ASME RT-1–2009

Safety Standard for Structural Requirements for Light Rail Vehicles

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Date of Issuance: September 18, 2009

The next edition of this Standard is scheduled for publication in 2014. This Standard will become effective 6 months after the Date of Issuance. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

On March 18, 1998, The American Society of Mechanical Engineers (ASME) formed the Standards Committee on Rail Transit Vehicles.

The Standards Committee on Rail Transit Vehicles develops and maintains standards that cover safety, functionality, performance, and operability requirements, as well as mechanical systems, components, and structural requirements for rail transit vehicles. Rail transit includes heavy rail and light rail, and excludes freight, commuter, high-speed, or any other rail operations under the jurisdiction of the Federal Railroad Administration.

The Standards Committee is responsible for developing a series of safety standards within its Charter under the designation of RT. The purpose of the RT standards is to provide the rail transit industry with safety standards that address vehicle mechanical systems, components, and structural requirements, so as to enhance public safety. Principles, recommendations, and requirements included in these standards promote good engineering judgment as applied in designing rail transit vehicles for safety. The standards are subject to revisions that are the result of Committee consideration of factors such as technological advances, new data, and changing environmental and industry needs.

Both SI (metric) and U.S. Customary units are used in this Standard, with the latter placed in parentheses. These units are noninterchangeable and, depending on the country as well as industry preferences, the user of this Standard shall determine which units are to be applied. Parameters are derived from IEEE/ASTM SI 10-1997 or the latest revision with the U.S. Customary units noted in parentheses.

The Standards Committee will review and address all comments, suggestions, and recommendations intended to improve this Standard, especially when the comments are based on actual experience in its application. Suggestions for changes to this Standard should be submitted to The American Society of Mechanical Engineers, Secretary, RT Standards Committee, Three Park Avenue, New York, NY 10016-5990, USA, and should be in accordance with the following format:

(a) Cite the specific paragraph designation of the pertinent volume.

(b) Indicate the suggested change (addition, deletion, or revision).

(c) Briefly state the reason and/or evidence for the suggested change.

(d) Submit suggested changes to more than one paragraph in the order in which the paragraphs appear in the volume.

This edition was approved by the American National Standards Institute on August 13, 2009, and designated as ASME RT-1–2009.

ASME RT COMMITTEE
Rail Transit Vehicles

(The following is the roster of the Committee at the time of approval of this Standard.)

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CORRESPONDENCE WITH THE RT COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending committee meetings. Correspondence should be addressed to

Secretary, RT Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. Upon request, the RT Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the RT Standards Committee.

The request for an interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The RT Standards Committee regularly holds meetings that are open to the public. Persons wishing to attend any meeting should contact the Secretary of the RT Standards Committee.

INTRODUCTION

Safety of light rail transit operations is a system characteristic. As do all transportation options in a given corridor, this operation has certain risks, including collision with another vehicle. The risks are mitigated by the design of the signal system and other system elements, by operating and maintenance procedures, and by the design of the vehicle. Risks are further mitigated by the elimination of grade crossings and the provision of safety barriers. Active safety systems on the vehicle include train control, communication, and propulsion and braking subsystems. The carbody, if properly designed, may be considered a passive safety device, and this Standard is intended to address the performance of the carbody in collisions.

This Standard draws from existing requirements for the design of the carbody of light rail vehicles currently in service in North America. It also considers recent developments in the design of rail carbody structures intended to optimize the structure performance under the conditions of an overload, as might occur during a collision. This topic is commonly identified as crash energy management (CEM). The intent of CEM is to better manage the dissipation of the portion of the energy of a collision that can reasonably be expected to be absorbed by the deformation of the carbody. CEM design, when appropriately applied, may reduce risk of injuries to occupants of the light rail vehicle due to loss of survivable volume and due to secondary collisions of occupants with the car interior. Specific portions of the carbody are designed for controlled deformation and energy absorption, and are located in the structure so as to limit the damage to and acceleration of, occupied volumes of the cars a light rail consists. For multiple-unit operation, distributing structural energy absorption through the train has been shown to be beneficial. This Standard requires the incorporation of CEM principles in the design of light rail vehicles for service in North America.

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SAFETY STANDARD FOR STRUCTURAL REQUIREMENTS FOR LIGHT RAIL VEHICLES

1 SCOPE

1.1 Subjects Covered by This Standard

This Standard applies to carbodies for newly constructed light rail vehicles for transit passenger service in North America. The Standard defines requirements for the incorporation of passive safety design concepts related to the performance of the carbody of light rail vehicles in collisions, so as to enhance passenger safety and limit and control damage. This Standard does not cover heavy rail transit vehicles; automated people movers; and freight, commuter, high-speed, or any other rail vehicles under the jurisdiction of the Federal Railroad Administration.

1.2 Subjects Not Addressed by This Standard

There are several issues related to safety that are not addressed, such as, but not limited to

(a) structural repairs
(b) fatigue
(c) corrosion
(d) fire protection (NFPA 130)
(e) interior vehicle design
(f) emergency egress from vehicle (NFPA 130)

1.3 Effective Date

This Standard applies to carbodies of newly constructed light rail vehicles and structcars for transit passenger service in North America ordered 180 days following the date of issuance of this Standard by the Standards Committee and ASME.

2 DEFINITIONS

This Standard applies, where practical, on terms already in use by ASME, the American Public Transportation Association (APTA), and the Institute of Electrical and Electronics Engineers (IEEE). For the purposes of this Standard, the following definitions apply:

anticlimber: a structural member located at each end of the vehicle, used to engage the anticlimber of an opposing or other coupled vehicle to resist relative vertical travel between the two carbodies during a collision.

articulation: the connection sometimes used at the center of a vehicle or at the intermediate ends of carbody sections to allow negotiation of tracks with various vertical and horizontal profiles.

average acceleration: the average computed longitudinal acceleration at the vehicle center of gravity predicted by finite element modeling of a collision. The average computed acceleration is defined over a period of time from first contact between vehicles to a time when the contact force between vehicles first reaches a magnitude of zero.

belt rail: a longitudinal structural member in the side frame arranged below the passenger side windows.

carbody (light rail): the vehicle body comprising its main load-carrying structure above all truck suspension units. It includes all components and structural articulation connector parts, if any, that are connected to this structure and contribute directly to its strength, stiffness, and stability. Mechanical or electrical equipment and other mounted parts are not considered part of the carbody, although their attachment brackets are. The "coupler" end of the carbody are the outside vehicle ends that contain the means for coupling to another vehicle. The "intermediate" ends, if any, contain the articulation system.

closing speed: the speed of a vehicle relative to another object or vehicle at the time of initial impact.

collision posts: a set of two structural posts located at each end of the carbody, extending from the bottom of the end underframe structure up to the structural shelf. They are located at the approximate one-third points across the width of the vehicle, and are forward of the seating position of any passenger or crew person. An alternative to a collision post is the use of a collision wall.

collision wall: a structure at the leading end of the vehicle spanning the area between the structural shelf, corner posts, and top of the underframe.

consist: the makeup or composition of the individual units of a train, generally by number and type of vehicle.

corner posts: a set of two full-height structural posts located at the outside corners of the passenger compartment or near the extreme corner of the carbody, extending from the bottom of the underframe structure up to the roof at the top of the side frame at its intersection with the roof.

crash energy management (CEM): a method of design and manufacture of vehicle structures that enhances crashworthiness by assigning certain sections of the carbody