

FTA

FEDERAL TRANSIT ADMINISTRATION

Review and Evaluation of Public Transportation Safety Standards

JANUARY 2017

FTA Report No. 0103
Federal Transit Administration

PREPARED BY
Center for Urban Transportation Research
University of South Florida, Tampa



U.S. Department of Transportation
Federal Transit Administration

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Federal Transit Administration
U.S. Department of Transportation 1200 New Jersey Avenue, SE
Washington, DC 20590

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SYMBOL		MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liter	L
ft³	cubic feet	0.028	cubic meters	m ³
yd³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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13. ABSTRACT Section 3020(a) of the Fixing America's Surface Transportation (FAST) Act (Pub. L. 114-94, December 4, 2015) requires the Secretary of Transportation to review public transportation safety standards and protocols to document existing standards and examine the efficacy of those standards and protocols. The content of the review must include minimum safety performance standards developed by the public transportation industry and safety performance standards, practices, or protocols in use by rail fixed guideway public transportation systems. The review also must include rail and bus safety standards, practices, or protocols in use by public transportation systems regarding rail and bus design and the workstation of rail and bus operators; scheduling fixed-route rail and bus service with adequate time and access for operators to use restroom facilities; fatigue management; and crash avoidance and worthiness. Section 3020(b) of the FAST Act requires the Secretary to conduct an evaluation following the review in consultation with the public transportation industry to assess the need to establish additional Federal minimum public transportation safety standards. This report was prepared in accordance with Section 3020(c) of the FAST Act. It presents the findings of the review of standards and the outcome of the evaluation. Due to significant limitations of the safety-related data reported to the National Transit Database (NTD) and limited or non-existent data from other sources, including the results of the public evaluation, the Federal Transit Administration (FTA) could not prepare a definitive assessment of the efficacy of the standards identified in its review and evaluation. Accordingly, this report includes a comprehensive set of recommendations to support FTA's collection of data and a risk-based analysis of the safety performance of transit modes. The report also identifies transit safety issues that may be mitigated through the issuance of additional safety standards.			
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ABSTRACT

Section 3020(a) of the Fixing America's Surface Transportation (FAST) Act (Pub. L. 114-94, December 4, 2015) requires the Secretary of Transportation (Secretary) to review public transportation safety standards and protocols to document existing standards and examine the efficacy of those standards and protocols. The content of the review must include minimum safety performance standards developed by the public transportation industry and safety performance standards, practices, or protocols in use by rail fixed guideway public transportation systems. The review also must include rail and bus safety standards, practices, or protocols in use by public transportation systems regarding rail and bus design and the workstation of rail and bus operators; scheduling fixed-route rail and bus service with adequate time and access for operators to use restroom facilities; fatigue management; and crash avoidance and worthiness. Section 3020(b) of the FAST Act requires the Secretary to conduct an evaluation following the review in consultation with the public transportation industry to assess the need to establish additional Federal minimum public transportation safety standards.

This report was prepared in accordance with Section 3020(c) of the FAST Act. It presents the findings of the review of standards and the outcome of the evaluation. Due to significant limitations of the safety-related data that is currently reported to FTA's National Transit Database (NTD) and limited or non-existent data from all other collection sources, including State Safety Oversight Program reporting and the results of the public evaluation, the Federal Transit Administration (FTA) currently does not have sufficient information to make a definitive assessment of the efficacy of the standards identified in its review and evaluation. Accordingly, this report includes a comprehensive set of recommendations to support FTA's collection of data and a risk-based analysis of the safety performance of transit modes. The report also identifies transit safety issues that may be mitigated through the issuance of additional safety standards.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance of Way Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BTS	Bureau of Transportation Statistics
BTW	Behind the Wheel
CBTC	Communications Based Train Control
CDC	Centers for Disease Control and Prevention
CEM	Crash Energy Management
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
CUTR	Center for Urban Transportation Research
DC	Direct Current
DOT	Department of Transportation
FAA	Federal Aviation Administration
FAST Act	Fixing America's Surface Transportation Act
FDOT	Florida Department of Transportation
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GAO	Government Accountability Office
HOS	Hours of Service
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
LRV	Light Rail Vehicle
MAP-21	Moving Ahead for Progress in the 21st Century Act
MTA	Maryland Transit Administration
MUTCD	Manual on Uniform Traffic Control Devices
NCTR	National Center for Transit Research
NIOSH	National Institute for Occupational Safety and Health
NFPA	National Fire Protection Association
NHTSA	National Highway Traffic Safety Administration
NHTS	National Household Travel Survey
NSP	National Public Transportation Safety Plan
NTD	National Transit Database
NTSB	National Transportation Safety Board

OCC	Operations Control Center
OSHA	Occupational Health and Safety Administration
ROW	Right of Way
RWP	Roadway Worker Protection
SAE	Society of Automotive Engineering
SEPTA	Southeastern Pennsylvania Transportation Authority
SDO	Standards Development Organization
SGR	State of Good Repair
SMS	Safety Management Systems
SSO	State Safety Oversight
TCRP	Transit Cooperative Research Program
TRACS	Transit Advisory Committee for Safety
TRB	Transportation Research Board
TRID	Transport Research International Documentation
UMTA	Urban Mass Transportation Administration
USC	United States Code
USCG	United States Coast Guard
US DOT	United States Department of Transportation
USF	University of South Florida
VRTC	Vehicle Research and Testing Center

EXECUTIVE SUMMARY

Public transportation spans a wide variety of transportation modes and operating environments. Since the mid-1990s, the Federal Transit Administration (FTA) has actively financed, supported, and participated in the development of voluntary safety and technical standards and recommended practices for the public transportation industry. Notably, it has supported the transit safety standard program coordinated through the industry's official Standards Development Organization (SDO), the American Public Transportation Association (APTA), and has partnered closely with other US Department of Transportation operating administrations on multi-modal regulations and rulemakings to adopt standards that affect, or have the potential to affect, public transportation.

The Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. 112-14), authorized FTA, for the first time, to develop a new comprehensive Public Transportation Safety Program covering all transit modes, which is codified at 49 U.S.C. § 5329. FTA has adopted Safety Management Systems (SMS) methods and principles as the foundation of the agency's development and implementation of its Public Transportation Safety Program, including the development of transit safety standards. SMS is a proactive, data-driven approach to identifying safety hazards and risks and ensuring the effectiveness of safety risk mitigations. The application of SMS to transit allows FTA to build a 21st-century safety regime that is flexible and scalable, risk-based, and responsive to emerging safety issues.

Per 49 U.S.C. § 5329(b), FTA is required to develop and implement a National Public Transportation Safety Plan to improve the safety of all transit systems that receive financial assistance under the Federal transit program. This Plan must include safety performance criteria for all modes of public transportation, minimum safety performance standards for transit vehicles (not including rolling stock otherwise regulated by the Secretary or another Federal agency), and minimum safety standards to ensure the safe operation of public transportation systems.

This report was prepared pursuant to Section 3020 of the FAST Act, which requires the Secretary to (1) review minimum safety performance standards developed by the public transportation industry and safety performance standards, practices, and protocols in use by rail fixed guideway and bus public transportation systems; (2) evaluate the need to establish additional Federal minimum public transportation safety standards; and (3) publish a report that includes the findings of the review, the outcome of the evaluation, a set of recommendations to improve the safety of the public transportation industry, and actions that the Secretary will take to address the recommendations.

This report is consistent with existing FTA standards development efforts initiated after the passage of MAP-21. Beginning in 2015, FTA engaged in several safety standards evaluation and development projects that will provide the necessary background

information, data, and analysis to support decisions by FTA in setting minimum safety performance standards for the public transportation industry. The effort will establish the adequacy of these standards and identify subject areas for public transportation systems and operations for which FTA may issue standards and protocols.

FTA examined multiple sources to develop an inventory of existing voluntary or regulatory safety standards and protocols that are applicable to or used in all public transit modes referenced in the National Transit Database (NTD). FTA also engaged in a public evaluation of its review of the inventory of standards through a *Federal Register* request for comments to ensure the completeness of the inventory, obtain statements related to the efficacy of existing standards, and gain valuable industry observations and insight into areas of risk and standards that could be advanced for rulemaking. Comments received are summarized in this report.

FTA Standards Development Initiatives

To meet the requirements of Section 3020 of the FAST Act, FTA compiled a Compendium of transit safety standards and protocols to facilitate its review and evaluation of existing transit safety standards. This report includes a comprehensive set of recommendations to support FTA's continued collection of data and a risk-based analysis of the safety performance of transit modes:

- Complete the Standards Strategic Plan Project and continue to implement its Standards Development Program.
- Continue FTA's efforts to expand safety data collection in the NTD.
- Request FTA statutory authority for data privacy protections, encouraging more industry data submission from agencies.
- Establish a subcommittee of FTA's Transit Advisory Committee for Safety (TRACS) to use Subject Matter Experts to conduct a data-driven assessment of the transit industry to determine which risks are best mitigated by federal regulation or other means.
- Request Congress to authorize and appropriate additional resources that will enable FTA to collect, manage, and analyze the safety data necessary for effective industry safety standards regulation.

This report also identifies transit safety issues that may be mitigated through the issuance of safety standards.

Section 1 Introduction

Background

From the inception of USDOT's Federal financial assistance program for state and local agencies, the Federal Transit Administration (FTA) and its predecessor agency, the Urban Mass Transportation Administration (UMTA), were prohibited from regulating any aspect of the day-to-day operations of grant recipients, including establishing national mandatory standards for transit safety. FTA's authority to regulate safety was limited to investigating safety hazards, testing buses for durability, and requiring recipients to have a drug and alcohol testing program. Notwithstanding the express prohibition against regulating the operation, routes or schedules of public transportation systems, since the mid-1990s, FTA has actively financed, supported, and participated in the development of voluntary safety and technical standards and recommended practices for the public transportation industry. Notably, FTA has supported the transit safety standard program coordinated through the industry's official Standards Development Organization (SDO), the American Public Transportation Association (APTA), and has partnered closely with other USDOT operating administrations, including the Federal Highway Administration (FHWA), the Federal Railroad Administration (FRA), the National Highway Traffic Safety Administration (NHTSA), and the Federal Motor Carrier Safety Administration (FMCSA), on multi-modal regulations and rulemakings to adopt standards that affect, or have the potential to affect, public transportation.

On July 6, 2012, President Barack Obama signed into law the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. 112-14), which authorized the new comprehensive Public Transportation Safety Program codified at 49 U.S.C. § 5329. The authorities under the Safety Program significantly strengthened FTA's position as a safety regulatory agency. In particular, FTA was required to develop and implement a National Public Transportation Safety Plan (NSP) to improve the safety of all transit systems that receive financial assistance under the Federal transit program, which must include safety performance criteria for all modes of public transportation and minimum safety performance standards for transit vehicles.¹ MAP-21's successor, the Fixing America's Surface Transportation (FAST) Act, further defined and directed the identification and establishment of transit safety-related standards. The FAST Act amended Federal transit law to require an NSP that includes operational standards. Section 3020 of the Fast Act also requires the US DOT Secretary to review standards

¹ In most instances, the requirements of the Public Transportation Safety Program will apply to each recipient of FTA funding, regardless of mode of transit provided. However, FTA is prohibited from promulgating safety performance standards for rolling stock that is already regulated by another Federal agency. 49 U.S.C. § 5329(2)(C)(i).

developed by the public transportation industry and safety performance standards, practices, and protocols in use by rail fixed guideway and bus public transportation systems, and evaluate the need to establish additional Federal minimum public transportation safety standards. Upon completion of the review and evaluation, the Secretary must make recommendations to improve the safety of the public transportation industry.

This report, prepared to fulfil the requirements of Section 3020, builds upon existing FTA standards development efforts initiated after the passage of MAP-21. On October 3, 2013, FTA issued an Advance Notice of Proposed Rulemaking that sought public comment on FTA's preliminary proposals to implement the Public Transportation Safety Program. (See 78 FR 61251–73.) FTA posed six questions about “minimum safety performance standards” for public transportation vehicles, noting that the standards must take into account both National Transportation Safety Board (NTSB) recommendations and available consensus-based standards and best practices from industry. FTA included a list of consensus-based safety performance standards related to vehicle crashworthiness, event data recorders, emergency access and egress from rail transit vehicles in distress, and fire-life safety and inquired whether these standards should be adopted in the NSP and, if so, how to prioritize their adoption. In January, 2017, FTA published the first iteration of its NSP, which strongly encourages all public transportation agencies to consider adopting a number of voluntary consensus-based safety performance standards.

Beginning in 2015, FTA engaged in several safety standards evaluation and development projects, listed below, in order to determine areas where transit safety standards may be beneficial. These projects will provide the necessary background information, data, and analysis to support decisions by FTA in setting minimum safety performance standards for the public transportation industry, which encompasses a variety of modes and operating environments. The effort will establish the efficacy of existing standards and identify subject areas for public transportation systems and operations for which FTA may issue standards and protocols.

- I. Safety Standards Strategic Plan and Data Collection Project
 - Conduct a risk-based safety data analysis to identify trends and areas of greatest safety risk and provide the basis for recommending areas for standards/protocols consideration
 - Conduct Economic Impact Analysis (EIA) on recommended standards
 - Develop an FTA Safety Standards Strategic Plan
 - Use comprehensive data analysis and supplementary reports and other documents to inform FAST Act activities
 - Review and compile safety standards and protocols

2. FTA Transit Standards Development Program

- Address transit safety-related standards in accordance with the FTA Safety Standards Strategic Plan
- Address other non-safety related transit standards
- Conduct background research and analysis on needs for new transit standards in areas where standards are lacking or gaps within existing standards
- Conduct background research and analysis on any existing standards deemed not adequate or not specific to transit that may be modified or enhanced for public transportation
- Conduct additional research, data collection, and economic impact assessment for rulemaking (would include only safety-related standards)
- Establish a working group to collaborate with industry stakeholders to inform the standards development process
- Work with SDOs to develop standards for voluntary or mandatory adoption

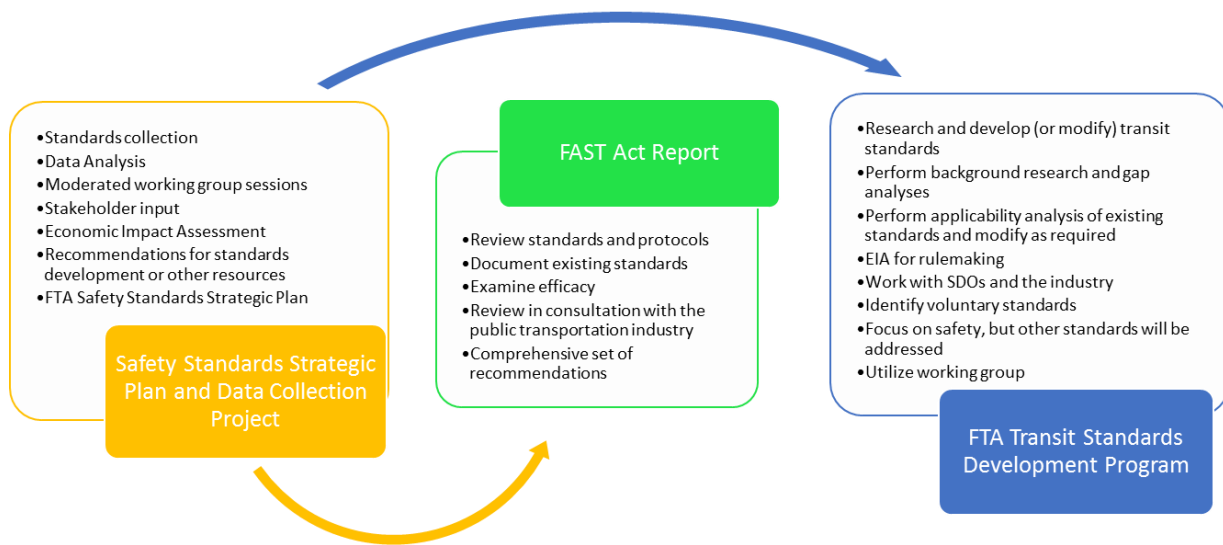


Figure 1 FTA Standards Development Initiatives

This report has been prepared in accordance with the legislative directives established in Section 3020(c) of the FAST Act (included in Appendix A), which provides:

After completing the review and evaluation required under subsections (a) and (b), and not later than 1 year after the date of enactment of this Act, the Secretary shall make available on a publicly accessible web site, a report that includes—

- 1) Findings based on the review conducted under subsection (a);
- 2) The outcome of the evaluation conducted under subsection (b);

- 3) A comprehensive set of recommendations to improve the safety of the public transportation industry, including recommendations for statutory changes if applicable; and
- 4) Actions that the Secretary will take to address the recommendations provided under paragraph (3), including, if necessary, the authorities under section 5329(b)(2)(D) of title 49, United States Code.

Methodology

For this report, FTA examined multiple sources to develop a comprehensive inventory of existing voluntary or regulatory safety standards and protocols that are applicable to or used in all public transit modes referenced in the National Transit Database (NTD), including Rail Transit (Alaska Railroad, Cable Car, Commuter Rail, Heavy Rail, Hybrid Rail, Inclined Plane, Light Rail, Monorail/Automated Guideway, and Streetcar) and Non-Rail Transit (Aerial Tramway, Bus, Bus Rapid Transit, Commuter Bus, Demand Response, Demand Response Taxi, Passenger Ferry, Jitney, Público, Trolleybus, and Vanpool). The inventory also included safety standards for other modes not regulated by FTA, such as Commuter Rail (regulated by FRA) and Intercity Motor Carrier (regulated by FMCSA). Although FTA will not be establishing standards for these modes, they were included in the inventory due to existing standards or protocols applicable to them that may have applicability to other public transit modes. The inventory of standards is available as the “Compendium of Transit Safety Standards” in Appendix B of this report.

FTA engaged in a public evaluation of its review of the inventory of standards through a *Federal Register* request for comments (81 FR 30605, May 17, 2016) to ensure the completeness of the inventory, obtain public comment related to the efficacy of existing standards, and gain valuable industry observations and insight into areas of risk and standards that could be advanced for rulemaking. The comments submitted to the *Federal Register* docket are summarized in Section 2 of this Report. FTA also reviewed existing available data from the NTD, the SSO reporting module and the FRA Rail Accident/Incident Reporting System (RAIRS) in its analysis of the efficacy of inventoried standards, as applied to transit. Due to the relative infancy of the Public Transportation Safety Program, and both the lack of existing mandatory transit specific safety standards and granular safety reporting requirements, FTA did not have sufficient information to make a definitive assessment of the efficacy of the standards identified in the compendium, as applied to transit.

Data Limitations

FTA is committed to developing, implementing, and consistently improving strategies and processes to ensure that all the varied modes in the public transportation industry achieve the highest practicable level of safety. Accordingly, it has adopted SMS as the

underlying policy for the Public Transportation Safety Program. The availability of current, relevant, and robust data is critical to the practice of SMS and to determining the efficacy of existing standards and protocols. Consistent with the methods and principles of SMS, FTA intends to prioritize its standards development, rulemaking, enforcement, oversight, and resources towards those issues that are identified, through the analysis of data, as posing the greatest risk to the safety of public transportation systems.

In February 2016, FTA published a proposed rule to require each transit operator that receives financial assistance from FTA to develop and implement a safety management system as part of a transit agency safety plan. To comply with the rule, transit operators would collect safety data related to the hazards and associated risks within their transit systems. To ensure recipient compliance with transit agency safety plan requirements and to identify safety issues that may require Federal intervention, FTA likely would collect data from its recipients to assess their compliance with the Safety Program. FTA currently is working to identify what types of safety information the agency needs to conduct a nationwide risk analysis. In addition to recipient reporting, and pursuant to the agency's new safety authority, FTA also is gathering safety information through investigations into safety accidents, audits, examinations and testing of transit agency operations, equipment and facilities.

FTA believes that the agency's transition towards the collection of a robust set of safety data will be hampered due to the agency's current inability to protect safety information from public disclosure. For example, FTA received a number of public comments on the issue of data protection to the notice of proposed rulemaking to require transit agency safety plans. Numerous commenters stated that transit agencies need data protection for the information in their safety plans. The commenters argued that SMS, by its nature, requires full and open review, evaluation, and prioritization of risk, and the possibility that these safety reviews could be released through the Freedom of Information Act (FOIA), State sunshine laws, or obtained through judicial proceedings serve as a barrier to well-documented and robust self-examination. The commenters encouraged FTA to state its intent to protect agency analyses to the full extent possible and pursue full authority to exempt safety analyses from discovery and use in judicial proceedings.

Unlike other Federal safety regulatory agencies, Congress has yet to provide FTA with statutory authority to otherwise exempt safety-related information from disclosure like other US DOT Operating Administrations. For example, Congress has provided both FHWA and FRA with express authority to prohibit the discovery of protected information and to prohibit admission of such information into evidence.

Section 4 of this report includes a number of recommendations and actions to guide and support FTA's development of a transit safety standards development program, including seeking the requisite legal authorities to protect safety data from disclosure.

However, due to significant limitations of the safety-related data that historically has been reported to FTA's NTD and limited or non-existent data from other sources, including State Safety Oversight Program reporting and the results of public evaluation, FTA could not prepare a definitive assessment of the efficacy of the standards identified in its review and evaluation. FTA is analyzing additional methods for obtaining safety-related data, including causal or contributing factors for events, and from transit agencies through its Safety Standards Strategic Plan project. The methods identified may include the collection of transit safety data from transit agencies beyond that currently reported to NTD and direct engagement with representatives of the industry. FTA's Safety Standards Strategic Plan project will enable FTA to establish data-driven priorities for standards development and the issuance of recommended practices and guidelines.

Section 2 Compendium of Transit Safety Standards

The proposed Compendium contained standards and protocols, including consensus standards and codes, regulations, recommended practices, guides/guidance documents, and best practices from the following sources:

- Industry Standards
 - American Public Transportation Association
 - American Railway Engineering and Maintenance of Way Association
 - Association of American Railways
- Other Standard Development Organizations
 - American Society of Civil Engineers
 - American Society of Mechanical Engineers
 - Institute of Electrical and Electronics Engineers
 - National Fire Protection Association
- Federal Standards, Laws and Regulations
 - Federal Transit Administration
 - Federal Emergency Management Agencies
 - Federal Motor Carrier Safety Regulations
 - Federal Motor Vehicle Safety Standards
 - Federal Railroad Administration Regulations
 - National Highway Traffic Safety Administration
 - Occupational Safety and Health Administration
- State Standards, Laws and Regulations
 - State Safety Oversight Agencies
 - State Departments of Transportation
- Other Standards, Guidelines, and Model Practices
 - Transportation Research Board, Transit Cooperative Research Program

The Compendium divides standards and protocols into the following categories:

- *Vehicle Standards* – includes the following sub-categories: Vehicle Components and Passenger Equipment Safety Standards; Vehicle Crashworthiness; Vehicle Interface/Communications Systems; and Vehicle Safety Standards.
- *Infrastructure Standards and Related Items* – includes the following sub-categories: Infrastructure – Fixed Structures (includes elevators and escalator safety standards and recommended practices); Bridge Safety Standards; Track and Roadbed; Power Systems; and Signals and Grade Crossings.
- *Operational Standards* – includes the following sub-categories: Operating Rules and Practices and Personnel Communications/Communication Procedures.

- *Personnel Standards (including Human Factors and Fatigue Management)* – includes the following sub-categories: Hours of Service Standards, Workplace/Worker Safety, Qualifications and Certifications of Operators and Engineers, Medical Examination Certification, Drug and Alcohol Testing, and Training and Certifications.
- *State of Good Repair/Maintenance Standards* – includes the following sub-categories: Maintenance and Safety Inspection Standards.
- *Emergency/Incident Management Standards* – includes the following sub-categories: Emergency Preparedness/Management and Incident Investigation, Reporting, and Recovery.

Public Comments

The public comment period for the Compendium began on May 16, 2016. In the *Federal Register* notice of availability, FTA asked a number of specific questions, including:

1. Are there standards not reflected for which you must observe/comply?
2. Are these mandated by a Federal or state agency, State Safety Oversight Agency (SSOA), regional body, or other?
3. Do you have observations or data-driven evidence demonstrating the effectiveness of any of these standards?
4. Are there specific areas of concern for which FTA should establish minimum standards?
5. Are there modes or specific areas of risk that require heightened focus from FTA?
6. If standards were established based on risk, how should those areas of risk and any related standards be prioritized?
7. Should standards be based on the exposure of the mode, number, or rate of injuries or fatalities?
8. Are there standards not reflected in the Compendium that should be evaluated by FTA?
9. Are you aware of standards within other industries that could be used in the public transportation industry to reduce risks?
10. Are you aware of existing safety standards that may address any of these areas of risk?
 - a. Reduce blind spots.
 - b. Protect rail and bus operators from assaults.
 - c. Allow sufficient time within route schedules for operators to use restroom facilities.

Summary of Public Comments and Responses

FTA received 21 unique comment submissions² and incorporated additional standards and protocols identified through public comment into a final Compendium, which is available as an Excel file on FTA's website at <https://www.transit.dot.gov/regulations-and-guidance/safety/compendium-transit-safety-standards>. A summary of responses is provided in Table I.

Table I Respondents by Organization Type

Number of Responses	Type of Organization
6	Transit Agencies
3	State Safety Oversight Agencies
1	Local Governments
2	Industry Associations
1	Consultants
1	Vendors
8	Individuals

1. Are there standards in place for your system that are not reflected in the Compendium?

COMMENTS: One respondent noted the adoption of the Vision Zero Program by their local government and the success of that campaign in their area. They further added that new technologies, such as advanced driver assistance systems in transit vehicles, offer practical means to safeguard pedestrians and cyclists adjacent to bus traffic and suggested that the recommendations issued by the Secretary support the adoption and use of these “potentially life–saving improvements.” They further welcomed continued discussion related to public transportation safety standards and, specifically, Vision Zero.

FTA'S RESPONSE: The US DOT has initiated the Road to Zero Program to lead America toward the Road to Zero traffic deaths. The Department has committed \$1 million for each of the next three years to support the coalition, including providing grants to national organizations on a competitive basis for innovative efforts that will cut traffic deaths. The Department's short-term focus is to promote innovative strategies that save lives over the next three to five years. Those strategies include improving seat belt use and motorcycle helmet; redesigning streets; truck safety; and leading driver behavioral change campaigns. In the long term, the US DOT's efforts will focus on overall system design, new vehicle technology, enforcement, and behavioral safety. With the rapid introduction of automated vehicle technologies that may prove to be a road safety game changer, our goal of zero deaths is achievable in our lifetimes.

² Docket Number FTA–2016–0024.

FTA recognizes the prevalence of injuries and fatalities to pedestrian and cyclists that result from collisions with public transportation vehicles and is committed to improving the safety of public transportation systems through the management of hazards to reduce risk. In the area of technology, FTA currently has a number of demonstration projects and research activities that are evaluating the use of collision avoidance technologies and associated practices. The outcome of these and subsequent research activities and evaluations will assist FTA in the development of standards, protocols, recommended practices, and guidelines for the public transportation industry.

COMMENTS: One commenter indicated that there are additional standards that should be considered for inclusion in the compendium:

- OSHA Occupational Safety and Health Standards, 29 CFR 1910
- OSHA Safety and Health Regulations for Construction, 29 CFR 1926
- Federal Environmental Protection Agency (EPA) regulations.

One commenter indicated that they adhere to a number of standards that are not included in the Compendium. Examples include emergency management principles used by the State of California, as well as the Federal Emergency Management Agency (FEMA). Specific references included the Standardized Emergency Management System (SEMS), the National Incident Management System (NIMS), the Incident Command System (ICS), and processes and procedures that include emergency response management by objectives, multi/inter-agency coordination and allocation of resources and emergency response activities, mutual aid requests for additional emergency resources from non-affected jurisdictions, and coordination of damage information, resource requests and emergency response among jurisdictions.

One commenter offered the following additions to the Compendium:

- Massachusetts Department of Public Utilities, 220 CMR 151
- Rail Fixed Guideway System: System Safety/Security Program Standard
- Massachusetts Architectural Access Board, 521 CMR 18, Transportation Terminals
- Massachusetts Department of Labor Standards, 454 CMR 25, Occupational Safety and Health for State Workers
- Occupational Safety & Health Administration, 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses
- United States Coast Guard (USCG) requirements, specifically 46 CFR 4 and 16 regarding drug and alcohol testing and 46 USC 8104 regarding USCG working hours
- Military Standard 882 (MIL-STD-882)
- Manuele's Risk Score Formula
- FTA Circular 5800.1, Safety and Security Management for Major Capital Projects.

One commenter recommended the addition of the *Manual of Uniform Traffic Control Devices* (MUTCD) as a standard. Part 8 of the MUTCD provides standards for Traffic Control for Railroad and Light Rail Transit Grade Crossings (see 23 CFR, Part 655, Subpart F). In addition, the commenter referenced the *Railroad-Highway Grade Crossing Handbook*, recognized as a single reference document on prevalent and best practices, as well as adopted standards relative to highway–rail grade crossings. The handbook was described as providing general information on highway–rail crossings, characteristics of the crossing environment and users, and the physical and operational improvements that can be made at highway-rail grade crossings to enhance the safety and operation of both highway and rail traffic over grade crossings.

FTA'S RESPONSE: FTA appreciates the input provided in response to this question. FTA has incorporated the above relevant standards into the Compendium. Further, FTA may consider these standards during its ongoing evaluation of transit safety standards.

2. Are the standards utilized within your system, but not listed in the Compendium, mandated or promulgated by a Federal or state agency, SSOA, regional regulatory body, or other entity? If so, what are they?

COMMENTS: One commenter indicated that the Compendium does not contain all related AREMA publications, only those recently developed. They also suggested that IEEE standards be more specifically identified, noting that the Compendium does not provide direct links to specific standards.

FTA'S RESPONSE: FTA will further review AREMA and IEEE standards and may amend the Compendium with those that have public transportation applicability. A number of standards included within the Compendium are proprietary and therefore not available for free download or access. As an example, to access the National Fire Protection Standards, you must pay for a subscription through the National Fire Codes Subscription Service.

COMMENTS: One commenter suggested that through the contractual obligations of FTA grant award recipients, any FTA issued guidance documents should be included in the Compendium. Examples provided included the *Handbook for Transit Safety and Security Certification* and *Hazard Analysis Guidelines for Transit Projects*. Additionally, the commenter suggested that related support standards included in guidance documents be listed, such as Military Standard 882 (MIL–STD–882). One commenter provided a list of additional standards for the bus mode that were associated with State of Oklahoma regulations. These included Oklahoma Statute Section 21–1901, the Bus Passenger Safety Act; Oklahoma Statute Section 4711–702, related to obedience to signal indicating approach of a train; and Oklahoma Statute 47–11–901c, a prohibition related to the unlawful use of cellular telephones. One respondent indicated that they must comply with the following standards promulgated by a state agency or SSOA:

- Pennsylvania Department of Labor requirements for employee safety and health (as self-insured entity) per Title 34 PA Code §129
- Pennsylvania Department of Transportation order for public bus drivers of local transportation organizations to Hours of Service (HOS) requirements per Title 67 PA Code § 231.7(7)
- Pennsylvania Department of Transportation requirements for the Inspection and Certification of Electric Mass Transit Vehicles per Title 67 PA Code § 257
- Pennsylvania Department of Environmental Protection requirements.
- In addition, they are bound by other state, county, and local jurisdictions' codes and regulations.

One commenter, in discussing facilities standards, provided a list of several agency and standard development organizations with regulations, codes, and standards related to facility design standards to which they must comply.

FTA'S RESPONSE: FTA does not agree that it should add its current guidance documents to the Compendium. The guidance documents do not include standards related to transit safety.

FTA will further review and evaluate these standards and regulations in its ongoing and comprehensive evaluation of public transportation safety standards and protocols. FTA will also continue its ongoing review of existing State laws and regulations, including those delineated in these comments. The outcome of these and subsequent research activities and evaluations will assist FTA in the development of standards, protocols, recommended practices, and guidelines for the public transportation industry.

3. What observations or data-driven statements can you provide stating or documenting the effectiveness of the standards included in the Compendium (or those in place for your system, but not reflected in the Compendium)?

COMMENTS: A commenter suggested that *the Railroad-Highway Grade Crossing Handbook* be adopted as a standard, noting that the guidelines and alternative improvements presented in the handbook are primarily those that have proven effective and are accepted nationwide.

FTA'S RESPONSE: FTA received multiple comments related to FHWA's *Railroad-Highway Grade Crossing Handbook*, many of which illustrated the usefulness and effectiveness of the Handbook. While originally published in 1986, revisions have been made to further improve upon what appears to be a nationally recognized effective "single reference document on prevalent and best practices, as well as adopted standards relative to highway-rail grade crossings" (FHWA 2007). FTA will evaluate the handbook and may consider it as a source for future actions.

Although not providing a comment to the efficacy of an existing standard, one commenter did provide a summary of the expected benefits that could be realized through a third rail insulator cleaning standard.

FTA'S RESPONSE: FTA appreciates the technical paper that was submitted by this commenter and recognizes the risks posed by poorly maintained third rail insulators. The maintenance practices for third-rail insulators may be examined in FTA's ongoing evaluation of public transportation safety standards and the consideration of future standards and protocols.

COMMENTS: One commenter in response to Question 3 stated that many of APTA's standards are outdated and recommended that FTA work with APTA to update and improve these standards, ensuring that the principles of SMS are incorporated.

FTA'S RESPONSE: FTA values its partnership with APTA and recognizes the value of APTA's Standards Development Program, as well as other SDO programs, to the public transportation industry. As FTA's identification and evaluation of transit safety standards continues, the agency will ensure that stakeholders are given the opportunity to provide input to this process.

COMMENTS: One commenter, in describing the efficacy of standards, indicated that the Compendium omits a number of effective non-rail transit standards that rail transit agencies must comply with on a regular basis. These were described as important to the safety of rail transit passengers, employees, and contractors, with examples including OSHA and Cal/OSHA regulations, State fire codes, building codes, and public safety regulations.

FTA'S RESPONSE: As mentioned previously, existing standards and protocols applicable to the public transportation industry that have been identified by commenters will be added to the Compendium and may be included in FTA's further examination and evaluation of standards and protocols. The outcome of these and subsequent research activities and evaluations will assist FTA in the development of standards, protocols, recommended practices, and guidelines for the public transportation industry.

COMMENTS: One commenter responded that standards serve to provide agencies with guidance based on industry research and experience. As such, they offered that implementing the standards is a generally accepted effective process.

FTA'S RESPONSE: FTA recognizes that many public transportation agencies are vigilant in the pursuit of improved transit safety and risk reduction. Systems across the country have established and continue the maintenance and evaluation of both proactive and reactive policies, procedures, locally-established standards, and protocols to address specific areas of risk and many of these have been effective in identifying, tracking, and otherwise monitoring areas of safety and security risks, whether identified based on lagging or leading indicators. In FTA's assessments of public transit systems, and through

research performed for and by FTA, the recognition of safety risks and focused efforts to overcome these risks are evident. FTA will continue to review the practices of public transportation agencies and industry associated research in an effort to identify model or successful practices that could inform the development of FTA issued guidelines or recommended practices.

4. Based on your experiences or safety-related trends at your agency, are there areas of concern for which standards should be established by FTA through subsequent rulemaking activity? If so, what are they?

COMMENTS: One commenter stated that the resources used to supplement standards are safety advisories and notifications from FTA, FRA, and manufacturer bulletins regarding design changes or safety risks. This commenter added that because these advisories and notifications are issued related to risks potentially affecting transit systems nationally, they serve as an excellent supplement for standards that could address specific areas of concern. The commenter added that many identified risks not fully addressed in current standards are assessed on an agency-by-agency basis.

FTA'S RESPONSE: FTA will continue its comprehensive review of public transportation safety standards and will examine advisories and notifications, recognizing that they may serve as supplementary documentation for future model practices, guidelines, or recommended practices.

COMMENTS: One commenter stated that their agency is required to notify their SSOA of all unacceptable or undesirable identified hazards. The commenter stated that one area in particular that seems to lack guidance and standards is in a Life Cycle Maintenance/ Asset Management Program and that an extremely helpful resource would be a national compendium of asset hierarchies and metrics to assist agencies less mature in these proactive processes. It was suggested that FTA support a national dialogue to identify transit specific risks and deficiencies by annually publishing a collection of the most severe or common hazards (with specific solutions) for use by transit agencies, noting that ideally this would be an anonymous listing to mitigate media inquiries into specific agency conditions, practices, or risks.

FTA'S RESPONSE: FTA appreciates this recommendation, and the agency continues to provide guidance to the industry on life cycle maintenance topics and transit asset management. Recently, FTA published its first iteration of a National Safety Plan. The NSP includes a list of broad safety focus areas and safety performance measures that should guide transit agencies in their identification and mitigation of safety risks. As FTA moves towards the collection of more relevant and robust safety data, the agency will continue to identify and analyze nationwide safety trends and communicate appropriate mitigations through the NSP, regulations, standards, technical assistance, or other means.

COMMENTS: A commenter stressed the importance of establishing standards related to Collision Avoidance Systems (CASs), stating that the ability to identify, process, and transmit real-time collision mitigation warnings provides drivers with an opportunity for greater situational awareness of the events, potential threats, and imminent hazards within the buses' environment. Intuitive and clear warnings enable drivers to make better and safer driving decisions.

FTA'S RESPONSE: FTA recognizes the advances that have been made in collision avoidance technologies and is aware of many deployments that are occurring within the public transportation industry. In the area of technology, FTA currently has a number of demonstration projects and research activities underway that are evaluating the use of collision avoidance technologies and associated practices. The outcome of these and subsequent research activities and evaluations may assist FTA in the development of future standards, protocols, recommended practices, and guidelines.

COMMENTS: The commenter provided three related standards that could be supplemented with collision avoidance technology content:

- APTA Bus Transit System Standards (Bus Safety) includes four recommended practices related to transit bus fire safety: safety shutdown, electrical system requirements, fire protection systems, and thermal event investigations.
- Federal Motor Vehicle Safety Standards, Title 49 CFR Part 571: Crash Avoidance (25 standards), includes requirements pertaining to controls and displays, transmissions, windshield defrosting, defogging, wiping and washing systems, braking systems, tires and rims, mirrors, hood latches and theft protection, accelerator control systems, warning devices, motorcycle braking, and controls and displays.
- APTA Bus Transit System Standards (Reducing Distracted Driving) includes two recommended practices to reduce distractions while operating a vehicle without referring to collision avoidance systems.

FTA'S RESPONSE: These standards appear in the Compendium and will be evaluated in consideration of future actions. In the evaluation of these standards, the relationship of these to existing or emerging collision avoidance system technologies will be considered.

COMMENTS: One commenter noted that Transit Cooperative Research Program (TCRP) Report 125, *Guidebook for Mitigating Fixed-Route Bus and Pedestrian Collisions*, although designed to assist transit agencies in identifying preventative or remedial strategies for reducing the frequency and severity of bus and pedestrian collisions, does not explore the use of CASs in mitigating collisions. They further added that FTA's Bus Testing Rule (81 FR 50367) does not address CASs as they relates to the new pass/fail standard and aggregated scoring system for buses and modified vans.

FTA'S RESPONSE: FTA appreciates this recognition that additional evaluation, research, and guidance needs to be developed for the selection, purchase, deployment, management, and operation of collision avoidance technologies. The significance of collisions in the public transportation industry and corresponding loss of life, injuries, and property loss due to these collisions is of great concern to FTA. Recognizing the potential positive contribution these systems may have in reducing safety risks, FTA will continue to evaluate and, if necessary, conduct demonstrations and analysis to assist in future standards rulemaking or the development of guidance documents and recommended practices.

COMMENTS: One commenter offered the following in response to Question 4: Areas of concern for which standards may be established by FTA: standardization of Hours of Service (HOS) requirements and limitations unique to the following rail transit activities/personnel; operators, control center personnel, roadway workers; standardization of HOS requirements/limitations unique to the following bus transit activities personnel; operators and control center personnel; and standardization of medical fitness for duty requirements unique to the following employee categories: rail transit operators, bus operators, transit police; and roadway workers.

FTA'S RESPONSE: Areas of risk including fatigue and employee fitness for duty are well recognized across the transit industry. FTA is aware of potential hazards with these issues and will continue to examine standards, practices, and existing regulations related to HOS and medical examination requirements. Supplementary support documentation for these topics may be considered in FTA's comprehensive standards development process.

COMMENTS: A commenter stated that there need to be Federal HOS regulations for both rail and bus transit and added that APTA, along with other transit agencies, should be consulted in exploring HOS regulations for transit.

FTA'S RESPONSE: FTA recognizes the significant risk associated with fatigue and will be examining and evaluating HOS regulations, standards, and recommended practices through its standards development process.

COMMENTS: One commenter offered that human error accounts for the majority of their preventable rail transit incidents. They referred to NTSB investigations of rail transit incidents over the last 10 years that highlight the role of human error as a significant contributing factor to these incidents and recommended that FTA focus on the risks associated with human factors, which include fatigue management and fitness for duty, as well as the failure to exercise proper Roadway Worker Protection (RWP) practices and measures, in the development of rail transit safety standards.

FTA'S RESPONSE: As indicated in FTA's earlier responses, fatigue management and fitness for duty are areas of focus in the ongoing evaluation of safety standards, regulations, and recommended practices. FTA's examination and evaluation of standards, protocols, and

recommended practices on this topic continues and will be an area for which standards or guidance documents and recommended practices may be issued.

COMMENTS: One commenter recommended that FTA consider establishing a national public transportation operator licensing program that would include mandatory medical examinations of safety-sensitive rail transit employees, similar to those required for Commercial Driver Licenses (CDLs). They suggested that the program include a point system similar to the Vehicle Violation Point System used by the California Department of Motor Vehicles and added that this not only would create a national standard for public transportation operators, it also would provide a unified personnel database for hiring purposes. They indicated that it would serve as a tool to heighten operator awareness, reduce complacency, and incentivize safety vigilance.

FTA'S RESPONSE: FTA appreciates the recommendation for a public transportation operator licensing program with associated unified personnel database and recognizes the benefits that a program such as the one described would bring to the industry. These recommendations will be considered in FTA's ongoing evaluation of safety standards and protocols.

COMMENTS: One commenter offered the following in response to Question 4 related to areas of concern: workplace safety (specific to transit workers), including right-of-way (ROW) safety, tunnel environment, transit facilities, electrical safety (including third rail and catenary), and fall protection; transit worker assaults (including bus and light rail operators, inspectors, and customer service agents); vehicle engineering: bus blind spots; fatigue management/hours of service; State of Good Repair (infrastructure and rolling stock); and protection of safety sensitive information.

FTA'S RESPONSE: FTA agrees that these are areas that pose high risk in the public transportation industry. These will be areas of focus for FTA when evaluating standards and protocols for rulemaking or for the development of guidelines or recommended practices that may mitigate these hazards.

5. Are there specific transit modes and associated areas of risk that should be areas of focus for FTA more than others? If so, what are they?

COMMENTS: One commenter identified these areas of risk by mode: rail transit – Roadway Worker Protection (active/passive recommended practices and guidelines versus "standards"); bus transit – vehicle/pedestrian safety recommended practices and guidelines; all modes – recommended practices and guidelines regarding operator distractions (i.e., use of personal portable electronic devices).

FTA'S RESPONSE: FTA agrees with the commenter. In FTA's ongoing safety data collection and analysis process, these continue to be areas that pose high risk for injuries and fatalities within the public transportation industry. As mentioned previously, these are areas of focus that may be addressed through future standards and guidance.

COMMENTS: A separate commenter provided additional areas of risk by mode: rail transit – fall protection and electrical safety; bus transit – hydrogen technology (especially in tunnel environments and maintenance facilities) and operator assaults; and all modes – State of Good Repair, fatigue management, Hours Of Service (HOS), and software integration, certification, and life cycle.

FTA'S RESPONSE: FTA agrees with the commenter. These are areas of risk within the nation's public transportation industry. FTA will review existing safety standards that could reduce these risks, identify any gaps that may currently exist within existing standards, and may consider the adoption or development of standards, protocols, guidance documents, or recommended practices to address these areas.

6. If standards were established based on various determinants of risk, how should those areas of risk be prioritized? Should standards be established based on exposure rates (passenger/vehicle miles), number or rate of injuries, or number or rate of fatalities, as examples?

COMMENTS: One respondent suggested that when assessing data, it is useful to have a common, consistent measure. They recommended the use of injuries and fatalities – either the number of each or reported as a rate of 100,000 passengers. They added that measuring safety performance based on the miles driven in a city can mask serious safety issues and concluded by adding that safety performance be measured as the real impact on people instead of a measure based on miles driven. Another respondent stated that FTA should consider using progressive indices tied to the size of rail systems and operational complexities, adding that FTA should consider such indices as: passenger volumes, trip miles, total revenue miles per day, total revenue miles per rail car, train operator to passenger ratios as the basis on which to require design considerations for equipment, track and infrastructure, maintenance, servicing and training, established at various intervals that are progressive to meet each rail system's operational complexity. They offered as an example that FTA could require that the higher number of trips, the more demanding inspection regime could be required for rail cars, tracks and systems tied to a baseline metric. The higher volume of passengers and the higher number of total trip miles per rail car could lead to more demanding inspection and servicing regiments on systems (e.g., power, automatic train control, and communications) tied to a baseline metric.

One commenter offered that any standards that are developed would necessarily consider the associated risks, but that risk should not be the sole determining factor for a standard. They further stated that standards should principally establish a foundation to ensure that the affected asset or process is monitored and administered to maximize operational, employee and public safety. They added that specific risk metrics and associated analytics should be developed jointly by each transit agency and their SSOA, and not prescribed as "one-size-fits-all" criteria.

FTA'S RESPONSE: The National Public Transportation Safety Plan (NSP) will be FTA's primary tool for communicating with the transit industry about its safety performance. FTA expects to update the NSP, from time to time, in response to trends in risk management in the transit industry, emerging technologies, best practices, findings from research, and other industry developments. The NSP establishes performance measures to improve the safety of public transportation systems that receive FTA Federal financial assistance. Transit agencies will set performance targets based on the measures in order to monitor and assess the safety performance of their public transportation systems. As FTA continues development of standards, and future iterations of the National Public Transportation Safety Plan, the concepts raised by the commenter may be considered. FTA recognizes that one size does not nor will not "fit all." FTA will continue to examine the data that is currently reported and identify data elements that may need to be collected, while being cognizant of the extraordinary variation in the size, operational characteristics (including location), and transit modes provided within public transportation agencies' service structure.

COMMENTS: One commenter provided that rather than establish static minimum standards based on various determinants of risk, it is that agency's philosophy that efforts should be focused more on continuous improvement as a central component of SMS implementation. It was suggested that goals for accident /incident reduction and hazard mitigation should derive from leading indicators and dynamic trend analysis. It added that whereas FTA may offer helpful guidance and best practices, an agency's ongoing data analysis and safety performance measurement processes are the best determinants of risk prioritization. Further, the commenter suggested that standards should encourage and empower programs focused on continuous improvement, to internally determine areas of high risk to persons, "accidents," and system State of Good Repair.

FTA'S RESPONSE: FTA agrees with the commenter; continuous improvement and advancing Safety Management Systems within the public transportation industry is a primary goal. The comments provided will be considered as FTA progresses into rulemaking activities or the development of guideline documents or recommended practices related to performance measurement and risk identification and prioritization.

COMMENTS: One commenter suggested that FTA develop standards for mitigating hazards based on industry trends and risk frequency. For example, for light rail systems, the most prevalent hazard is grade-crossing collisions. Although some TCRP research documents and others listed in the Compendium address such hazards, the commenter suggested that none of them are enforceable standards that require specific mitigation measures to be included in the design of new lines. For this particular example, the commenter recommended that the MUTCD and FHWA's *Railroad-Highway Grade Crossing Handbook* be referenced in the Compendium. They added that many of the safety elements in these documents, such as four quadrant gates, pedestrian gates, swing

gates, pedestrian barriers, active signs, as examples, are used by agencies on a voluntary basis. The commenter provided that some of the more recent strategies that agencies have implemented or are planning to implement to mitigate grade crossing collisions, such as in-pavement lights, and left turn lane gates are not included in MUTCD and FHWA's handbook. For this reason, the commenter added that given the ubiquitous nature of grade crossing collisions, FTA should adopt these elements as their standard and promulgate their use on a mandatory basis, (with the only exception being a physically constrained right-of-way that could not accommodate such elements), as a condition of funding.

FTA'S RESPONSE: FTA's process for the review and, if warranted, development of safety standards will consider the specific safety risks identified through data collection and analysis, as well as other factors. As an inventory of existing safety related standards and protocols, the Compendium has been updated to include the MUTCD and FHWA's *Railroad-Highway Grade Crossing Handbook*. Upon further review and evaluation of the standards included within the referenced materials, FTA may elect to initiate rulemaking, guidance documents, or safety advisory/directive activities.

7. Are there any safety standards utilized in the public transportation industry that are not reflected in the Compendium or in place within your agency that should be included in the Compendium? If so, what are they?

COMMENTS: One respondent suggested that FTA include standards related to natural gas vehicles, both those that currently exist and those that are under development as follows:

- ANSI/CSA NGV 1 Compressed natural gas vehicle (NGV) fueling connection devices
- ANSI/NGV 2 Compressed natural gas vehicle fuel containers
- ANSI/NGV 3.1/CSA 12.3 Fuel system components for compressed natural gas powered vehicles
- ANSI/IAS NGV 4.1/CSA 12.5 NGV Dispensing Systems
- ANSI/NGV 4.2/CSA 12.52 Hoses for natural gas dispensing systems
- ANSI/CSA NGV 4.3 Temperature compensation for natural gas fueling
- ANSI/IAS NGV 4.4/CSA 12.54 Breakaway Devices for Natural Gas Dispensing Hoses and Systems
- ANSI/NGV 4.8/CSA 12.8 Natural gas vehicle fueling station reciprocating compressor guidelines
- ANSI/NGV 5.2/CSA 12.6 Vehicle fueling appliances
- ANSI/CSA NGV 6.1 CNG. Fuel Storage and Delivery Systems for Road Vehicles
- ANSI/CAN/CSA – ISO 12617 Road vehicles– Liquefied natural gas (LNG) refueling connector
- ANSI/CSA LNG 2 LNG Fuel Containers for Vehicles

- CSA Group EXP 2.1 Best Practice for defueling, decommissioning, and disposal of compressed natural gas vehicle fuel containers

They further added that consideration should be made to establish personnel certification standards for compressed natural gas vehicle fuel system inspectors.

One commenter identified FRA regulation 49 CFR 236.18, Software Management Control Plan (currently used for Commuter Rail).

FTA'S RESPONSE: FTA has modified the Compendium to include the standards referenced above and will include these in the ongoing evaluation of safety standards for rulemaking or in the development of guidelines or recommended practices. In addition, FTA will be evaluating standards and protocols related to personnel training certifications. Those specific to the inspectors of CNG vehicle fuel systems will also be examined.

8. Are you aware of safety standards utilized in other industries that should be examined? If so, what are they?

COMMENTS: One respondent suggested that FTA explore using hydrogen gas standards that were primarily developed to support light duty vehicles, as follows:

- ANSI/CSA CHMC 1 – Test methods for evaluating material compatibility in compressed hydrogen applications – Metals
- ANSI H PAD 1 – Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers
- ANSI/CSA HGV 2 – Standard for Compressed Hydrogen Gas Vehicle Fuel Containers
- ANSI/CSA HGV 3.1 – Fuel system components for compressed hydrogen gas powered vehicles
- ANSI/CSA HGV 4.1 – Standard for hydrogen dispensing systems
- ANSI/CSA HGV 4.2 – Hoses for Compressed Hydrogen Fuel Stations, Dispensers and Vehicle Fuel Systems
- ANSI/CSA HGV 4.3 – Test methods for hydrogen fueling parameter evaluation
- ANSI/GSA HGV 4.4 – Breakaway devices for compressed hydrogen dispensing hoses and systems
- ANSI/CSA HGV 4.6 – Manually operated valves for use in gaseous hydrogen vehicle fueling stations
- ANSI/CSA HGV 4.7 – Automatic valves for use in gaseous hydrogen vehicle fueling stations
- ANSI/GSA HGV 4.8 – Hydrogen gas vehicle fueling station compressor guidelines
- ANSI/CSA HGV 4.9 – Hydrogen fueling station

- ANSI/GSA HGV 4.1 0 – Fittings for compressed hydrogen gas and hydrogen rich gas mixtures

One commenter provided a series of standards and guidelines that FTA should consider in future rulemaking activities. They did recognize that some transit agencies may already observe these standards, but offered these suggestions in response to Question 8 (specific standards by source were provided in the docket):

- ASCE/ Transportation & Development Institute /ANSI – standards for escalators and elevators, automated people movers, and building design loads. The respondent indicated that although these are federal requirements and those that design and build these systems are aware of these items, administrative, safety, maintenance and operations personnel who will be performing SMS duties under FTAs new requirements may not know or understand these requirements.
- CDC National Institute for Occupational Safety and Health (NIOSH) – these standards would be applicable to employee health and safety, handling emergencies, epidemics and pandemics, blood borne pathogens and communicable diseases, and workplace safety practices.
- International Building Code (IBC) – applies to transportation facilities.
- International Standards Organization (ISO) – standards for quality management, training and metrology (the commenter added that FTA should issue these as guidance documents, since it would be difficult for most transit properties to be certified as ISO companies; however, these standards provide important guidance in these areas for transit systems).
- National Safety Council (NSC) – many transit systems use voluntary standards and training offered by the NSC, especially in smaller and demand–response service. The commenter suggested that FTA should endorse these programs for all applicable transit systems.
- OSHA – the commenter indicated that many of the most detailed work conducted by public transportation is governed by OSHA, but since many transit employees do not have an occupational safety background and many states opt out of having any industrial standards under the 1970 OSHA Act’s opt-out clause, they offered that it would be very helpful to include applicable standards in the Compendium.

FTA'S RESPONSE: FTA has modified the Compendium to include the standards referenced above and will include these in the ongoing evaluation of safety standards for rulemaking or in the development of guidelines or recommended practices.

COMMENTS: One commenter noted that the hazards and risks created by a lack of formal and enforced industrial safety programs at transit properties results in significant losses to employee lost–time injuries and increased risk.

FTA'S RESPONSE: FTA appreciates these comments related to formal and enforced industrial safety programs within transit agencies and the losses associated with injuries and increased risk. These comments will be included in FTA's ongoing dialogue and decision making related to transit safety risks and standards, protocols, or guidance that may be issued to mitigate these risks.

COMMENTS: One commenter offered the following safety standards that FTA should examine: ISO 14000 – Environmental Management; ISO 45001 – Occupational Health and Safety; ISO 27000 –Information Security; and ISO 31000 – Risk Management.

FTA'S RESPONSE: The International Standards Organization (ISO) is a source of myriad consensus-based international safety standards, many of which have direct applicability to the public transportation industry. FTA will review ISO standards and will add those applicable to the public transportation industry to the Compendium. In addition, ISO standards may be considered in the ongoing evaluation of safety standards for rulemaking or in the development of guidelines or recommended practices for the public transportation industry.

COMMENTS: One commenter indicated that they have developed an Automatic Track Information System (ATIS) based on the Federal Aviation Administration (FAA) Order 7032.13 – Air Traffic Requirements for the Digital Automatic Terminal Information Service System. The agency's Operations Control Center uses ATIS to disseminate the location of roadway workers via radio broadcasts, monitor displays, and dedicated phone lines. One commenter recommended FTA should consider FMCSA regulations for future rulemaking, stating that transit is more closely related to FMCSA than to FAA. One commenter stated that FRA serves as a valuable resource for rail transit agencies and encouraged FTA to consider FRA regulations in the formulation of future rulemaking. Further, they added that FRA standards allow interoperability between rail systems and companies. They added that the direct implementation of FRA rules to transit would prove financially and logistically challenging. One commenter offered the following standards that FTA should examine the following:

- Voluntary reporting programs, described as an invaluable tool FAA uses to collect data and identify trends across the industry. Similar to this and FRA/commuter rail's Confidential Close-call Reporting System (C3RS), it was suggested that FTA examine a program that allows transit employees an opportunity to self-report violations and errors in a protected (non-punitive) manner, provided the employee did not act in a reckless manner. They indicated that FAA has been using the Aviation Safety Action Program (ASAP) for more than 10 years, which has brought to light previously unreported hazards that are now being mitigated in a proactive manner.
- Line Operations Safety Audit (LOSA) was reported as another voluntary program the FAA endorses (ACI20-90) that allows highly-trained observers to ride in the flight deck during regularly scheduled flights to collect safety-related

data on environmental conditions, operational complexity, and flight crew performance. This program collects confidential data and non-punitive assurance that gets sent to the operator's safety department for meta-analysis. LOSA can be implemented across all forms of transit utilizing safety-minded, highly trained personnel to conduct these observations with the help of the organization's safety department supplying the checklist for that observer to utilize. It was suggested that FTA examine this proactive voluntary program as a way for a transit authority to demonstrate and implement SMS principals.

- The commenter also identified FAA's Fatigue Risk Management Program (FRMP), a regulatory safety program mandated to promote fatigue awareness and to ensure all industry employees safely perform their duties. The FAA requires air carriers develop a plan to allow individuals report fatigue-related issues in a proactive manner. An additional benefit noted was that a FRMP may also aid a transit authority's SMS based on a proactive objective of reducing fatigue-related events. It was suggested that FTA examine the need for further research into the fatigue of operating personnel.

One commenter requested that FTA consider FMCSA regulations, particularly those related to hours of service, vehicle inspection and maintenance, and qualifications of drivers, referencing 49 CFR Parts 395, 396, and 391. In addition, they recommended a review of 49 CFR, Part 383 and licensing, noting the need to review the CDL requirements within each state.

FTA'S RESPONSE: Regulations, standards, protocols, and recommended practices issued by other US DOT operating Administrations will be examined in FTA's ongoing review and evaluation and may be the source of future rulemaking or guidance documents and recommended practices.

9. FTA was unable to identify any standards or protocols related to the following topics: reducing blind spots, protecting rail and bus operators from assaults, and allowing sufficient time within route schedules for operators to use restroom facilities. Are you aware of any existing safety standards or protocols that may address any of these areas of risk? If so, please identify each standard or protocol by its reference and source and provide information you may have related to the efficacy of such standard or protocol.

COMMENTS: One commenter offered reduction of blind spots – 49 CFR 571.111, FMVSS, related to rearview mirrors; protecting rail and bus operators from assaults – state and local assault laws/regulations; and sufficient time within route schedules – none were known. Although one commenter indicated that they were not aware of standards in the area of blind spots, they suggested that reducing blind spots for bus operations would help the operator navigate urban streets with bicycles and pedestrians present. They offered that large vehicles, such as those used by fire departments, have installed side- and front-view cameras that they felt may help increase the driver's field of vision

for lane changes. They suggested a formal safety risk assessment be completed to determine if installing side-, rear-, and front-view cameras will decrease the amount of incidents caused by blind spots. The commenter also provided that another approach to reducing blind spots would be for the bus manufacturers to reduce the width of the A-pillar without reducing the structural integrity of the pillar. They added that the design would also have to protect the driver in the event of a collision involving the windshield. They provided an example of the panoramic windshields that are employed in fire department vehicles. They cautioned that if there is a design to push the A-pillar aft of the driver's seat, it may reduce the blind spot driver's face when turning/merging into another lane. The commenter suggested that other emerging innovative technologies, such as pedestrian turn warning systems, could prove beneficial in FTA's effort to reduce blind spots.

FTA'S RESPONSE: FTA recognizes the critical need to address blind spot or field-of-vision limitations that have been identified as causal or contributing factors in transit collisions, specifically those with pedestrians and cyclists. Although existing standards are limited in this area, FTA will evaluate and review those that do exist. In addition, because of FTA's recognition of this risk, it is advancing research, including demonstrations that will evaluate various technologies or design elements that may be utilized to mitigate these risks.

On the topic of operator assaults, a commenter offered that cities across the country have tested bus safety shields over the past decade with organization-wide implementation undertaken by a few and others abandoning pilot projects due to the costs of the bus safety shields. It was suggested that FTA conduct research across transit agencies that have implemented these shields and determine if the incidence rate has decreased. They added that if there is a correlation between installing safety shields and reducing employee assaults, transit agencies may be able to justify installing and maintaining the shields. The commenter also added that assaults on public employees in Massachusetts are considered felony crimes (MGL c.265, s. 13D).

FTA'S RESPONSE: FTA recognizes the critical need to address transit worker safety protection. FTA's Transit Advisory Committee for Safety (TRACS) report on "Preventing and Mitigating Transit Worker Assaults in the Bus and Rail Transit Industry" (July 2015) states that in 2013, 28 transit workers died due to violence on the job, and the vast majority of assaults against transit workers were non-fatal. FTA believes that any form of violence against transit workers poses a serious threat on the physical safety and emotional well-being of transit workers and also endangers the safety of passengers and the public. FTA launched a 'National Online Dialogue on Transit Worker Assault' to engage the industry which closed for public comment on August 31, 2016. The purpose of the dialogue was to establish a forum and collect inputs from the stakeholders on this important issue. Additionally, Section 3022 of the FAST Act requires the Secretary to promulgate a rule to protect public transportation operators from the risk of the

assault. The rule must consider the different safety needs of different modes, differences in operating environments, the use of technology to mitigate assault risks, existing experience in assault mitigation, and the impact of the rule on future rolling stock procurements. This rule is currently under development.

Other Comments

COMMENTS: One commenter provided that to apply many of the standards included in the Compendium, FTA should conduct further analysis on how such standards can, in practical terms, be applied universally, in a uniform way to all urban rail fixed guideway systems; how such requirements could or should be enforced by state safety oversight entities; and how to prevent the preponderance of rail systems from seeking relief through waivers, which in turn would make these safety standards obsolete. They warned that in this situation, there would eventually be a patchwork of standards throughout the nation that are not consistent in spite of an additional set of regulations. This commenter also added that FTA should consider standards in the context of SMS implementation and whether such safety standards would help or dilute the deployment of SMS.

FTA'S RESPONSE: FTA's review and evaluation of transit safety standards, protocols, and practices will include an analysis of the considerations posed in this comment, as well as others. FTA has adopted the principles and methods of SMS as the basis for its development and implementation of the Public Transportation safety Program. 49 CFR 670.3 (81 FR 53046, August 11, 2016). Accordingly, FTA's decisions on which standards and protocols to advance into rulemaking or those that would be best disseminated through guidance or recommended practices documents will align with SMS concepts.

COMMENTS: One commenter stated that the Compendium is a good reference archive from which generic modal guidelines may be developed that allow for customization by the transit agency or SSOA to accommodate differences among agency operations and/or assets. They further added that FTA should avoid crafting standards that are overly-prescriptive (offering FRA and the California Public Utilities Commission as examples). They further stated that any guideline template or recommended practice should be provided in a format consistent with those issued by APTA's Standard Development Program.

FTA'S RESPONSE: FTA appreciates the concerns illustrated by these comments and will not only be reviewing and evaluating standards and regulations for potential rulemaking, but also will be developing strategies for implementation and enforcement. In addition, not all standards, protocols, and practices that are being reviewed and evaluated will be advanced to rulemaking. Many of these may serve as resources in the development and dissemination of guidance, safety advisories/directives, or recommended practices.

COMMENTS: One commenter suggested that the Compendium should include a subcategory for power generation – overhead, third rail, and/or sub-stations – and

further added that elevator/escalator standards should be included as a stand-alone subcategory. In addition, they suggested that “on-track safety/roadway worker protection be included as a subcategory within Operational Standards.

FTA'S RESPONSE: FTA recognizes the potential risks associated with power generation and elevator/escalator infrastructure and components and the demonstrated risks of injury and fatalities to roadway workers. These topics will be examined in FTA's standards development process. In addition, because of FTA's recognition of the risks for transit roadway workers, it is advancing research, including demonstrations, that will evaluate various technologies or design elements that may be utilized to mitigate these risks.

COMMENTS: One commenter provided several recommendations to improve the safe operation of transit systems ensuring the safety of pedestrians, bicyclists, and persons with disabilities. A few of these included requiring buses to observe a 6-ft buffer between the bus and bicyclists when passing, increasing bicycle capacity on buses and trains, allowing bicycles to be stored on buses under certain circumstances, operational considerations related to waiting periods at bus stops, and public restrooms at transit centers and park and ride lots.

FTA'S RESPONSE: Although these recommendations refer to local operational considerations and policies, FTA recognizes the risks to cyclists and pedestrians related to collisions with public transportation vehicles. These topics will be considered in FTA's ongoing standards development activities.

COMMENTS: One commenter provided a general statement of caution about the applicability of the standards and protocols listed in the Compendium to the transit industry. Further, they suggested that various State rules listed in the Compendium may serve as a resource for other states or transit agencies, but should not be imposed for implementation at the Federal level.

FTA'S RESPONSE: FTA's standards development process will include a thorough examination and evaluation of existing standards and state and Federal laws and regulations. In the event that certain standards or regulations are advanced for rulemaking, additional analyses will be performed to evaluate the impacts of those standards or regulations on the public transportation industry.

COMMENTS: One commenter stated that the following CPUC General Orders be removed from the Compendium: GO 110 – Radio communications in railroad operations; GO 126 – Contents of first-aid kits provided by railroads; GO 135 – The occupancy of public grade crossings by railroads; and GO 176 – Rules for Overhead 25 kV Railroad Electrification Systems for a High Speed Rail System.

FTA'S RESPONSE: The Compendium has been updated to reflect this recommendation, removing the CPUC General Orders. However, standards, protocols, and practices

related to radio communications, grade crossings, and overhead electrical systems will continue to be evaluated for rulemaking considerations or used to develop guidelines or recommended practices that will be disseminated to the industry.

COMMENTS: One respondent described the need for bus operator education programs to address awareness of pedestrians and bicyclists.

FTA'S RESPONSE: In FTA's review and evaluation of standards, protocols, and practices, driver training and certification programs will be examined to determine if minimum standards should be developed or if guidelines or recommended practices should be developed.

COMMENTS: One commenter suggested that additional oversight be required of public transit agencies to ensure compliance with Federal regulations and laws.

FTA'S RESPONSE: FTA recognizes the need for additional oversight of the public transportation industry. MAP-21 and the FAST Act expanded US DOT's safety mission and provided new authority to strengthen public transportation safety under the Public Transportation Safety Program (PTSP), furthering FTA's position as a safety regulatory agency. At a minimum, oversight activities will include an expanded Triennial Review Process that incorporates the tenants of SMS and the components that have been established through the PTSP.

COMMENTS: One commenter stated that the standards, reports, guidelines, and regulations that comprise the Compendium are impressive and exhaustive, but not efficacious. They offered that many of the documents listed are not regulatory in nature, are not enforceable and, hence, not necessarily a standard that is in wide use in the transit industry. The commenter recommended that FTA adopt or develop specific standards and make them mandatory, particularly for agencies that receive federal funding for new start or extension projects.

FTA'S RESPONSE: As FTA continues its comprehensive evaluation of safety standards and regulations, such as those under the purview of other US DOT Operating Administrations, any public transportation safety standards or new regulations may include specific mandated requirements.

COMMENTS: A commenter added that other known significant industry hazards, such as train vs. train collisions, over-speed in curves, doors opening on the wrong side of platforms or when trains are not properly berthed, red signal violations, and roadway worker accidents, can be mitigated to a great extent with available technology and by designing out these hazards during the early planning and design phases of rail projects. They added that none of the documents cited in the Compendium require measures that would address such hazards. Therefore, this commenter recommended that FTA develop standards that will require agencies, particularly those which are federally funded, to incorporate safety interventions such as automatic train control, berthing

interlocking with door controls, and supplemental roadway worker technology to eliminate, to the greatest extent practical, known industry hazards.

FTA'S RESPONSE: FTA will evaluate the existing technologies and associated standards in the review and evaluation of safety standards and protocols. Through current and proposed FTA sponsored transit safety research initiatives, FTA anticipates that additional standards, protocols, guidelines for implementation and deployment of these technologies and associated recommended practices will be identified and disseminated.

Section 3 Efficacy

FTA examined the efficacy of existing transit safety-related standards and safety standards with public transportation applicability with a two-pronged approach. This section is divided into the following two sub-sections:

1. A summary of the efficacy of existing standards referenced in the Compendium revealed through a research process that used, at a minimum, Transport Research International Documentation (TRID) and Google Scholar.
2. A summary of related public comments submitted on the Compendium (Docket Number FTA–2016–0024).

Efficacy of Existing Standards – Research Results

The research on the efficacy of standards reflected in the Compendium revealed limited documentation or evidence of the effectiveness of those standards as applied to transit vehicles or operations. This report includes a comprehensive set of recommendations that are intended to enable FTA to undertake further data-driven, risk-based analysis of the safety performance of transit modes and the applicability and effectiveness of the standards and protocols identified in the Compendium.

The standards and protocols for which efficacy could not be confirmed are reflected in the Compendium (link provided in Appendix B) with the following statement: “Efficacy of standard could not be confirmed/documented.” The following provides specific examples of standards for which efficacy has been examined.

- APTA Track Safety Standards (specific standard reference not provided)

<http://www.nap.edu/read/22394/chapter/7>

Survey responses summarized in TCRP Synthesis 107 provided that “APTA has developed minimum track safety standards, but they cannot be enforced.” The authors provided that survey respondents are calling for a new generic maintenance standard that can be modified to accommodate differences in infrastructure and vehicles, adding that “agencies appear to have concluded that it is time to develop universal track safety standards before newer systems get too old, and ensure that all passengers are riding on safe track.”

- APTA–PR–CS–S–16–99 Rev2 – Row-to-Row Seating in Commuter Rail Cars
http://ntl.bts.gov/lib/47000/47400/47423/rail_cw_2005_07.pdf

Results indicated that the table design concept “lacks the energy absorption efficiency of other designs, and may not equally protect the aisle-side and window-side occupants,” among other things.

- APTA–PR–M–S–015–06 – Standard for Wheel Flange Angle for Passenger Equipment

http://www.tcrponline.org/PDFDocuments/TCRP_RPT_71v5.pdf

Although this research was not designed to specifically evaluate this standard, the researchers did suggest that high flange angles above 72° is “strongly recommended to improve operational safety.” APTA Passenger Rail Safety Standard Task Force Technical Bulletin 20 provided guidance on reducing the probability of wheel climb derailment by suggesting a minimum wheel flange angle of 72°.

- APTA–BTW–SS–RP–001–05 – Recommended Practice for Transit Bus In–Service Brake System Performance Testing

<http://www.apta.com/resources/standards/Documents/APTA–BTS–BC–RP–001–05.pdf>

D.5.1 Service brake effectiveness research indicated that the deceleration requirement of 0.435g provided in Federal Motor Carrier Safety Regulation 393.52 historically has been considered too lenient by transit operators. It suggested the requirements for performance–based brake testers be elevated to satisfy transit needs.

- APTA–BTS–SS–RP–002–05 – Recommended Practice for Transit Bus Foundation Brake Lining

<https://deepblue.lib.umich.edu/bitstream/handle/2027.42/57494/1/00608.pdf?sequence=1>

The first foundation lining installed under APTA BT–RP–002–05 was certified, but as of the writing of the report, the first audit test had not yet been done.

- Crash and Safety Testing Standard for Paratransit Buses Acquired by the State of Florida (FL–Standard)

<http://www.dot.state.fl.us/transit/Pages/CrashSafetyTestingStandardsFullDocument.pdf>

This Standard applies to single-deck vehicles designed and constructed for more than 8 but less than 22 passengers, whether seated or standing, in addition to the driver and crew. It indicates that either full-scale experimental crash tests or computational mechanics finite element methods (FE) can be used for the assessment. Full-scale crash tests include a side impact test and a rollover test. Satisfactory performance of the paratransit buses during actual or simulated side impact and rollover tests is required for their approval as eligible for purchase. Several laboratory tests are required for validation of the FE models for simulation-based approvals. An uncompromised residual space concept is adopted in this standard as a pass/fail criterion.

- ASME RT–I 2009: Safety Standard for Structural Requirements for Light Rail Vehicles

<http://www.fta.dot.gov/documents/CollisionSafetyImprovementsforLRVs.pdf>

This evaluated the bumper design of the structural requirements of light rail vehicles for both frontal and corner impacts with an unbelted dummy in the driver seat of four types of vehicles. The results did indicate potential improvement to the survivability of the occupants. More evaluations were recommended for additional vehicle types, occupant conditions, light rail vehicle speeds, and auto orientations.

- <http://onlinepubs.trb.org/onlinepubs/IDEA/FinalReports/Transit/Transit77.pdf>

A Retrofit bumper was evaluated to meet the safety standards of ASME RT–I 2009 focusing on the survivability of the deformable structural bumper design. The analysis indicated minimization of permanent damage and reduction of struck vehicle occupant injury.

- ASME RT–2 2008 was revised to ASME RT–2 2014: Safety Standard for Structural Requirements for Heavy Rail Vehicles
<http://www.apta.com/gap/testimony/2009/Pages/testimony091208.aspx>

RT–2 was re–examined to address over–ride protection in the event of a high–speed impact.

- Federal Motor Vehicle Safety Standard (FMVSS) 121 – Air Brake Systems
http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/121_Stopping_Distance_FR.pdf

Testing of enhanced drive/trailer axle S-cam drum brakes had not yet been completed (either 16.5” x 8” or 16.5” x 8.625”) under its dynamometer test program at FHWA’s Vehicle Research and Testing Center (VRTC) to determine the reasons for improved torque generation. However, it was determined likely that the wider brake drum increased thermal capacity.

- IEEE 1473–1999: Standard for Communications Protocol Aboard Trains
<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1254963>

Two variants of the standard, Type T and Type L, were found to increase safety and reliability by incorporating safe default behavior into message responses.

<http://www.wseas.us/e-library/transactions/systems/2008/31-211.pdf>

IEEE 1473–L was reported as providing high compatibility, secure, high availability, flexibility, common node and fault tolerant system when applied in conjunction with IEE 1475, IEEE–1476, IEEE 1477, IEEE 1478, and IEEE–1482.

- IEEE 1474.1–2004, 1474.2–2003, 1474.3–2008
http://www.fta.dot.gov/documents/FTA_REPORT_No._0045.pdf

Research concluded that IEEE Standard 1474.1 and other IEEE standards in the 1474 series represent a useful starting point for other transit properties

developing procurement specifications for Communications Based Train Control (CBTC). The standards not only define the capabilities of CBTC systems and typical CBTC system architectures, but also mandatory and optional functions as well as information that needs to be defined by the transit property in developing a CBTC procurement specification.

http://open_jicareport.jica.go.jp/pdf/12244661_01.pdf

Research concluded that the standardization of the CBTC system allows for high level onboard logic based train control with application of high speed communication network aided data transmission between wayside and onboard.

- IEEE 1477–1998 Standard for Passenger Information System for Rail Transit Vehicles

<http://eng.monash.edu.au/civil/assets/document/research/centres/its/caitr-home/prevcaitrproceedings/caitr2007/bachok-caitr2007.pdf>

In the evaluation of passenger information systems, it was recommended that real-time information media be developed in the long term, with prioritized investments in variable message signs and personal messaging for integrated public transit information. (This did not specifically evaluate the standard itself, but rather evaluated what the standard refers to.)

- IEEE 1483–2000 Standard for Verification of Vital Functions in Processor–Based Systems Used in Rail Transit Control

<http://www.lbd.dcc.ufmg.br/colecoes/dsn/2015/018.pdf>

The research established that IEEE Standard 1483:2000 is intended to complement the execution of a total system safety program and does not address all system safety issues (e.g. the system safety program have to require a system-level hazards analysis, including the hazard tracking, and a risk analyses that demonstrate the level of hazards mitigation).

- IEEE 1570–2002 Standard for the Interface between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection

<https://www.fra.dot.gov/Elib/Details/L02829>

The research established that the standard was developed to coordinate information transfer between the two with emphasis on digital data communication and to enable interoperability among the various types of equipment. Success was reported with variable message signs that were the primary enabling technology of many of the projects reviewed. It was further reported that in-vehicle warning systems have played a much more limited role due to the use of technologies that have not been standardized and, for the most part, have been dismantled. Research suggested that standardizing the interface allows interoperability between wide varieties of equipment.

- IEEE 1698–2009 Guide for the Calculation of Braking Distances for Rail Transit Vehicle Signals

http://www.fta.dot.gov/documents/Safety_Advisory_14-2_Verification_of_Rail_Vehicle_Safe_Stopping_Distances.pdf

FTA lists this standard as a supporting resource and directs “each rail transit agency to immediately conduct a review of the configuration of terminal stations to verify that designed safe braking distances address the actual operating conditions in these stations, including authorized train speeds, train length and length of platform, the position of signals and trip stops, and the bumping post installation,” also noting that if the stopping distance is inadequate, “to immediately initiate its safety hazards management process to evaluate and resolve this safety deficiency.”

- 49 CFR Part 228 Subparts B,C, D and E – Hours of Service of Railroad Employees

<http://ncit.msstate.edu/PDF/HoursofService.pdf>

Suggests that optimal performance, depending upon the type of task that an individual is engaged in, will require higher levels of cognitive capacity. Performance is noted to decline steadily, and after eight hours on a task performance is nearly 20% off baseline or at 80% effectiveness.

- 49 CFR Part 229 Subpart D – Railroad Locomotive Safety Standards

https://www.researchgate.net/profile/David_Tyrell/publication/267588122_Crashworthiness_Requirements_for_Commuter_Rail_Passenger_Seats/links/552d6c920cf29b22c9c4f4a1.pdf

Recognizes that seat design requirements for interior crashworthiness were driven by the severity of the environment in crash energy management (CEM) cab cars after a collision. The author stated that the collision safety of all commuter rail service can be improved by applying these design requirements to commuter seats on any type of rail equipment.

- SAE J1802 – Brake Lock Effectiveness Rating

<https://trid.trb.org/view/2000/M/713213>

The research was conducted by the NHTSA in an effort to establish performance standards for original equipment or replacement brake linings for air-braked vehicles. Recognizing that the procedure for determining lining performance was critical to any standard developed, this study was performed to examine the variability in the SAE J1802 recommended practice. The conclusion of the research indicated that while only a very limited number of tests were performed, much of the variability found in the past round-robin testing performed in accordance with J1802 may have come from sources other

than the test fixtures (dynamometer, operator, slightly different set-up procedures, brake lining and/or brake drum material differences, etc.).

Efficacy of Existing Standards – Industry Stakeholder Comments

Respondents were asked a series of questions, including a specific inquiry related to efficacy: “What observations or data driven statements can you provide stating or documenting the effectiveness of the standards included in the Compendium (or those in place for your system, but not reflected in the Compendium)”? FTA received comments, but they were not specific observations or data-driven statements documenting efficacy of standards. A summary of the responses received to this question are below.

- One commenter suggested that FTA consider adopting FHWA’s *Railroad–Highway Grade Crossing Handbook* as a standard and noted that the guidelines and alternative improvements presented in the handbook are primarily those that have proven effective and are accepted nationwide.
- Although not providing a comment to the efficacy of an existing standard, one commenter did provide a summary of the expected benefits that could be realized through a third rail insulator cleaning standard.
- One commenter stated that many of APTA’s standards are outdated and recommended that FTA work with APTA to update and improve these standards, ensuring that the principles of SMS are incorporated.
- One commenter, in describing the efficacy of standards referenced in the Compendium, suggested that the inventory omits a number of effective non–rail transit standards that rail transit agencies must comply with on a regular basis. These were described by the commenter as important to the safety of rail transit passengers, employees, and contractors. Examples provided included OSHA and Cal/OSHA regulations, state fire codes, building codes, and public safety regulations.
- One commenter provided that standards serve to provide agencies with guidance based on industry research and experience. As such, they offered that implementing the standards is a generally accepted effective process.

There were no additional comments submitted to the *Federal Register* docket addressing the efficacy of existing transit safety standards.

Potential Standards/Protocol Areas of Emphasis

Despite the lack of data to substantiate the safety standards and protocols used by the transit industry, a number of focus areas are readily apparent, as listed below. These focus areas are not presented in order of priority, nor should this list be considered all-inclusive or comprehensive in content.

- Fatigue Management and Hours of Service Regulations

- Scheduling of adequate time for employee restroom breaks
- Medical Fitness for Duty Requirements
- Crash Avoidance Technology Standards
- Crash Worthiness Standards
- Rail and Bus Design Standards
- Employee Close Call Reporting Systems
- Distraction Prevention
- Industry Definitions
- Rail Communication Requirements
- Emergency Preparedness and Response
- Fire-Life Safety Standards
- Employee Assault Prevention
- Event Recorder Standards
- Operational Rules and Practices Standards
- Training Standards
- Operations Control Center Procedural Standards
- Track and Structure Standards
- RWP Standards
- Signal Standards
- Traction Power Electrification Standards
- Maintenance Standards

Through the various ongoing standards efforts, and with industry input, FTA will perform an analysis of each of the above standard/protocol focus areas to determine those that should be addressed by FTA through regulation or other means.

Section 4 Recommendations and Actions

Recommendations and Actions for the Secretary

The content of this report serves as the basis for the recommendations provided in the following section. It prescribes the establishment of a TRACS subcommittee and effort to obtain statutory authority for data privacy protections. It recognizes the limitations of the current data reported to the NTD and the need for robust transit safety data in FTA's standards development process. Further, recommendations made by those who provided comments to the Compendium Docket have been considered in the determination of the recommendations.

1. Complete the Standards Strategic Plan Project and continue to implement its Standards Development Program.

FTA will finalize the Standards Strategic Plan Project to further inform the development of standards under the Standards Development Program for issue areas identified as potential areas of safety emphasis in this report. Expected outcomes from the Standards Development Program include the formation of an industry working group, a working partnership with TRACS, and input from other industry stakeholders to inform the standards development process.

2. Request FTA statutory authority for data privacy protections, encouraging more industry data submission from agencies.

There are limited data and research available to determine the efficacy of existing standards and protocols. FTA needs greater accessibility to other avenues of data to assess risk and make well-informed evaluations. FTA data collection efforts would be greatly enhanced by having statutory authority from Congress for data privacy protections. FTA previously has made requests to Congress for data protections. The first request was included in FTA's original safety oversight proposal submitted to Congress in 2010 after the Fort Totten crash at WMATA in Washington, D.C. The request was made again in both of the Administration's GROW AMERICA proposals in 2014 and 2015. The FAST Act directed the Secretary to coordinate with the National Academy of Sciences on a study of Evidentiary Protection of Public Transportation Safety Program Information (Sec. 3021), and the results of that study, which is being completed in coordination with the Transportation Research Board, will be published in 2017.

3. Continue FTA's efforts to expand safety data collection through its NTD.

FTA will continue to expand the data collected through its NTD by requesting additional asset information in coordination with the transit asset management efforts already underway, and additional safety data in order to inform FTA's efforts in setting

safety standards. New reporting requirements for transit asset management begin in 2018 (see Appendix C). This effort will include establishing a safety terminology dictionary, applicable to all rail transit systems nationwide. It was found, for example, that a stop signal overrun at one property is not necessarily counted the same way at all other properties. To obtain improved data, the industry needs to be working from the same set of safety terminology.

4. Establish a TRACS subcommittee to use Subject Matter Experts to conduct a data-driven assessment of the transit industry to determine which risks are best mitigated by federal regulation or other means.

FTA will establish a TRACS Subcommittee Working Group to use the expertise of Subject Matter Experts to conduct a comprehensive and robust data-driven risk assessment of the transit industry (a discussion of public transportation safety data and associated limitations is included in Appendix D). This task is critical in identifying recommended practices and guidelines deemed critical in furthering transit safety and for providing input on areas for public transit standards development. This effort also will further inform which safety areas are best mitigated through federal regulation. The conclusion of this effort will provide a substantiated path forward for regulation or directive development.

5. Request that Congress provide sufficient resources that will allow FTA to collect, manage, and analyze the safety data required for effective industry safety standards regulation.

FTA needs additional resources to undertake large-scale safety data collection efforts to support FTA's SMS approach to the development and implementation of the Public Transportation Safety Program.

Appendix A: FAST Act, Section 3020: Review of Public Transportation Safety Standards

SEC. 3020. REVIEW OF PUBLIC TRANSPORTATION SAFETY STANDARDS.

(a) REVIEW REQUIRED.

(1) IN GENERAL.—Not later than 90 days after the date of enactment of this Act, the Secretary shall begin a review H. R. 22—181 of the safety standards and protocols used in public transportation systems in the United States that examines the efficacy of existing standards and protocols.

(2) CONTENTS OF REVIEW.—In conducting the review under this paragraph, the Secretary shall review—

(A) minimum safety performance standards developed by the public transportation industry;

(B) safety performance standards, practices, or protocols in use by rail fixed guideway public transportation systems, including—

(i) written emergency plans and procedures for passenger evacuations;

(ii) training programs to ensure public transportation personnel compliance and readiness in emergency situations;

(iii) coordination plans approved by recipients with local emergency responders having jurisdiction over a rail fixed guideway public transportation system, including—

(I) emergency preparedness training, drills, and familiarization programs for the first responders; and

(II) the scheduling of regular field exercises to ensure appropriate response and effective radio and public safety communications;

(iv) maintenance, testing, and inspection programs to ensure the proper functioning of—

(I) tunnel, station, and vehicle ventilation systems;

(II) signal and train control systems, track, mechanical systems, and other infrastructure; and

(III) other systems as necessary;

(v) certification requirements for train and bus operators and control center employees;

(vi) consensus-based standards, practices, or protocols available to the public transportation industry; and

(vii) any other standards, practices, or protocols the Secretary determines appropriate; and

(C) rail and bus safety standards, practices, or protocols in use by public transportation systems, regarding—

(i) rail and bus design and the workstation of rail and bus operators, as it relates to—

(I) the reduction of blind spots that contribute to accidents involving pedestrians; and

(II) protecting rail and bus operators from the risk of assault; (ii) scheduling fixed route rail and bus service with adequate time and access for operators to use restroom facilities;

(iii) fatigue management; and

(iv) crash avoidance and worthiness.

(b) EVALUATION.—After conducting the review under subsection (a), the Secretary shall, in consultation with representatives of the public transportation industry, evaluate the need to establish additional Federal minimum public transportation safety standards.
H. R. 22—182

(c) REPORT.—After completing the review and evaluation required under subsections (a) and (b), and not later than 1 year after the date of enactment of this Act, the Secretary shall make available on a publicly accessible Web site, a report that includes—

(1) findings based on the review conducted under subsection (a);

(2) the outcome of the evaluation conducted under subsection (b);

(3) a comprehensive set of recommendations to improve the safety of the public transportation industry, including recommendations for statutory changes if applicable; and

(4) actions that the Secretary will take to address the recommendations provided under paragraph (3), including, if necessary, the authorities under section 5329(b)(2)(D) of title 49, United States Code.

Appendix B: Compendium of Public Transportation Safety Standards

The Compendium contains standards for all public transportation modes (where available), including commuter rail and ferry boat, modes for which regulatory oversight rests within another US DOT Operating Administration. It includes those standards or protocols applicable to or used in those transit modes referenced in the NTD, including Rail Transit (Alaska Railroad, Cable Car, Commuter Rail, Heavy Rail, Hybrid Rail, Inclined Plane, Light Rail, Monorail/ Automated Guideway, and Streetcar) and Non-Rail Transit (Aerial Tramway, Bus, Bus Rapid Transit, Commuter Bus, Demand Response, Demand Response Taxi, Ferryboat, Jitney, Público, Trolleybus, and Vanpool).

Further, it identifies State and Federal regulations and minimum safety performance standards that have been developed by the public transportation industry (within modes described above), as well as those specific standards or protocols in use by rail fixed guideway public transportation systems, including those related to emergency plans and procedures for passenger evacuations, training programs that ensure personnel compliance and readiness in emergency situations, and coordination plans with emergency responders. Hyperlinks to the specific standards, protocols, regulations, or laws are provided within the Compendium.

<https://www.transit.dot.gov/regulations-and-guidance/safety/compendium-transit-safety-standards>

Appendix C: Data Limitations

The following provides supplementary discussion of NTD reporting, the primary source of existing transit safety-related data. The first section summarizes NTD safety reporting and provides corresponding benefits and limitations. Included within this examination is a summary of data elements provided by Rail Transit Agencies (RTAs) to State Safety Oversight Agencies (SSOAs) and those reporting elements required for the FRA Rail Accident/Incident Reporting System (RAIRS). The relevance of NTD data in the determinations made will be examined specifically for two separate areas of focus. This is followed by general observations and recommendations that may result in an improved transit safety data reporting module in the NTD.

National Transit Database

A comprehensive risk-based safety data analysis relies on an assessment of the safety performance of current transit modes and identification of transit safety issues, and security and safety event trends. The primary source of data for transit safety and security is the NTD, maintained by FTA. FTA provides systematic guidelines, assistance, and oversight to ensure not only that agencies comply with reporting requirements, but also that the reported data are robust.

The Major Incident Report form (S&S-40) is used by public transit agencies to provide monthly reports, including detailed information on the most severe safety and security reportable events occurring in a transit agency's environment. According to NTD definitions, a Reportable Event is a safety or security event occurring on transit right-of-way (ROW), in a transit revenue facility, in a transit maintenance facility, or involving a transit revenue vehicle that results in one or more of the following conditions:

- A fatality confirmed within 30 days of the event
- An injury requiring immediate medical attention away from the scene for one or more persons
- Property damage equal to or exceeding \$25,000
- Collisions involving transit vehicles that require towing away from the scene for a transit roadway vehicle or other non-transit roadway vehicle
- An evacuation due to or under hazardous conditions or to the rail ROW
- Rail transit vehicle collisions occurring at a grade crossing
- Rail transit vehicle collisions with an individual on the rail ROW
- Rail transit vehicle collisions with another revenue or non-revenue rail transit vehicle
- A mainline or yard derailment of revenue or non-revenue vehicles
- Occupational events occurring in administrative buildings are excluded

These thresholds mirror those established by the FTA for the State Safety Oversight Program at 49 CFR Part 659. However, FTA revised those definitions in its new SSO regulation at 49 CFR Part 674 and the NTD is being revised for 2017, accordingly.

NTD Safety and Security Reporting Limitations and Recommendations

It is important to emphasize both the advantages and disadvantages of NTD data. In the FTA-sponsored report *State of Bus Safety in the US*, it was noted that NTD has the potential to become an even more comprehensive, rich, and consistent source of data on transit safety. The authors highlighted a few characteristics of NTD that makes its use as the source for research challenging and recommended a few refinements to increase the richness and usefulness of the data while still striving to minimize the reporting burden to agencies.

The NTD Major Incident Report form (S&S 40) captures most of the important descriptors of an incident. However, current NTD reporting is not intended to capture all the details of incidents, such as causal factors (including, for example, operator errors or vehicle system failures or defects). While the form does allow for a narrative description of each event, there is no standard format in the presentation of the data and, therefore, there is wide variation in the level of detail provided, both among the participating agencies and within each agency over time. Further, the form must be submitted within 30 days of the incident date, so any information collected after the incident reported to NTD is not available in the database.

Another important limitation of current safety reporting to the NTD is that the safety data are not validated or audited. The data are self-reported by the agencies and, although the incident forms are checked by NTD analysts to be sure the reported data conform to NTD definitions, there is no formal process now in place for the validation of the information. A formal validation process can be developed to correct this limitation.

Reporting Causal or Contributing Factors

State Safety Oversight Agency (SSOA) Reporting

FTA maintains State Safety Oversight (SSO) data reported by rail transit modes that do not fall under FRA oversight. SSO rail accident reporting includes information for all accidents meeting the thresholds established under 49 CFR Part 659.33.

The SSO Rail Accident Database is populated with data from both NTD (FTA) and RAIRS (FRA). SSOAs indicate probable cause for these reportable events by selecting from a predefined list of causes. These categories reflect the terms used in the rail transit industry to describe the proximate cause of an event. Each cause is identified below, as well as the causal groupings used by FTA for analysis purposes:

- Equipment failure – an event caused by the failure of a system component
- Rules violations/human factors – an event caused by employee error or organizational issues
- Poor maintenance – an event caused by failures arising due to inadequate maintenance
- Slips and falls – an event caused by a person slipping or falling in a station or vehicle
- Action of motorist – an event caused by the driver of a non-transit vehicle
- Imprudent customer actions: An event caused by inappropriate behavior by a transit customer
- Pedestrian actions – an event caused by behavior of an individual who is not a transit employee or customer
- Suicides – an event caused by a suicide attempt
- Trespassing – an event caused by an individual trespassing on transit agency property
- Medically-related – an event caused by a medical condition of a person (or a person found deceased)
- Other – an event due to unknown causes or acts of nature

Probable cause is noted within the following four primary categories:

- Workforce/Infrastructure
 - Equipment Failure
 - Rules Violations/Human Factors
 - Poor Maintenance
- Customer Behavior
 - Slips and Falls
 - Imprudent Customer Actions
- Public Behavior
 - Actions of Motorists
 - Pedestrian Actions
 - Suicides
 - Trespassers
- Other
 - Medically-Related
 - Other

FRA Reporting (RAIRS)

Federal railroad safety regulations require that each railroad subject to 49 CFR Part 225, complete reports and records of accident and incidents in accordance with FRA's current *Guide for Preparing Accident/Incident Reports*. This includes immediate telephonic

reporting of certain accidents and incidents; annual reports to FRA – annual report of employee hours worked and casualties by state; and monthly reports of all reportable accidents/incidents. FRA’s accident/incident data points include the causal factor options:

- Human factor-caused
- Track-caused
- Motive power/equipment-caused
- Signal-caused, all track types
- Signal-caused, mainline track
- Miscellaneous-caused

Additional NTD Data Fields

A major objective of FTA’s *State of Bus Safety in the US* was to ascertain causal factors for incidents, including those relating to the transit vehicle and those relating to human factors. To perform this analysis, it was necessary for the study team to go beyond the basic NTD data fields and read through the incident descriptions to try and determine causal or contributing factors. Additional incident classifications were identified and could be considered for NTD reporting.

Data Reporting and Collection Recommendations

NTD safety reporting may be enhanced by having an initial submittal for the Major Incident form (as it is currently), and a “close-out” version of the form, in which the reporting agency can fill in additional information (relating to causal factors, for example) after the initial submittal and after all investigation has been completed. This may also serve as a benefit to the reporting agency by having all the relevant information related to each major incident in one location via the NTD online system.

Based on the analysis conducted for *State of Bus Safety in the US*, consider, at a minimum, the addition of the following incident classifications to NTD:

- Other vehicle pulled in front of or into transit vehicle
- Other vehicle hit stopped transit vehicle
- Other vehicle ran stop sign or signal
- Other vehicle turned in front of transit vehicle
- Transit vehicle hit object or curb
- Transit vehicle made a left turn without clearance
- Transit vehicle ran stop sign or signal
- Mechanical problem that required evacuation
- Incident involving road supervisor vehicle

In addition, causal or contributing factors collected by SSOAs or FRA could also be considered for NTD data collection. SSOAs are required to submit data on causal factors in their annual reports, but collection limitations still exist.

The review of data reported to NTD and RAIRS, data reported by SSOAs, and the examination of other reporting tools and reports allows some conclusions related to data reporting and collection activities. Observations and recommendations in response to this examination follow. In addition, based on additional FTA TSO research other data reporting/collection recommendations for improvement were made, some of which were also included in the Data Management Program Planning Action Items from September 2013 (see Table I).

- Expand (by drop down menu, as an example) the classification of fatality and injury types by person, specifically for “Transit Employee” and “Other Worker.” The extent of ROW worker injuries and fatalities cannot easily be determined from NTD data. A ROW worker could be classified as “Other Worker” because they are working as a contractor (or for a contractor) to the agency, whereas others could be classified as a “Transit Employee.” These categories currently capture a number of transit employees and others.
- Expand FTA data collection activities to include detailed information on causal or contributing factors in transit safety events.
- NTD categories such as “Other” and “NOC” or “OSONOC” continue to be the default categorization for those incidents that do not easily fit into the more descriptive categories. This creates significant difficulties when attempting to identify safety issue areas. To identify the characteristics of these events, a review of tens of thousands of narrative incident descriptions (explained with great variation in detail) from the S&S 40 form would have to be undertaken. Expand the list of codes for OSONOCs and NOCs.