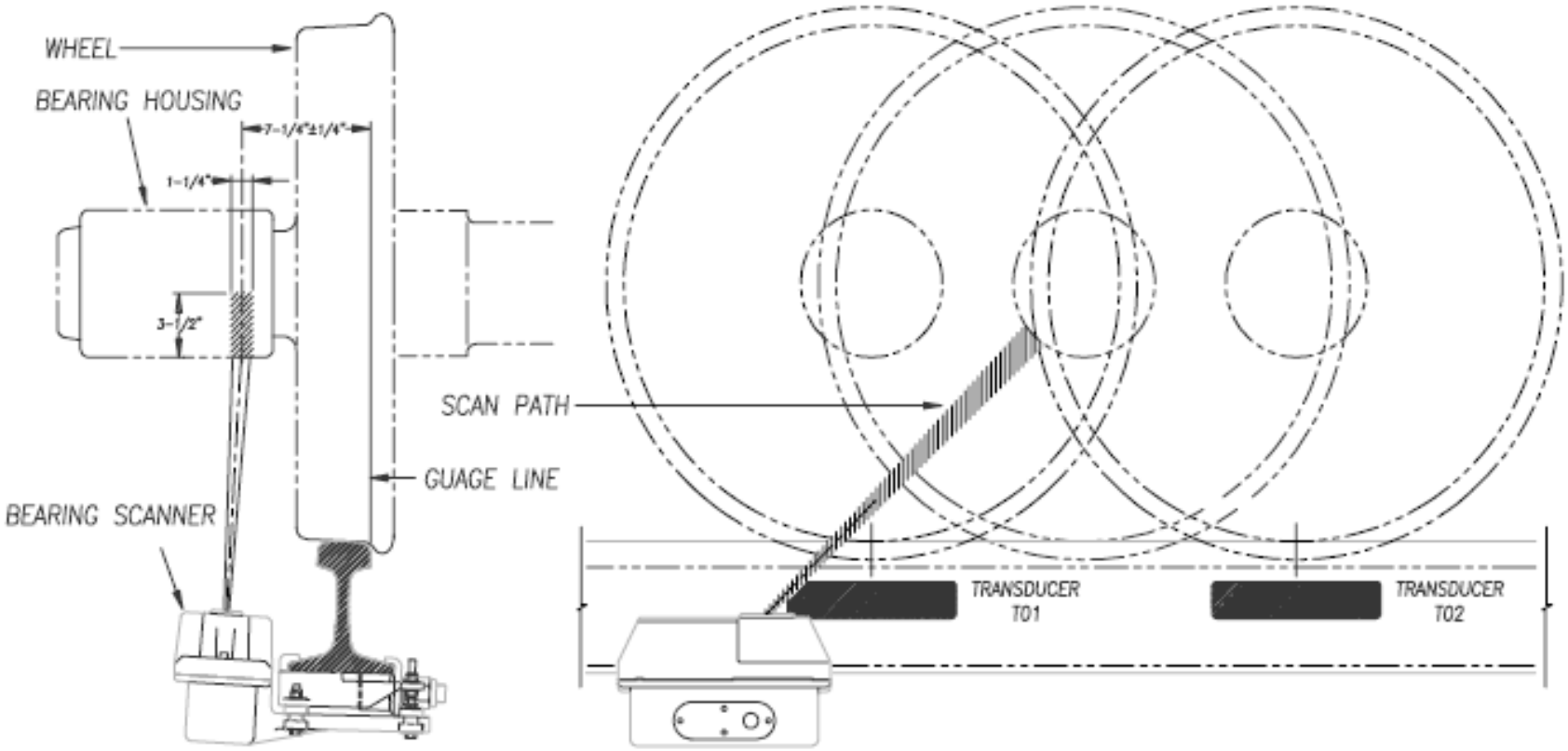


Precision Profile Measurement Technology



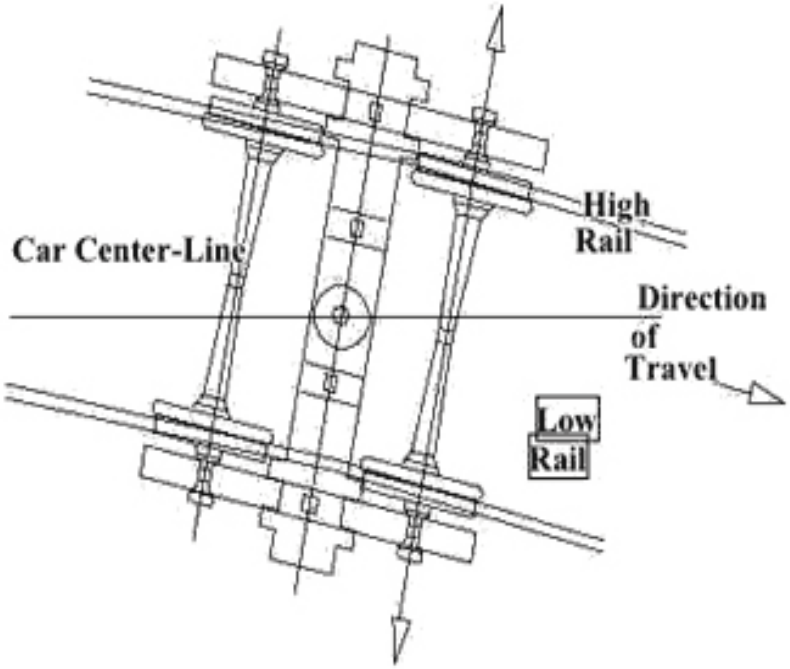


Hot Bearing Detection

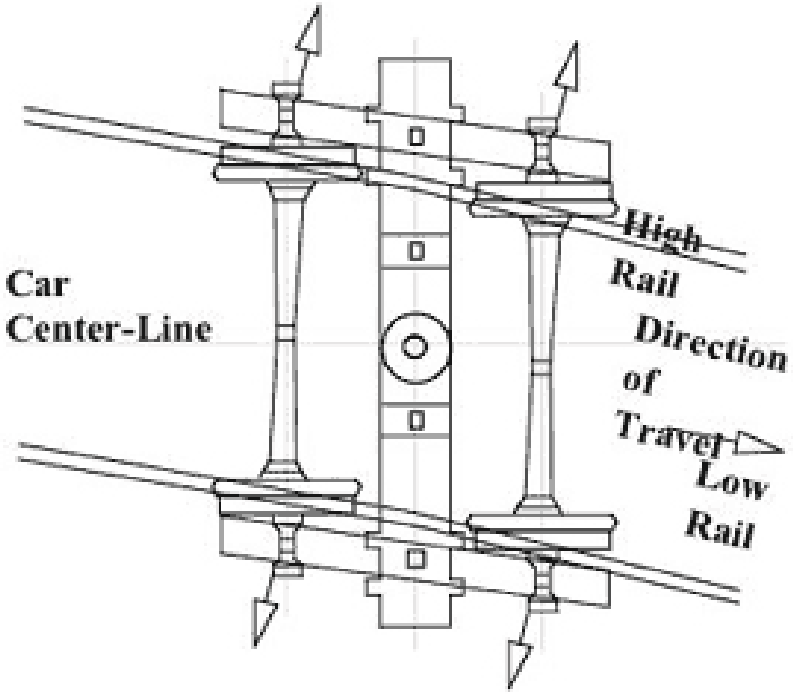


Truck Performance Detector

Truck Performance

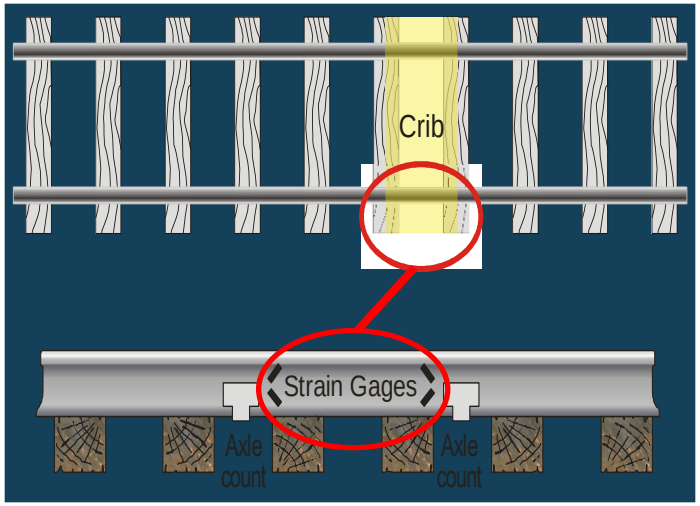


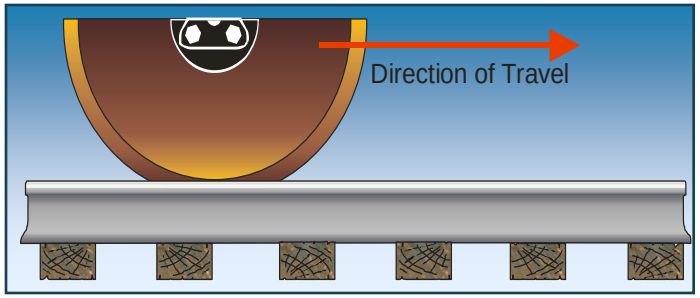
Nominally Curving Trucks



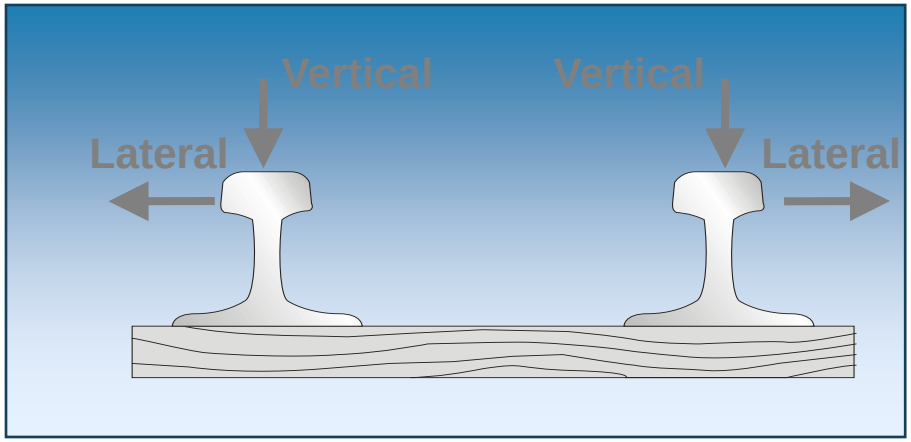
Warped Truck

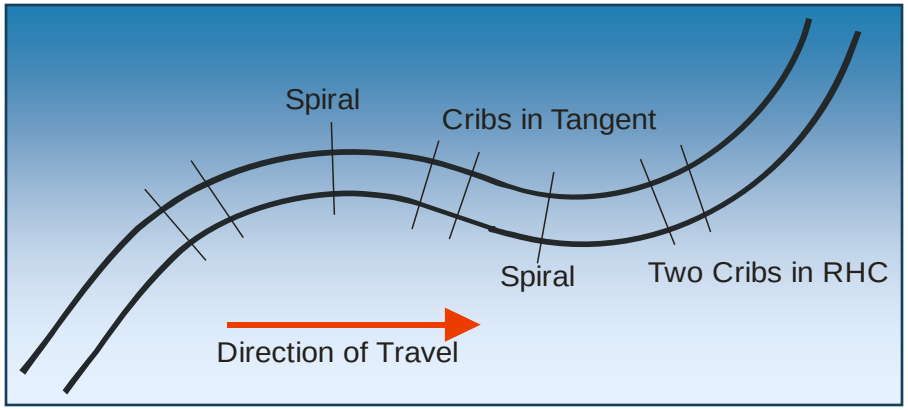
The Action of a Wheelset on the Track





… on each wheel pass …





… across successive cribs at a site

Research to Reduce Broken Wheel Derailments

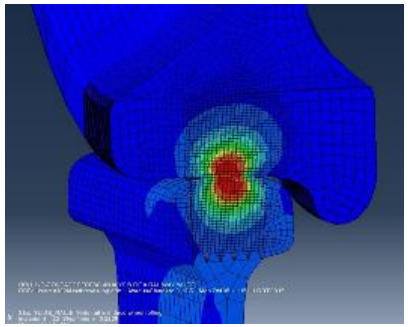
DETECTION: Improved Wheel Inspection

Cracked Wheel Detection Systems

PREVENTION: Improved Wheel Materials

- **High Strength Wheel Steels**
- **HPW1 Test: Eight wheel types**
  - Three are still in service and doing well
  - One has accumulated 500k miles
  - One has no removals, some surface defects
- **HPW2 Test: 14 wheel types**

Root Cause Analysis and Modeling



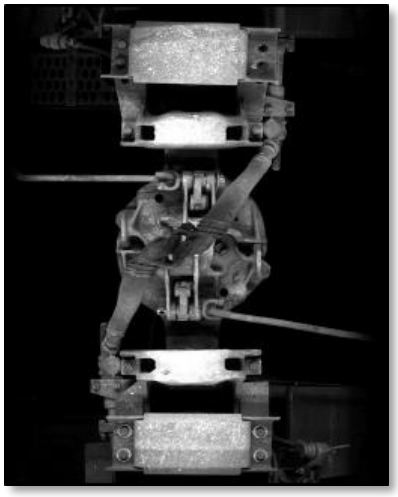
- **VSR Research**
  - Modeling, lab analysis and inspection of failed VSR wheels

Maximize Safety and Efficiency by Automating Equipment Inspections

Challenges

Reliable Detection Systems

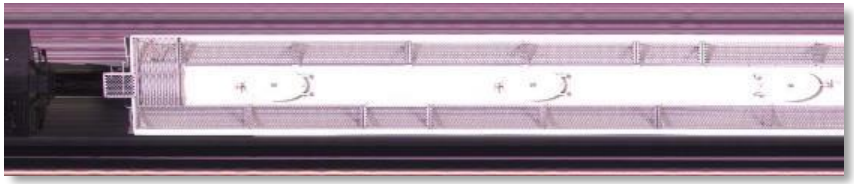
Institutional and Regulatory Barriers to Implementations



- **End Products: New / Alternative Machine Vision Detection Systems Capable of Inspecting all Trains at all Times under all Weather Conditions**

Full Train Scan Inspection Portal

Top



Side

Axle

Bottom

OT-55
AAR's Recommended Railroad Operating Practices for Transportation of Hazardous Materials

Contents

- Background
- “Key Trains”
- Definition of “Key Routes”
- Yard Operating Practices
- Storage
- TRANSCAER
- Criteria for Shipper Notification
- Time Sensitive Materials
- Electronic Emergency Response Information
- Special Provision for Spent Nuclear Fuel (SNF)and High Level Radioactive Waste (HLRW)
- Applicability
- Appendices
- Other Railroad Industry Safety Programs for Hazardous Materials

OT-55 Background

- First issued in 1990
- Industry-wide hazardous materials handling practices
- Minimum Standards
- Regularly reviewed and updated

"Key Trains"

- Definition
  - 1 tank car PIH or anhydrous ammonia
  - 20 carloads or IM portable tank loads of any combination of hazardous material,
  - 1 or more carloads of SNF or HLRW
- Restrictions
  - Maximum speed - 50 MPH
  - Meets - key train hold main track unless siding is FRA class 2 or better
  - All cars must be roller bearing equipped
  - Wayside detector - 30 MPH until next detector or arrival at terminal

"Key Routes"

- Definition
  - 10,000 carloads of hazardous material
  - 4,000 carloads PIH, anhydrous ammonia, flammable gas, Division 1.1 or 1.2 explosives, environmentally sensitive chemicals, spent nuclear fuel (SNF) or high level radioactive waste (HLRW)
- Requirements
  - Defective bearing detector every 40 miles of equivalent technology
  - Inspection by rail defect and track geometry vehicles
    - Main track - 2 times per year
    - Sidings - once a year
  - Class 2 or better track

Yard Operations

- Coupling speed - 4 MPH, maximum reasonable effort

- 2 car cuts - PIH, anhydrous ammonia, flammable gas
  - Released
  - Cars to couple into

Storage

- Applicable to new facilities
- Reasonable effort to apply to existing facilities
- Specifies distance from class 2 or higher track
  - Loading and unloading
  - Storage of loaded tank cars
  - Storage in tanks

TRANSCAER

- Assist in implementing TRANSCAER (**Trans**portation **C**ommunity **A**wareness and **E**mergency **R**esponse)
  - Demonstrate commitment to shippers to safe transport of hazmat
  - Improve relationships between shippers, carriers and local officials
  - Assist Local Emergency Planning Committees (LEPC's) in assessing hazmat movement though their communities
  - Assist LEPC's in developing emergency response plans
  - Assist community response organizations in preparing for hazmat incidents

Criteria for Shipper Notification

- Initiate shipper's emergency response system by calling CHEMTREC
- Incident - rail car derailed and not upright, sustained body or tank shell damage, or any release of product.
- Any reason to suspect potential for injury to people, property or environment
- When providing shipping papers to CHEMTREC, confirm receipt

Time Sensitive Materials

- Joint responsibility for monitoring shipments
- To ensure movement to arrive within time specified by DOT
- Railroads will implement escalation process, if shipment delayed

Electronic Emergency Response Information

- AskRail
  - Type of car (e.g. tank car, hopper car, etc.)
  - Whether the car is loaded or empty/residue
  - The quantity in the car
  - Proper shipping name, hazard class and packing group
  - UN/NA ID number
  - The handling railroad
  - The Emergency Response Guidebook information associated with any hazardous materials in the train
  - A map based representation of the isolation zone (as defined in the ERG) associated with the hazardous materials in the train showing items of interest in the area including educational institutions, hospitals and health facilities, police and fire stations
  - 24-hour emergency response phone numbers for all the Class 1 railroads and Amtrak
  - The top 125 hazardous materials transported by rail
  - The AAR Field Guide to Tank Cars.

Special Provision SNF and HLRW

- No meeting of another train carrying loaded tank cars of flammable gas, flammable liquids, or combustible liquids in a single bore double track tunnel

Applicability

- These recommendations apply to rail operations within the United States of America

Appendices

- A - List of Poison Inhalation Hazard Materials sorted by Class and Shipping Name
- B - List of Poison Inhalation Hazard Materials sorted by HMRC
- C - Environmentally Sensitive Chemicals
- D - Time Sensitive Materials
- E - Spent Nuclear Fuel (SNF) and High Level Radioactive Waste (HLRW)
- F - Sample Request For Hazardous Materials Commodity Flow Information

Availability

https://www.aar.org/wp-content/uploads/2021/08/2021-4-20-OT-55-R-CPC-1384.pdf

Other Railroad Industry Safety Programs for Hazardous Materials

- AAR North American Non-Accident Release (NAR) Program
- Transportation & Community Awareness & Emergency Response (TRANSCAER)
- ACC Responsible Care
- AskRail
- TTCI's Security & Emergency Response Training Center (SERTC)
- AAR’s Tank Car Facility Certification Program - BOE Auditors

Questions?

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