

AN AMERICAN NATIONAL STANDARD

POWERED AND NONPOWERED INDUSTRIAL TRUCKS

ASME B56.5a-1994

ADDENDA

to

ASME B56.5-1993
SAFETY STANDARD FOR GUIDED
INDUSTRIAL VEHICLES AND
AUTOMATED FUNCTIONS OF
MANNED INDUSTRIAL VEHICLES

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center • 345 East 47th Street • New York, N.Y. 10017

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ASME B56.5a-1994

Following approval by the ASME B56 Committee and ASME, and after public review, ASME B56.5a-1994 was approved by the American National Standards Institute on October 26, 1994.

Addenda to the 1993 edition of ASME B56.5 are issued in the form of replacement pages. Revisions, additions, and deletions are incorporated directly into the affected pages. It is advisable, however, that this page, the Addenda title and copyright pages, and all replaced pages be retained for reference.

SUMMARY OF CHANGES

This is the first Addenda to be published to ASME B56.5-1993.

Replace or insert the pages listed. Changes given below are identified on the pages by a margin note, (a), placed next to the affected area. The pages not listed are the reverse sides of the listed pages and contain no changes.

<i>Page</i>	<i>Location</i>	<i>Change</i>
1	General	Third paragraph revised
4	4.2.5	Revised
9	8.10.2	Revised
	8.10.4	Revised
10	8.11.6	Revised
15	Appendix A	Following references revised: ASME B56.1 ASME B56.8 ANSI/NFPA 30
17	Appendix B	Statement below heading revised

SPECIAL NOTE:

The Interpretations to ASME B56.5 are included in this Addenda as a separate section for the user's convenience. This section, however, is not part of this Addenda or of the Standard itself.

POWERED AND NONPOWERED INDUSTRIAL TRUCKS

GENERAL

This Standard is one of a series that has been formulated with the American Society of Mechanical Engineers as Sponsor in accordance with the Accredited Organization method, the procedures accredited by the American National Standards Institute, Inc., and the following scope.

Establishment of the safety requirements relating to the elements of design, operation, and maintenance; standardization relating to principal dimensions to facilitate interchangeability, test methods, and test procedures of powered and nonpowered industrial trucks (not including vehicles intended primarily for earth moving or over-the-road hauling); and maintenance of liaison with the International Organization for Standardization (ISO) in all matters pertaining to powered and nonpowered industrial trucks.

One purpose of the Standard is to serve as a guide to governmental authorities having jurisdiction over subjects within the scope of the Standard. It is expected, however, that the Standard will find a major application in industry, serving as a guide to manufacturers, purchasers, and users of the equipment.

- (93) For convenience, Standards for Powered and Non-powered Industrial Trucks have been divided into separate volumes:

Safety Standards

- B56.1 Low Lift and High Lift Trucks
- B56.5 Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles
- B56.6 Rough Terrain Forklift Trucks
- B56.7 Industrial Crane Trucks
- B56.8 Personnel and Burden Carriers
- B56.9 Operator Controlled Industrial Tow Tractors
- B56.10 Manually Propelled High Lift Industrial Trucks

Standardization Standards

- B56.11.1 Double Race or Bi-Level Swivel and Rigid Industrial Casters

- B56.11.3 Load Handling Symbols for Powered Industrial Trucks
- B56.11.4 Hook-Type Forks and Fork Carriers for Powered Industrial Forklift Trucks
- B56.11.5 Measurement of Sound Emitted by Low Lift, High Lift, and Rough Terrain Powered Industrial Trucks
- B56.11.6 Evaluation of Visibility From Powered Industrial Trucks

Safety standards that were previously listed as B56 volumes but now have different identification due to a change in standards development assignments are as follows.

- NFPA 505 Fire Safety Standard for Powered Industrial Trucks — Type Designations, Areas of Use, Maintenance and Operation (formerly B56.2)
- UL 583 Standard for Safety for Electric-Battery-Powered Industrial Trucks (formerly B56.3)
- UL 558 Standard for Safety for Internal Combustion Engine-Powered Industrial Trucks (formerly B56.4)

If adopted for governmental use, the references to other national standards in the specific volumes may be changed to refer to the corresponding governmental regulations.

The use of powered and nonpowered industrial trucks is subject to certain hazards that cannot be completely eliminated by mechanical means, but the risks can be minimized by the exercise of intelligence, care, and common sense. It is therefore essential to have competent and careful operators, physically and mentally fit, and thoroughly trained in the safe operation of the equipment and the handling of the loads. Serious hazards are overloading, instability of the load, obstruction to the free passage of the load, collision with objects or pedestrians, poor maintenance, and use of equipment for a purpose for which it was not intended or designed.

Suggestions for improvement of these volumes, especially those based on actual experience in their application, shall be submitted to the Secretary of the B56

Committee, ASME, United Engineering Center, 345 East 47th Street, New York, NY 10017.

Comments shall be written in accordance with the following format:

(a) specify paragraph designation of the pertinent volume;

(b) indicate suggested change (addition, deletion, revision, etc.);

(c) briefly state reason and/or evidence for suggested change;

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

The appropriate B56 Subcommittee will consider each suggested revision at its first meeting after receipt of the suggested revision(s).

(93)

SAFETY STANDARD FOR GUIDED INDUSTRIAL VEHICLES AND AUTOMATED FUNCTIONS OF MANNED INDUSTRIAL VEHICLES

(93)

Part I Introduction

(93) 1 SCOPE

This Standard defines the safety requirements relating to the elements of design, operation, and maintenance of powered, not mechanically restrained, unmanned automatic guided industrial vehicles and automated functions of manned industrial vehicles.

This Standard applies to guided industrial vehicles in automatic mode of operation in nonrestricted areas. Portions of this Standard, when designated, also apply to semiautomatic, manual, and maintenance modes and restricted areas of vehicle operation. It is recognized that restricted areas may exist, and require the user and/or manufacturer to determine appropriate safety provisions.

Portions of this Standard, when designated, also apply to automated functions of manned industrial vehicles.

This Standard does not apply to passenger carrying vehicles.

(93) 2 PURPOSE

The purpose of this Standard is to promote safety through the design, construction, application, operation, and maintenance of unmanned guided industrial vehicles and automated functions of manned industrial vehicles.

This Standard may be used as a guide by governmental authorities desiring to formulate safety rules and regulations. This Standard is also intended for voluntary use by others associated with manufacturing or use of unmanned guided industrial vehicles and automated functions of manned industrial vehicles.

3 INTERPRETATION

3.1 Mandatory and Advisory Rules

To carry out the provisions of this Standard, the word *shall* is to be understood as mandatory and the word *should* as recommended.

3.2 Classification of Approved Guided Industrial Vehicles

The word *approved* means the classification or listing of guided industrial vehicles as to fire, explosion, and electric shock hazard by a nationally recognized testing laboratory.

3.3 Requests for Interpretation

The B56 Committee will render an interpretation of any requirement of the Standard. Interpretations will be rendered only in response to a written request sent to the Secretary of the B56 Committee, ASME, 345 East 47th Street, New York, NY 10017. The request for interpretation shall be in the following format.

- Subject: Cite the applicable paragraph number(s) and provide a concise description.
- Edition: Cite the applicable edition of the pertinent 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 approval of a proprietary design or situation. The inquirer may also include any plans or drawings which are necessary to explain the question; however, they should not contain proprietary names or information.

ASME procedures provide for reconsideration of any interpretation when or if additional information which 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.

3.4 Metric Conversions

The values stated in U.S. customary units are to be regarded as the standard.

Part II For the User

4 GENERAL SAFETY PRACTICES

4.1 Introduction

4.1.1 Before putting a guided industrial vehicle system into service, the user shall be responsible for all factors affecting the operation and maintenance, as referenced in Part II of this Standard.

4.1.2 Guided industrial vehicles can cause injury or damage if improperly used or maintained.

4.1.3 Part II contains safety standards applicable to vehicle operations. Unusual operating conditions may require additional safety precautions. Guided industrial vehicles which can be operated by manual controls may have restricted operational characteristics.

(93) **4.1.4** Part IV contains safety standards applicable to automated functions of manned industrial vehicles.

4.2 Modifications, Nameplates, Markings, Capacity, and Stability

4.2.1 Modifications and/or additions to hardware or software which affect rated capacity, safe operation, or any emergency control or device shall not be performed without manufacturer's verifiable approval. Where such authorization is granted, capacity, operation, and maintenance instruction (plates, tags, or decals) shall be changed accordingly.

4.2.2 The user shall see that all nameplates and caution and instruction markings are in place and legible.

4.2.3 When utilizing lifting equipment such as elevators, cranes, ship hoisting gear, etc., to relocate a guided industrial vehicle, the user shall assure that the capacity of the hoisting equipment being used is not exceeded.

4.2.4 The user shall consider that changes in load(s), load position(s), or dimension(s), coupling type(s) or position(s), and floor surface condition(s) or battery weights may affect rated capacities and safe operation. Only stable or safely arranged loads shall be handled.

(a) **4.2.5** The user shall be responsible for the load stability and retention. When deemed necessary by the user, verification shall be required.

4.2.6 Some users may decide to establish, for their own use, stability requirements that will vary from those in para. 8.7.4. However, the requirements in para. 8.7.4 should serve as a guide for the user, working with the

manufacturer, in establishing his own more stringent requirements.

4.3 Stopping Distance

4.3.1 The determination of the vehicle's stopping distance (whether used as a load carrying vehicle or a tow vehicle) depends on many factors, such as other vehicle and pedestrian traffic, clearances, condition of the floor, and stability of load(s). The prime consideration is that the emergency braking system shall cause the vehicle to stop prior to impact between the vehicle structure and the obstruction.

4.3.2 Caution should be exercised with changed environments. Changes in weather, surface conditions, or applications may affect the vehicle stopping distance; speeds, loads, brake settings, and/or operation should be adjusted accordingly.

4.4 Sensors

If a load exceeds the width and/or length of the vehicle, the user should require that sensors in the direction of travel covering the maximum moving width and/or length be provided to prevent contact between the load and any obstruction.

4.5 Changing and Charging of Batteries

The user shall make battery changing and charging provisions in accordance with ANSI/NFPA 505. Battery types and charging systems supplied or specified by the vehicle manufacturer (e.g., opportunity charging) but not referenced in ANSI/NFPA 505 shall be safely operated and charged per the instructions supplied by the vehicle manufacturer.

4.6 Hazardous Locations

4.6.1 It shall be the responsibility of the user to determine the hazard classification of any particular atmosphere or location according to ANSI/NFPA 505.

4.6.2 Vehicles operated in hazardous areas shall be of the type required by ANSI/NFPA 505 and shall be so identified.

4.7 Aisles and Doors

4.7.1 Restricted areas of vehicle operation require identification and/or marking.

4.7.2 In nonrestricted areas, the floor space boundary required for the vehicle and its load and/or train shall

(c) *Braking.* Controlled braking means shall be provided on vehicles which are designated for automatic ramp operation. Emergency braking performance shall be the same as for level horizontal operation. See para. 8.8.1.

8.7.4 Stability. For vehicles with lift of more than 12 in. (300 mm), the stability requirements of ASME B56.1 shall apply. For vehicles with lift of 12 in. (300 mm) or less, the stability requirements of ASME B56.8 shall apply.

8.8 Braking Functions

8.8.1 Vehicles shall have the following braking functions. Multiple functions may be provided by a single braking means.

(a) *Emergency Brake.* Emergency braking shall be provided for all vehicles. The emergency brake shall be mechanically set and require power or force from a source external to the brake to release. During automatic operations, this brake may be automatically actuated and deactuated. The prime consideration is that the emergency brake shall cause the vehicle to stop prior to impact between the vehicle structure and the obstruction.

(b) *Parking Brake.* A parking brake, which may be a part of or include the service brake or emergency brake, shall be provided. When a vehicle is in a stopped condition, this brake should be applied to prevent inadvertent movement of the stationary vehicle.

(c) *Service Brake.* A service brake, which may be a part of or include the parking brake or emergency brake, shall be provided. During manual operation, this brake is used for slowing or stopping the vehicle.

8.8.2 Controlled braking may be provided. Controlled braking is a means for slowing or stopping the vehicle. This may be accomplished by electrical or mechanical means.

8.9 Warning Devices

8.9.1 Prior to initiation of vehicle movement or remote reactivation from a sleep or inactive condition, a warning device (on or off the vehicle) shall be activated, to be either audible, visual or a combination thereof, indicating the imminent movement of the vehicle under automatic control. The warning light(s), such as strobe or flashing, shall be readily visible.

8.9.2 Vehicles shall provide a warning indication, either audible, visual, or a combination thereof, during all vehicle motion.

8.9.3 Vehicles in motion shall provide a warning indication distinctive from the indication of para. 8.9.2 prior to travel in reversing or traversing direction.

8.9.4 An indication shall be provided to alert personnel of vehicle malfunction or safety device activation including the following:

- (a) loss of path reference or deviation from the intended guidepath;
- (b) loss of speed control;
- (c) other control system malfunctions that require intervention by a qualified operator.

8.9.5 An indication should be provided for all vehicles capable of automatic operation to identify low battery condition when automatic routing to battery charging is not provided.

8.10 Vehicle Emergency Controls and Devices

8.10.1 Vehicle emergency controls and devices are those which automatically and rapidly stop propulsion, prohibit automatic restart, stop moving components, and apply the emergency braking. Local manual intervention is required to return to normal operating conditions. After detection of emergency condition, emergency controls shall directly activate an emergency stop.

8.10.2 Mandatory emergency control functions and devices shall include the following:

- (a) Emergency stop switches (e.g., red mushroom), located on or off the vehicle and accessible to personnel;
- (b) detection of loss of speed control;
- (c) detection of unplanned loss of guidepath reference or intended path;
- (d) processor monitor (watchdog timer), if a processor is used;
- (e) motive power interrupt;
- (f) failure detection of power supplies/sources that are critical to vehicle safety aspects;
- (g) a sensing device or combination of devices to prevent contact of the object sensed with the vehicle structure in the direction(s) of travel.

The failure of any of these devices shall bring the vehicle to an emergency stop.

8.10.3 Object Detection Devices. Additional object detection devices may be provided at the request of the user and/or as required by installation criteria.

8.10.4 Bumpers. If used as emergency sensing devices, bumpers shall not exert a force greater than 30 lb (133 N) applied parallel to the floor and opposing the direction of travel with respect to the bumper. Bumper activation shall cause an emergency stop within the collapsible range of the bumper.

8.11 Vehicle Non-Emergency Controls and Devices

8.11.1 Vehicle Non-Emergency Devices. When actuated, vehicle non-emergency devices normally cause a slowing, stopping, or inhibiting of vehicle action. The vehicle action may be reinitiated automatically when the device no longer senses the undesirable situation. These devices shall not be used in lieu of para. 8.10.2(g).

8.11.2 Object Detection Devices. Object detection devices may be supplied which will detect objects within the path of the vehicle and its intended load. These detectors may be used to slow or stop vehicle travel as user system criteria require. Specific sizes, shapes, and reflectivity of the detected objects and area of effective coverage need to be defined and agreed upon between manufacturer and user.

8.11.3 Subsystem Monitor. Optional monitors may be provided, such as automatic battery condition, load sensing, location of vehicle, belt failure, load interface locations, etc.

8.11.4 Controlled Stop Switch(es). A switch(es) that, when activated, will provide controlled stopping may be provided on the vehicle in a readily accessible location.

8.11.5 Manual Operator Controls. When operator controls are in use, automatic operation of functions under the operator's control shall be deactivated. The operator shall be completely responsible when the vehicle is under his control. The operating speed of vehicles manually operated with a pendant or equivalent control shall be controlled to ensure positive manual control.

(a) **8.11.6 Bumpers.** If used as non-emergency sensing devices, bumpers shall not exert a force greater than 30 lb (133 N) applied parallel to the floor and opposing the direction of travel with respect to the bumper. Bumper activation shall cause a stop within the collapsible range of the bumper.

8.12 Control Disconnect

8.12.1 A manually operated switch (may be key-type) to disconnect all control circuits shall be provided.

8.12.2 In the manual mode, means convenient to the operator when in normal operating position shall be provided to quickly disconnect the battery power circuit in the event of an emergency. Emergency stop switches, if not overridden, are acceptable if they disconnect the battery power circuit.

8.13 Operational Modes

8.13.1 Automatic. No operator intervention is required for vehicle operation.

(a) *Sleep (Optional).* A condition, in automatic operation, in which all vehicle power is shut off except for the ability to receive a "wake-up" signal.

8.13.2 Semiautomatic (Optional). Operator intervention is required for certain vehicle operations. Continuous operator activation of an enabling device(s) shall be required.

8.13.3 Manual. Complete vehicle operation under control of local operator. Continuous operator activation of a vehicle enabling device(s) shall be required. Safety devices required for automatic or semiautomatic operation may be overridden in manual mode.

8.13.4 Maintenance (Optional). A diagnostic or service mode where safety device overrides are permissible.

8.14 Manual Operation

8.14.1 Manual controls shall be provided in accordance with ASME B56.1, ASME B56.8, ASME B56.9, or other safety standards, as applicable.

8.14.2 Special manual controls (e.g., pendant) shall be such that the authorized operator can anticipate the resultant movement(s).

8.15 Protection From Moving Parts

Protection shall be provided to reduce foreseeable risk of personnel injury from moving parts (including wheels).

8.16 Load Handling Devices

8.16.1 Each vehicle powered load handling device shall have emergency stop switch(es) on the vehicle accessible to operators, which can be the same as the vehicle emergency stop switches.

8.16.2 When the load handling device is not in a position designated as safe for transport, the vehicle load handling devices shall have an appropriate interlock to restrict vehicle movement to that required for safe positioning.

8.16.3 Powered load handling devices shall have an interlock when used in conjunction with powered load handling stands or devices external to the vehicle. Proper vehicle alignment and confirming signal shall be re-

**APPENDIX A
REFERENCES****(93)****(a)**

(This Appendix is an integral part of ASME B56.5-1993 and is placed after the main text for convenience.)

The following are safety standards and codes (unless otherwise noted) referenced within this Standard. It is the intent of this Standard to refer to the standards and codes listed below in their latest edition when they are referenced within the Standard.

ASME B56.1-1993	Safety Standard for Low Lift and High Lift Trucks
ASME B56.8-1993	Safety Standard for Personnel and Burden Carriers
ASME B56.9-1992	Safety Standard for Operator Controlled Industrial Tow Tractors
ANSI/NFPA 505-1992	Fire Safety Standard for Powered Industrial Trucks – Type Designations, Areas of Use, Maintenance, and Operation
ANSI/UL 558-1991	Standard for Safety for Internal Combustion-Engine-Powered Industrial Trucks
ANSI/UL 583-1991	Standard for Safety for Electric-Battery-Powered Industrial Trucks

The following are related documents:

ANSI/NFPA 30-1993	Flammable and Combustible Liquids Code
ANSI/NFPA 58-1992	Storage and Handling of Liquefied Petroleum Gases
ANSI/IES RP7-1990	Practice for Industrial Lighting (not a safety standard)
ANSI Z94.0-1989	Terminology (not a safety standard)

Copies of the publications listed above are available from:

ANSI	American National Standards Institute, Inc. 11 West 42nd Street, New York, NY 10036
ASME	The American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017 ASME Order Department 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300
NFPA	National Fire Protection Association Batterymarch Park, Quincy, MA 02269

APPENDIX B

GLOSSARY OF COMMONLY USED WORDS AND PHRASES

(This Appendix is an integral part of ASME B56.5-1993 and is placed after the main text for convenience.)

(a)

aisle, guidepath clearance — the envelope of space required for the vehicle and its load to move automatically without contacting fixed obstructions

ampere-hour capacity — the ampere-hours that a storage battery can deliver under specified conditions such as temperature, rate of discharge, and final voltage

authorized person — a trained person who has been given responsibility to operate or maintain the vehicle system

battery charging, automatic — charging achieved through the automatic connection of the charging equipment to the battery while the battery is in the vehicle

battery charging, central — battery charging in a designated area while the vehicle is not in service

battery charging, opportunity — charging of the battery while the vehicle is in service

brake, emergency — a device(s) to stop the vehicle (from rated speed with a rated load) between the object sensed and contact with the vehicle frame or load

brake, parking — a device(s) to prevent inadvertent moving of the stationary vehicle

brake, service — a device(s) for slowing or stopping the vehicle during manned operation

braking — any controlled or emergency means to slow or stop the vehicle

bumper — a mechanically actuated device which, when depressed, causes the vehicle to stop

controlled braking — a means for slowing or stopping the vehicle

drawbar pull, breakaway — the maximum pull in pounds (Newtons) a vehicle will develop statically on a level floor having the prescribed coefficient of friction

drawbar pull, maximum — the maximum pull in pounds (Newtons) a tractor or tow vehicle will develop on a level floor having the prescribed coefficient of friction, when moving a load at a uniform rate

emergency stop — (also known as E-stop) one that occurs for unprogrammed events such as vehicle contact

with an object or person through sensors or an emergency button on the vehicle

fail-safe — a design in which no single failure can cause an unsafe condition

guidance reference, external — information apart from the vehicle that enables the vehicle or vehicle system logic to determine the location of the vehicle relative to the intended path

guidance reference, internal — information within the vehicle that enables the vehicle or vehicle system logic to determine the location of the vehicle relative to the intended path

guided industrial vehicle system — see vehicle system, guided industrial

guided tow vehicle — see vehicle, guided tow

guidepath — an intended path for guided industrial vehicle use with automatic guidance

guidepath clearance aisle — see aisle, guidepath clearance

local operator — an operator within reach of the vehicle, its control, or safety devices

manned industrial vehicle — a vehicle with an operator and/or other person on board associated with vehicle function

nonrestricted area — area in which the guidepath is installed which is shared with personnel

passenger — a person that rides the vehicle or a unit towed by the vehicle for transportation purposes. A passenger has no responsibilities or duties associated with any function of the vehicle in any mode of operation.

pendant control — a hand-held device for vehicle control

processor monitor — a hardware device that ensures that the software program in the computer is being executed

qualified person — a person who, by possession of a recognized degree or certificate of professional standing, or who, by extensive knowledge, training, and experience has successfully demonstrated the ability to

solve or resolve problems relating to the subject matter and work

rated capacity — the load, its position, and the vehicle speed, as established by the manufacturer, at which design performance can be expected

rated load — the weight, envelope, and center of gravity, as established by the manufacturer, at which design performance can be expected

rated speed — the speed, as established by the manufacturer, at which design performance can be expected

restricted area — an area in which the guidepath is installed and from which unauthorized personnel are prohibited, including small areas of inadequate personnel clearance in an otherwise nonrestricted area

vehicle, guided tow — a vehicle which tows wheeled containers connected to, but separate from, the vehicle itself

vehicle system, guided industrial — guided industrial vehicle(s) capable of automatic operation, and all components of the installation related to the vehicle(s) (e.g. guidepaths, controls, vehicle trailers, load when on the vehicle or trailers, and other equipment when interfacing with these items)

verifiable approval — documentation from the vehicle manufacturer indicating approval of the proposed change to the vehicle

watchdog timer — see *processor monitor*

ASME B56.5-1993

(REVISION OF ASME/ANSI B56.5-1988)

POWERED AND NONPOWERED INDUSTRIAL TRUCKS

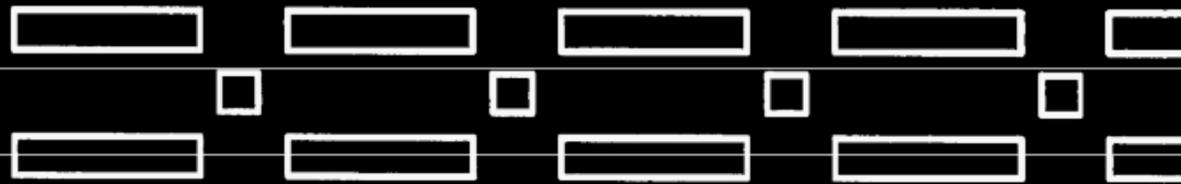


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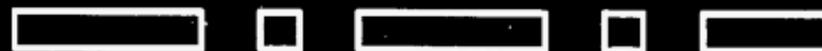
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Safety Standard for Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles

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(REVISION OF ASME/ANSI B56.5-1988)



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**ASME B56.5-1993
SUMMARY OF CHANGES**

The 1993 Edition of ASME B56.5 includes all revisions and corrections introduced in B56.5a-1989, B56.5b-1990, B56.5c-1991, and B56.5d-1992, as well as the following changes, identified by (93).

<i>Page</i>	<i>Location</i>	<i>Change</i>
Cover	Title	Revised
iii	Foreword	Revised
vii	Contents	Revised
1	General	(1) Third paragraph revised (2) Footnote deleted
3	Title	Revised
	1 SCOPE	Revised
	2 PURPOSE	Revised
4	4.1.4	Added
7	8.1	Revised
12-14	Part IV	Added
15	Appendix A	References revised: ANSI/NFPA 505 ANSI/NFPA 30 ANSI/NFPA 58 ANSI/IES RP 7

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FOREWORD

(93)

(This Foreword is not part of ASME B56.5-1993.)

On September 8, 1972, the B56.5 Subcommittee started work on this Standard at the direction of the B56 Committee and the Sponsor, The American Society of Mechanical Engineers (ASME). Following a number of work sessions and ballots within the Subcommittee and the B56 Standards Committee, it was submitted to ASME for B56 Committee ballot, public review, and Secretariat approval. After obtaining such approval, the Standard was submitted to the American National Standards Institute, Inc. (ANSI). ANSI approval to issue the Standard as American National Standard B56.5 was granted on August 30, 1978.

On October 18, 1984, the B56.5 Subcommittee held a meeting to begin work on the revision of ANSI B56.5-1978. After a number of additional subcommittee meetings, the Subcommittee had come to consensus agreement on a proposed revision. The proposed revision was submitted for B56 Committee ballot and public review. After consideration of comments received, the proposed revision was submitted to the Sponsor for its approval. After obtaining such approval, the proposed revision was submitted to ANSI and was approved and designated as an American National Standard on May 17, 1988.

Subsequently, addenda to the 1988 Edition were approved and published in 1989, 1990, 1991, and 1992. Proposed revisions for inclusion in the 1993 Edition were approved by the B56 Committee and the Sponsor, and were submitted for public review. The 1993 Edition, which incorporated the revisions contained in the four addenda to the 1988 Edition plus those revisions approved for the 1993 Edition, was approved and designated as an American National Standard by ANSI on August 30, 1993.

This Standard shall become effective 1 year after the date of issuance. Part III applies only to vehicles manufactured after the effective date.

Safety codes and standards are intended to enhance public health and safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

**ASME STANDARDS COMMITTEE B56
Powered and Nonpowered Industrial Trucks**

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

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POWERED AND NONPOWERED INDUSTRIAL TRUCKS

GENERAL

This Standard is one of a series that has been formulated with the American Society of Mechanical Engineers as Sponsor in accordance with the Accredited Organization method, the procedures accredited by the American National Standards Institute, Inc., and the following scope.

Establishment of the safety requirements relating to the elements of design, operation, and maintenance; standardization relating to principal dimensions to facilitate interchangeability, test methods, and test procedures of powered and nonpowered industrial trucks (not including vehicles intended primarily for earth moving or over-the-road hauling); and maintenance of liaison with the International Organization for Standardization (ISO) in all matters pertaining to powered and nonpowered industrial trucks.

One purpose of the Standard is to serve as a guide to governmental authorities having jurisdiction over subjects within the scope of the Standard. It is expected, however, that the Standard will find a major application in industry, serving as a guide to manufacturers, purchasers, and users of the equipment.

(93) For convenience, Standards for Powered and Nonpowered Industrial Trucks have been divided into separate volumes:

Safety Standards

- B56.1 Low Lift and High Lift Trucks
- B56.5 Guided Industrial Vehicles
- B56.6 Rough Terrain Forklift Trucks
- B56.7 Industrial Crane Trucks
- B56.8 Personnel and Burden Carriers
- B56.9 Operator Controlled Industrial Tow Tractors
- B56.10 Manually Propelled High Lift Industrial Trucks

Standardization Standards

- B56.11.1 Double Race or Bi-Level Swivel and Rigid Industrial Casters

- B56.11.3 Load Handling Symbols for Powered Industrial Trucks
- B56.11.4 Hook-Type Forks and Fork Carriers for Powered Industrial Forklift Trucks
- B56.11.5 Measurement of Sound Emitted by Low Lift, High Lift, and Rough Terrain Powered Industrial Trucks
- B56.11.6 Evaluation of Visibility From Powered Industrial Trucks

Safety standards that were previously listed as B56 volumes but now have different identification due to a change in standards development assignments are as follows.

- NFPA 505 Fire Safety Standard for Powered Industrial Trucks — Type Designations, Areas of Use, Maintenance and Operation (formerly B56.2)
- UL 583 Standard for Safety for Electric-Battery-Powered Industrial Trucks (formerly B56.3)
- UL 558 Standard for Safety for Internal Combustion Engine-Powered Industrial Trucks (formerly B56.4)

If adopted for governmental use, the references to other national standards in the specific volumes may be changed to refer to the corresponding governmental regulations.

The use of powered and nonpowered industrial trucks is subject to certain hazards that cannot be completely eliminated by mechanical means, but the risks can be minimized by the exercise of intelligence, care, and common sense. It is therefore essential to have competent and careful operators, physically and mentally fit, and thoroughly trained in the safe operation of the equipment and the handling of the loads. Serious hazards are overloading, instability of the load, obstruction to the free passage of the load, collision with objects or pedestrians, poor maintenance, and use of equipment for a purpose for which it was not intended or designed.

Suggestions for improvement of these volumes, especially those based on actual experience in their application, shall be submitted to the Secretary of the B56

Committee, ASME, United Engineering Center, 345 East 47th Street, New York, NY 10017.

Comments shall be written in accordance with the following format:

(a) specify paragraph designation of the pertinent volume;

(b) indicate suggested change (addition, deletion, revision, etc.);

(c) briefly state reason and/or evidence for suggested change;

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

The appropriate B56 Subcommittee will consider each suggested revision at its first meeting after receipt of the suggested revision(s).

(93)

SAFETY STANDARD FOR GUIDED INDUSTRIAL VEHICLES AND AUTOMATED FUNCTIONS OF MANNED INDUSTRIAL VEHICLES

(93)

Part I Introduction

(93) 1 SCOPE

This Standard defines the safety requirements relating to the elements of design, operation, and maintenance of powered, not mechanically restrained, unmanned automatic guided industrial vehicles and automated functions of manned industrial vehicles.

This Standard applies to guided industrial vehicles in automatic mode of operation in nonrestricted areas. Portions of this Standard, when designated, also apply to semiautomatic, manual, and maintenance modes and restricted areas of vehicle operation. It is recognized that restricted areas may exist, and require the user and/or manufacturer to determine appropriate safety provisions.

Portions of this Standard, when designated, also apply to automated functions of manned industrial vehicles.

This Standard does not apply to passenger carrying vehicles.

(93) 2 PURPOSE

The purpose of this Standard is to promote safety through the design, construction, application, operation, and maintenance of unmanned guided industrial vehicles and automated functions of manned industrial vehicles.

This Standard may be used as a guide by governmental authorities desiring to formulate safety rules and regulations. This Standard is also intended for voluntary use by others associated with manufacturing or use of unmanned guided industrial vehicles and automated functions of manned industrial vehicles.

3 INTERPRETATION

3.1 Mandatory and Advisory Rules

To carry out the provisions of this Standard, the word *shall* is to be understood as mandatory and the word *should* as recommended.

3.2 Classification of Approved Guided Industrial Vehicles

The word *approved* means the classification or listing of guided industrial vehicles as to fire, explosion, and electric shock hazard by a nationally recognized testing laboratory.

3.3 Requests for Interpretation

The B56 Committee will render an interpretation of any requirement of the Standard. Interpretations will be rendered only in response to a written request sent to the Secretary of the B56 Committee, ASME, 345 East 47th Street, New York, NY 10017. The request for interpretation shall be in the following format.

- Subject: Cite the applicable paragraph number(s) and provide a concise description.
- Edition: Cite the applicable edition of the pertinent 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 approval of a proprietary design or situation. The inquirer may also include any plans or drawings which are necessary to explain the question; however, they should not contain proprietary names or information.

ASME procedures provide for reconsideration of any interpretation when or if additional information which 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.

3.4 Metric Conversions

The values stated in U.S. customary units are to be regarded as the standard.

Part II For the User

4 GENERAL SAFETY PRACTICES

4.1 Introduction

4.1.1 Before putting a guided industrial vehicle system into service, the user shall be responsible for all factors affecting the operation and maintenance, as referenced in Part II of this Standard.

4.1.2 Guided industrial vehicles can cause injury or damage if improperly used or maintained.

4.1.3 Part II contains safety standards applicable to vehicle operations. Unusual operating conditions may require additional safety precautions. Guided industrial vehicles which can be operated by manual controls may have restricted operational characteristics.

(93) **4.1.4** Part IV contains safety standards applicable to automated functions of manned industrial vehicles.

4.2 Modifications, Nameplates, Markings, Capacity, and Stability

4.2.1 Modifications and/or additions to hardware or software which affect rated capacity, safe operation, or any emergency control or device shall not be performed without manufacturer's verifiable approval. Where such authorization is granted, capacity, operation, and maintenance instruction (plates, tags, or decals) shall be changed accordingly.

4.2.2 The user shall see that all nameplates and caution and instruction markings are in place and legible.

4.2.3 When utilizing lifting equipment such as elevators, cranes, ship hoisting gear, etc., to relocate a guided industrial vehicle, the user shall assure that the capacity of the hoisting equipment being used is not exceeded.

4.2.4 The user shall consider that changes in load(s), load position(s), or dimension(s), coupling type(s) or position(s), and floor surface condition(s) or battery weights may affect rated capacities and safe operation. Only stable or safely arranged loads shall be handled.

4.2.5 The user shall define and be responsible for load stability and retention. When deemed necessary by the user, verification shall be required.

4.2.6 Some users may decide to establish, for their own use, stability requirements that will vary from those in para. 8.7.4. However, the requirements in para. 8.7.4 should serve as a guide for the user, working with the

manufacturer, in establishing his own more stringent requirements.

4.3 Stopping Distance

4.3.1 The determination of the vehicle's stopping distance (whether used as a load carrying vehicle or a tow vehicle) depends on many factors, such as other vehicle and pedestrian traffic, clearances, condition of the floor, and stability of load(s). The prime consideration is that the emergency braking system shall cause the vehicle to stop prior to impact between the vehicle structure and the obstruction.

4.3.2 Caution should be exercised with changed environments. Changes in weather, surface conditions, or applications may affect the vehicle stopping distance; speeds, loads, brake settings, and/or operation should be adjusted accordingly.

4.4 Sensors

If a load exceeds the width and/or length of the vehicle, the user should require that sensors in the direction of travel covering the maximum moving width and/or length be provided to prevent contact between the load and any obstruction.

4.5 Changing and Charging of Batteries

The user shall make battery changing and charging provisions in accordance with ANSI/NFPA 505. Battery types and charging systems supplied or specified by the vehicle manufacturer (e.g., opportunity charging) but not referenced in ANSI/NFPA 505 shall be safely operated and charged per the instructions supplied by the vehicle manufacturer.

4.6 Hazardous Locations

4.6.1 It shall be the responsibility of the user to determine the hazard classification of any particular atmosphere or location according to ANSI/NFPA 505.

4.6.2 Vehicles operated in hazardous areas shall be of the type required by ANSI/NFPA 505 and shall be so identified.

4.7 Aisles and Doors

4.7.1 Restricted areas of vehicle operation require identification and/or marking.

4.7.2 In nonrestricted areas, the floor space boundary required for the vehicle and its load and/or train shall

be clearly marked, including the clearance necessary for turns and maneuvering.

4.7.3 Doors subject to automatic actuation and blind corners shall have suitable audible and/or visual alarms to anticipate the approach of the automatic vehicle or door actuation. Passive devices such as mirrors are recommended also.

4.7.4 A minimum clearance of 1.5 ft (450 mm) should be maintained between obstructions and vehicles (including loads). All other areas having reduced clearance shall be restricted areas and be clearly marked by signs, stripes, lights, or other designations.

4.7.5 Doors

(a) Automatic vehicle guidepaths should not be routed through doorways frequented by personnel unless the opening is wide enough for personnel to remain outside the guidepath clearance aisle. Also, opening and closure of powered or nonpowered doors shall be accomplished in a manner that alerts or restricts personnel near the doorway.

(b) In order to minimize the possibility of blocking the complete closing of a fire door, the vehicle will respond to a signal such as an input from a limit switch and/or heat sensor and stop prior to the fire door.

(c) System design should not have a normal stop location where a vehicle or its load would block a fire door closure.

4.8 Ambient Lighting

There are no ambient lighting requirements for automatic vehicle systems.

4.9 Safety Devices (Systems)

4.9.1 Vehicle

(a) *Warning Devices.* The user and manufacturer should agree upon the time interval(s) for warning device actuation. See para. 8.9.

(b) *Emergency Devices.* See para. 8.10.

(c) *Non-Emergency Devices.* See para. 8.11.

(d) *Turn Signals.* These are not mandatory, but should be made available by the manufacturer, if requested.

4.9.2 Facility. Signs, warning devices, and other safety devices should be used as required to alert and to protect the personnel from contact with the vehicle or items actuated by the vehicle. This includes equipment that is designed to interact with the vehicle system.

4.9.3 Safety Devices. Vehicle safety devices shall not be manually overridden in automatic or semiautomatic modes of operation.

4.10 Vehicle Emergency and Non-Emergency Controls and Devices

Requirements in addition to those specified in paras. 8.10 and 8.11 may be specified by the user, but shall not negate the provisions of para. 8.10.

5 INSTALLATION

5.1 General Guidelines

(a) All hazardous areas of use shall be marked in accordance with ANSI/NFPA 505.

(b) Permanent aisles, roadways, and passageways shall be marked.

(c) Restricted areas shall be clearly marked.

(d) Central battery changing and charging facilities and procedures shall be in accordance with Section 5-3 of ANSI/NFPA 505.

(e) Vehicle nameplate ratings are based on level, dry surfaces having a minimum coefficient of friction with the driven and brake tire of 0.6. Other surface conditions may impact vehicle safety and require appropriate vehicle derating.

5.2 Operating Environment

5.2.1 Travel Surface. The surfaces over which the vehicle system operates shall be maintained to ensure that the traction required for travel, steering, and braking performance can be met under the environmental conditions which may be expected on that surface.

5.2.2 Physical Environment. The physical environment, including temperature, humidity, ambient weather (e.g., exposed dock), air quality (e.g., explosive, particulates, and/or gaseous constituents) shall be a part of the vehicle design criteria. Changes to the environment shall be evaluated to verify there is no adverse effect on the vehicle's safety systems.

5.2.3 Radiated Emissions. Many types of devices may emit energy, such as electromagnetic, electrostatic, or optical, that could affect the operation of the vehicle system. Likewise, vehicle systems may emit energy that could affect other systems and/or personnel. Users should seek guidance from the vehicle manufacturer if interference is suspected. The conditions acceptable for the vehicle system installation shall be defined by user and vehicle manufacturer agreement.

6 OPERATION

6.1 User Responsibility

The user is responsible for the safe operation of the vehicle system.

6.2 Manual Functions

Only personnel trained in accordance with para. 6.3 shall manually operate a guided industrial vehicle. Operators shall be qualified as to their ability to safely operate the equipment.

6.3 Operator Training

An operator training program shall include the manufacturer's documented operating instructions and procedures and the user's local applicable requirements. The training shall be presented to all operators and not condensed for those claiming previous experience. Oral, written, or operational performance tests and evaluations should be given during and at completion of the course. Refresher courses, which may be condensed versions of the primary course, and periodic on-the-job operator evaluation, are as important as initial training.

6.4 Operator Responsibility

The operator shall abide by applicable safety rules and practices.

6.5 General Instructions

Safety and operating instructions shall be provided to the operators. If applicable, these include the following:

- (a) safeguarding of personnel
- (b) passenger riding restrictions
- (c) loading of vehicles and trailers
- (d) maintaining a safe distance from the edge of ramps, platforms, and other objects
- (e) use on trailer(s) or railcar(s)
- (f) using vehicles in hazardous locations
- (g) reporting of vehicle incidents
- (h) keeping vehicles clear of fire aisles, doors, access to stairways, and fire equipment
- (i) sequence of operation with interfacing equipment
- (j) use of braking system(s)

6.6 Manual Operation

6.6.1 Manual operation of fork-type guided industrial vehicles shall also comply with applicable sections of ASME B56.1 not addressed in this Standard.

6.6.2 Manual operation or burden carrier-type guided industrial vehicles shall also comply with applicable sections of ASME B56.8 not addressed in this Standard.

6.6.3 Manual operation of towing-type guided industrial vehicles shall also comply with applicable sections of ASME B56.9 not addressed in this Standard.

6.6.4 Other type vehicles may require additional considerations.

7 MAINTENANCE

7.1 Warning

Vehicles may become hazardous if maintenance is neglected. Therefore, maintenance facilities, trained personnel, and procedures shall be provided.

7.2 Maintenance

Maintenance and inspection of all vehicle systems shall conform to the manufacturer's recommendations.

7.2.1 Preventive

(a) All manufacturer's supplied plates, tags, and decals shall be maintained in legible condition.

(b) All components shall be inspected at regular intervals and maintained in accordance with the vehicle manufacturer's recommendations. Special attention shall be paid to the condition of electrical insulation.

(c) Vehicle systems shall be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

(d) Safety and warning systems shall be maintained in operational readiness.

7.2.2 Diagnosis and Repair

(a) Only authorized personnel shall be permitted to maintain, repair, adjust, and inspect vehicle systems.

(b) Modifications and/or additions to hardware or software which affect rated capacity, safe operation, or any emergency control or device shall not be performed without the manufacturer's verifiable approval. Where such authorization is granted, capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.

(c) Care shall be taken to ensure that all replacement parts are interchangeable with the original parts and of a quality and performance at least equal to that provided in the original equipment.

7.2.3 Batteries and Chargers. The user shall maintain batteries and changing and charging systems in accordance with ANSI/NFPA 505. Battery types and

charging systems supplied or specified by the vehicle manufacturer (e.g., opportunity charging) but not referenced in ANSI/NFPA 505 shall be maintained in accordance with instructions supplied by the vehicle manufacturer.

7.3 Training

7.3.1 Only authorized persons shall be permitted to control or maintain a vehicle system.

7.3.2 Maintenance and support personnel of the system shall be trained by qualified persons. Training may include the following:

- (a) operations
- (b) electrical maintenance
- (c) mechanical/fluidic maintenance
- (d) systems level (where applicable)

7.3.3 It is the user's responsibility to follow all procedures for safe maintenance of equipment.

7.4 Documentation of Maintenance Activities

Records of maintenance activities performed should be kept.

Part III For the Manufacturer

8 DESIGN AND CONSTRUCTION STANDARDS

(93) 8.1 Introduction

Part III contains safety standards for the design and construction of unmanned guided industrial vehicles. Part IV contains safety standards applicable to automated functions of manned industrial vehicles.

8.2 Rated Capacity of Towing Vehicles

8.2.1 Guided tow vehicles shall have an established breakaway drawbar pull, maximum drawbar pull and normal rated drawbar pull. These ratings are based on level, dry surfaces having a minimum coefficient of friction with the driving and braking tire of 0.6. The battery weight and size used shall be within limits stated on the vehicle nameplate.

8.2.2 Maximum drawbar pull in pounds (Newtons) shall be defined by the manufacturer at the specified coupler height under the conditions of para. 8.2.1 when traveling at a minimum of 44 ft/min (0.22 m/s) and for a minimum of 30 sec.

8.2.3 Normal rated drawbar pull is the greatest continuous towing force in pounds (Newtons) which can be sustained under the conditions of para. 8.2.1 including rated speed or duty cycle.

8.2.4 If the vehicle has load carrying capacity in addition to towing capabilities, load testing is also required. See para. 8.3.

8.2.5 Drawbar pull rating tests shall be performed as follows:

(a) *Test Conditions*

- (1) course surface to be as defined in para. 8.2.1;
- (2) one trailer train loaded to require a measured drawbar pull equal to the normal rated drawbar pull;
- (3) one trailer train loaded to require a measured drawbar pull equal to 10% of the normal rated drawbar pull.

(b) *Test Methods*

- (1) sixty percent of total test time, the vehicle will be towing a test load;
- (2) the test cycle is made up of the following:
 - (a) one 200 ft (61 m) run with trailer load as per (a)(2) above;
 - (b) one 200 ft (61 m) run with trailer load as per (a)(3) above;
 - (c) vehicle shall accelerate to rated speed during each run and loads shall be cycled at least 6 times per hour;
 - (d) continuous test until a stable temperature has been reached for a minimum of 1 hr on components.

(c) In addition to the above test, alternate rated drawbar pull is the sustained towing force in pounds (Newtons) using special test conditions and test methods to suit the user's operation.

8.3 Rated Capacity of Load Carrying Vehicles

8.3.1 Guided load carrying vehicles shall have an established carrying capacity. This rating is based on level, dry surfaces having a minimum coefficient of friction with the driving and braking tire of 0.6. The battery weight and size used shall be within limits stated on the vehicle nameplate.

8.3.2 If the vehicle has towing capacity in addition to load carrying capabilities, towing testing is also required. See para. 8.2.

8.3.3 Load carrying capacity tests shall be performed as follows:

(a) *Test Conditions*

- (1) as defined in para. 8.3.1
- (2) vehicle with rated load
- (3) unloaded vehicle

(b) Test Methods

(1) the test cycle is made up of the following:

- (a) one 200 ft (61 m) run carrying full rated load;
- (b) one 200 ft (61 m) run with no load condition;

(c) vehicle shall accelerate to rated speed during each run and loads shall be cycled at least 6 times per hour;

(d) continuous test until a stable temperature has been reached for a minimum of 1 hr on components.

8.4 Additional Guided Industrial Vehicle Requirements

8.4.1 Fork-type guided industrial vehicles shall also comply with applicable sections of ASME B56.1 not addressed in this Standard.

8.4.2 Burden carrier-type guided industrial vehicles should also comply with applicable sections of ASME B56.8 not addressed in this Standard.

8.4.3 Towing-type guided industrial vehicles should also comply with applicable sections of ASME B56.9 not addressed in this Standard.

8.4.4 Other type vehicles may require additional considerations.

8.5 Vehicle Nameplate Data

On every vehicle, the manufacturer shall install a durable, corrosion resistant nameplate(s) legibly inscribed with the following:

(a) vehicle model or vehicle serial number or both. The vehicle serial number shall be stamped on the frame of the vehicle.

(b) weight of unloaded vehicle without battery or fuel (empty weight);

(c) designation of compliance with the mandatory requirements of Part III of this Standard;

(d) indication of type if in conformance with or rated per ANSI/UL 583 or ANSI/UL 558;

(e) maximum and normal or alternate rated draw-bar pull for towing vehicles (see para. 8.2.5);

(f) rated load (weight, envelope, and center of gravity) and lift height, if applicable;

(g) identification of battery classification, if applicable, minimum and maximum weight and dimensions of battery(s), rated ampere-hour capacity, and nominal voltage;

(h) for towing applications, the coupling height at which capacities were determined;

(i) rated speed (speed of vehicle for purposes of rating);

(j) if non-battery-powered, identification of fuel requirements;

(k) maximum grade capability at rated load.

8.6 Guidance

8.6.1 Deviation of travel from the intended path by more than 3 in. (75 mm) when using an external guidance reference (e.g., guide wire) or by more than 6 in. (150 mm) when using an internal guidance reference (e.g., inertial guidance) shall require an emergency stop.

8.6.2 Loss of guidance reference shall require an emergency stop.

8.7 Travel Performance**8.7.1 Control**

(a) *Factors Affecting Vehicle Speed.* Vehicle speed may be affected by dynamic operating characteristics of the vehicle system operating area including but not limited to the following:

- (1) floor conditions
- (2) load stability and retention
- (3) personnel access
- (4) environmental conditions
- (5) emergency devices
- (6) intended path

(b) *Acceleration.* The maximum acceleration rate should be commensurate with requirements for load stability during normal operation.

(c) *Deceleration*

(1) For normal operation, the deceleration rate should be commensurate with requirements for load stability.

(2) For emergency operation, the maximum deceleration rate shall be commensurate with emergency stop dynamic criteria. See para. 4.3.1.

(d) *Monitoring.* Loss of speed control shall require an emergency stop.

8.7.2 Steering. Steering characteristics shall not degrade vehicle dynamic stability.

8.7.3 Ramps

(a) *Definition.* A variation in floor grade in excess of 3% and of a length where rating data variance is required shall constitute a ramp. See para. 8.17.1(a).

(b) *Speed Control.* Means shall be provided to control vehicle speed on ramps consistent with the application. Vehicle travel speed and safe speed limit on ramps shall be agreed to by the manufacturer and user as part of system parameters. Vehicles rated for ramp operation shall have provisions for starting and stopping on ramps.

(c) *Braking*. Controlled braking means shall be provided on vehicles which are designated for automatic ramp operation. Emergency braking performance shall be the same as for level horizontal operation. See para. 8.8.1.

8.7.4 Stability. For vehicles with lift of more than 12 in. (300 mm), the stability requirements of ASME B56.1 shall apply. For vehicles with lift of 12 in. (300 mm) or less, the stability requirements of ASME B56.8 shall apply.

8.8 Braking Functions

8.8.1 Vehicles shall have the following braking functions. Multiple functions may be provided by a single braking means.

(a) *Emergency Brake*. Emergency braking shall be provided for all vehicles. The emergency brake shall be mechanically set and require power or force from a source external to the brake to release. During automatic operations, this brake may be automatically actuated and deactuated. The prime consideration is that the emergency brake shall cause the vehicle to stop prior to impact between the vehicle structure and the obstruction.

(b) *Parking Brake*. A parking brake, which may be a part of or include the service brake or emergency brake, shall be provided. When a vehicle is in a stopped condition, this brake should be applied to prevent inadvertent movement of the stationary vehicle.

(c) *Service Brake*. A service brake, which may be a part of or include the parking brake or emergency brake, shall be provided. During manual operation, this brake is used for slowing or stopping the vehicle.

8.8.2 Controlled braking may be provided. Controlled braking is a means for slowing or stopping the vehicle. This may be accomplished by electrical or mechanical means.

8.9 Warning Devices

8.9.1 Prior to initiation of vehicle movement or remote reactivation from a sleep or inactive condition, a warning device (on or off the vehicle) shall be activated, to be either audible, visual or a combination thereof, indicating the imminent movement of the vehicle under automatic control. The warning light(s), such as strobe or flashing, shall be readily visible.

8.9.2 Vehicles shall provide a warning indication, either audible, visual, or a combination thereof, during all vehicle motion.

8.9.3 Vehicles in motion shall provide a warning indication distinctive from the indication of para. 8.9.2 prior to travel in reversing or traversing direction.

8.9.4 An indication shall be provided to alert personnel of vehicle malfunction or safety device activation including the following:

- (a) loss of path reference or deviation from the intended guidepath;
- (b) loss of speed control;
- (c) other control system malfunctions that require intervention by a qualified operator.

8.9.5 An indication should be provided for all vehicles capable of automatic operation to identify low battery condition when automatic routing to battery charging is not provided.

8.10 Vehicle Emergency Controls and Devices

8.10.1 Vehicle emergency controls and devices are those which automatically and rapidly stop propulsion, prohibit automatic restart, stop moving components, and apply the emergency braking. Local manual intervention is required to return to normal operating conditions. After detection of emergency condition, emergency controls shall directly activate an emergency stop.

8.10.2 Mandatory emergency control functions and devices shall be of a fail-safe design and include the following:

- (a) Emergency stop switches (e.g., red mushroom), located on or off the vehicle and accessible to personnel;
- (b) detection of loss of speed control;
- (c) detection of unplanned loss of guidepath reference or intended path;
- (d) processor monitor (watchdog timer), if a processor is used;
- (e) motive power interrupt;
- (f) failure detection of power supplies/sources that are critical to vehicle safety aspects;
- (g) a sensing device or combination of devices to prevent contact of the object sensed with the vehicle structure in the direction(s) of travel.

8.10.3 Object Detection Devices. Additional object detection devices may be provided at the request of the user and/or as required by installation criteria.

8.10.4 Bumpers. If used as emergency sensing devices, bumpers shall activate from a force applied parallel to the floor not greater than 8 lb (36 N) and shall cause an emergency stop within the collapsible range of the bumper in the direction of travel.

8.11 Vehicle Non-Emergency Controls and Devices

8.11.1 Vehicle Non-Emergency Devices. When actuated, vehicle non-emergency devices normally cause a slowing, stopping, or inhibiting of vehicle action. The vehicle action may be reinitiated automatically when the device no longer senses the undesirable situation. These devices shall not be used in lieu of para. 8.10.2(g).

8.11.2 Object Detection Devices. Object detection devices may be supplied which will detect objects within the path of the vehicle and its intended load. These detectors may be used to slow or stop vehicle travel as user system criteria require. Specific sizes, shapes, and reflectivity of the detected objects and area of effective coverage need to be defined and agreed upon between manufacturer and user.

8.11.3 Subsystem Monitor. Optional monitors may be provided, such as automatic battery condition, load sensing, location of vehicle, belt failure, load interface locations, etc.

8.11.4 Controlled Stop Switch(es). A switch(es) that, when activated, will provide controlled stopping may be provided on the vehicle in a readily accessible location.

8.11.5 Manual Operator Controls. When operator controls are in use, automatic operation of functions under the operator's control shall be deactivated. The operator shall be completely responsible when the vehicle is under his control. The operating speed of vehicles manually operated with a pendant or equivalent control shall be controlled to ensure positive manual control.

8.11.6 Bumpers. If used as non-emergency sensing devices, bumpers shall activate from a force applied parallel to the floor not greater than 8 lb (36 N) and shall cause a stop within the collapsible range of the bumper.

8.12 Control Disconnect

8.12.1 A manually operated switch (may be key-type) to disconnect all control circuits shall be provided.

8.12.2 In the manual mode, means convenient to the operator when in normal operating position shall be provided to quickly disconnect the battery power circuit in the event of an emergency. Emergency stop switches, if not overridden, are acceptable if they disconnect the battery power circuit.

8.13 Operational Modes

8.13.1 Automatic. No operator intervention is required for vehicle operation.

(a) *Sleep (Optional).* A condition, in automatic operation, in which all vehicle power is shut off except for the ability to receive a "wake-up" signal.

8.13.2 Semiautomatic (Optional). Operator intervention is required for certain vehicle operations. Continuous operator activation of an enabling device(s) shall be required.

8.13.3 Manual. Complete vehicle operation under control of local operator. Continuous operator activation of a vehicle enabling device(s) shall be required. Safety devices required for automatic or semiautomatic operation may be overridden in manual mode.

8.13.4 Maintenance (Optional). A diagnostic or service mode where safety device overrides are permissible.

8.14 Manual Operation

8.14.1 Manual controls shall be provided in accordance with ASME B56.1, ASME B56.8, ASME B56.9, or other safety standards, as applicable.

8.14.2 Special manual controls (e.g., pendant) shall be such that the authorized operator can anticipate the resultant movement(s).

8.15 Protection From Moving Parts

Protection shall be provided to reduce foreseeable risk of personnel injury from moving parts (including wheels).

8.16 Load Handling Devices

8.16.1 Each vehicle powered load handling device shall have emergency stop switch(es) on the vehicle accessible to operators, which can be the same as the vehicle emergency stop switches.

8.16.2 When the load handling device is not in a position designated as safe for transport, the vehicle load handling devices shall have an appropriate interlock to restrict vehicle movement to that required for safe positioning.

8.16.3 Powered load handling devices shall have an interlock when used in conjunction with powered load handling stands or devices external to the vehicle. Proper vehicle alignment and confirming signal shall be re-

quired prior to activation of load transfer mechanism(s). This interlock shall be capable of inhibiting movement of both the vehicle and the fixed equipment, when activated.

8.17 Signs

8.17.1 All vehicle signs shall be durable. An appropriate symbol may be used in lieu thereof.

(a) Vehicles designed for ramp operation shall be labeled **MAXIMUM GRADE CAPABILITY = _____ %**, on the vehicle in letters at least 1.5 in. (40 mm) high.

(b) Vehicles capable of fully automatic operation shall have a label clearly visible, that states, **CAUTION: AUTOMATIC VEHICLE**, in letters at least 1.5 in. (40 mm) high.

(c) Vehicles not designed with specific personnel compartments or platforms incorporating appropriate safety protection shall be labeled **NO RIDING**. Vehicles with specific personnel compartments or platforms incorporating appropriate safety protection shall be labeled **UNAUTHORIZED RIDING PROHIBITED**. The label shall be visible from at least two opposing sides of the vehicle using letters at least 1.5 in. (40 mm) high.

(d) Vehicles with a nominal voltage of 48 V or more that are designed for opportunity charging (see para. 8.18.3) should contain a sign, **CAUTION: _____ VOLTS**.

(e) Pendant controls should be labeled **AUTHORIZED OPERATOR ONLY**.

(f) Vehicles should be marked to indicate lift points, if applicable.

8.17.2 Vehicle base color and markings shall render the vehicle highly visible in the user's specified environment. Compliance with Section 5-4.2.2 of ANSI/NFPA 505 shall be required.

8.18 Changing and Charging of Batteries

8.18.1 Battery types and charging systems supplied or specified by the vehicle manufacturer (e.g., opportunity charging) but not referenced in ANSI/NFPA 505 shall have safe operating and charging instructions supplied by the vehicle manufacturer.

8.18.2 The battery compartment shall be designed in accordance with ANSI/UL 583. Battery arrangement shall allow venting to prevent accumulation of fumes.

8.18.3 Batteries for use in electric vehicles shall have the battery weight legibly stamped in the battery tray near the lifting means as follows: **SERVICE WEIGHT _____ lb (kg)**. Where multiple batteries are used in a liftout tray with total combined service weight of bat-

teries and tray exceeding 100 lb (45 kg), the maximum combined weight of the batteries and tray shall be legibly stamped on the battery tray near the lifting means with the following information: **SERVICE WEIGHT _____ lb (kg)**.

8.18.4 When opportunity or automatic charging is specified, the following shall also apply.

(a) The vehicle shall have separate circuitry for carrying the charging current to the battery.

(b) The charging voltage as measured at the battery shall meet the battery manufacturer's recommendations.

(c) The vehicle should control the charger on/off. The charging circuitry external to the vehicle shall be active only when a vehicle is present. A signal shall be given when charging connections have been disconnected and the charger turned off. The vehicle shall not proceed from the charging position until this signal is present.

(d) The charging contacts on the vehicle shall be protected to prevent unintentional battery discharge.

8.19 Documentation

The manufacturer shall provide the user with a maintenance manual which will describe at least the following:

(a) a recommended preventive maintenance program outlining routine service checks and appropriate procedures;

(b) diagnostic check procedures. This shall be in the form of a troubleshooting guide that follows check procedures to provide recommended repair instructions.

(c) procedures for repair of the equipment;

(d) other pertinent information to operate and maintain reliability of all the system equipment;

(e) the sequence of operations for all equipment and electronics.

Part IV

Automated Functions of Manned industrial Vehicles

(93)

9 MANUFACTURER AND USER PRACTICES

9.1 Introduction

9.1.1 Part IV contains safety standards applicable to manufacturer and user practices. The user should understand that when functions on manned industrial vehicles are automated, the operation of the vehicle is changed and it may result in modified performance characteristics, maintenance procedures, and additional safety precautions.

9.1.2 Before putting an industrial vehicle system into service, the user shall be responsible for all factors affecting the operation and maintenance, as referenced in Part II of this Standard.

9.1.3 Industrial vehicles can cause injury or damage if improperly used or maintained.

9.1.4 The addition of any automatic function to a manned industrial vehicle requires the evaluation of the impact of the automation on all other functions. It may be necessary to automate other functions to some degree. The basic functions covered by this Standard are:

- (a) steering (guidance)
- (b) travel
- (c) control and sensing
- (d) lifting/load manipulation

9.1.5 Automated functions shall comply with Part IV of this Standard. Manual functions shall comply with the applicable vehicle standard.

9.2 General Safety Practices

9.2.1 Operator Responsibility. Safe operation is the responsibility of the operator. When operator controls are in use, automatic operation of functions under the operator's control shall be deactivated. All operating speeds or motions of manually operated functions shall be such that manual control can be maintained.

9.2.2 Modifications, Nameplates, Markings, and Capacity

(a) Modifications and/or additions of hardware or software which affect rated capacity, safe operation, or any emergency control or device shall not be performed without manufacturer's verifiable approval. Where such authorization is granted, capacity, operation, and maintenance instruction (plates, tags, or decals) shall be changed accordingly.

(b) A nameplate shall be provided to designate compliance with the mandatory requirements of Part IV of this Standard.

(c) When an automated function is provided, all affected nameplate data (para. 8.5) shall be inscribed on a nameplate.

(d) The user shall see that all required nameplates and caution and instruction markings are in place and legible.

(e) The user shall consider that changes in load(s), load position(s) or dimension(s), coupling type(s) or position(s), and floor surface condition(s) or battery weights may affect rated capacities and safe operation. Only stable or safely arranged loads shall be handled.

(f) The user shall define and be responsible for load stability and retention. When deemed necessary by the user, verification shall be required.

9.2.3 Warnings. Vehicles shall be equipped with an automatic device(s), either audible, visible, or a combination thereof, which shall function during all vehicle motion not under control of the operator.

9.2.4 Safety Device Activation. An indication, either audible, visual, or a combination thereof, shall be provided to alert personnel of safety device activation for automated functions. (See paras. 8.10 and 8.11).

9.2.5 Protection from Moving Parts. The addition of an automatic function(s) shall provide the same protection from moving parts as specified by the applicable vehicle standard.

9.2.6 Special Manual Controls. Special manual controls for automated functions (e.g., pendant) shall be such that the authorized operator can anticipate the resultant movement(s).

9.3 Control and Sensing

Additional control and sensing devices may be provided. When provided, the control and sensing devices shall conform to paras. 8.10 and 8.11, where applicable.

9.4 Steering (Guidance)

Automatic steering functions may be provided. When provided, there shall be no combining of automatic and manual steering modes. Where both modes are provided, there shall be means for the operator to select one mode or the other (see paras. 8.6 and 8.7.2).

9.5 Travel

Automatic travel function(s) may be provided. When provided, they shall not be shared but may be overridden by the operator or limited by the automatic mode (see paras. 8.7.1, 8.7.3, and 8.8).

9.6 Lifting/Load Manipulation

Automatic lifting/load manipulation functions may be provided. When automated, they shall conform to para. 8.16. Characteristics of the automated function may require additional sensing.

9.7 Documentation

The manufacturer of the automated function shall provide the user with a maintenance manual which will de-

scribe at least the following:

- (a) the sequence of operations;
- (b) a recommended preventive maintenance program outlining routine service checks and appropriate procedures;
- (c) diagnostic check procedures. This shall be in the form of a troubleshooting guide that follows check procedures to provide recommended repair instructions;
- (d) procedures for repair of the equipment;
- (e) other pertinent information to operate and maintain reliability of all the system equipment.

**APPENDIX A
REFERENCES****(93)**

(This Appendix is an integral part of ASME B56.5-1993 and is placed after the main text for convenience.)

The following are safety standards and codes (unless otherwise noted) referenced within this Standard. It is the intent of this Standard to refer to the standards and codes listed below in their latest edition when they are referenced within the Standard.

ASME B56.1-1988 (ASME/ANSI B56.1)	Safety Standard for Low Lift and High Lift Trucks
ASME B56.8-1988 (ASME/ANSI B56.8)	Safety Standard for Personnel and Burden Carriers
ASME B56.9-1992	Safety Standard for Operator Controlled Industrial Tow Tractors
ANSI/NFPA 505-1992	Fire Safety Standard for Powered Industrial Trucks—Type Designations, Areas of Use, Maintenance, and Operation
ANSI/UL 558-1991	Standard for Safety for Internal Combustion-Engine-Powered Industrial Trucks
ANSI/UL 583-1991	Standard for Safety for Electric-Battery-Powered Industrial Trucks

The following are related documents:

ANSI/NFPA 30-1990	Flammable and Combustible Liquids Code
ANSI/NFPA 58-1992	Storage and Handling of Liquefied Petroleum Gasses
ANSI/IES RP7-1990	Practice for Industrial Lighting (not a safety standard)
ANSI Z94.0-1989	Terminology (not a safety standard)

Copies of the publications listed above are available from:

ANSI	American National Standards Institute, Inc. 11 West 42nd Street, New York, NY 10036
ASME	The American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017 ASME Order Department 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300
NFPA	National Fire Protection Association Batterymarch Park, Quincy, MA 02269

ASME B56.5-1993

GUIDED INDUSTRIAL VEHICLES AND AUTOMATED FUNCTIONS
OF MANNED INDUSTRIAL VEHICLES

UL

Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062

APPENDIX B

GLOSSARY OF COMMONLY USED WORDS AND PHRASES

(This Appendix is not part of ASME B56.5-1993 and is included for information purposes only.)

aisle, guidepath clearance — the envelope of space required for the vehicle and its load to move automatically without contacting fixed obstructions

ampere-hour capacity — the ampere-hours that a storage battery can deliver under specified conditions such as temperature, rate of discharge, and final voltage

authorized person — a trained person who has been given responsibility to operate or maintain the vehicle system

battery charging, automatic — charging achieved through the automatic connection of the charging equipment to the battery while the battery is in the vehicle

battery charging, central — battery charging in a designated area while the vehicle is not in service

battery charging, opportunity — charging of the battery while the vehicle is in service

brake, emergency — a device(s) to stop the vehicle (from rated speed with a rated load) between the object sensed and contact with the vehicle frame or load

brake, parking — a device(s) to prevent inadvertent moving of the stationary vehicle

brake, service — a device(s) for slowing or stopping the vehicle during manned operation

braking — any controlled or emergency means to slow or stop the vehicle

bumper — a mechanically actuated device which, when depressed, causes the vehicle to stop

controlled braking — a means for slowing or stopping the vehicle

drawbar pull, breakaway — the maximum pull in pounds (Newtons) a vehicle will develop statically on a level floor having the prescribed coefficient of friction

drawbar pull, maximum — the maximum pull in pounds (Newtons) a tractor or tow vehicle will develop on a level floor having the prescribed coefficient of friction, when moving a load at a uniform rate

emergency stop — (also known as E-stop) one that occurs for unprogrammed events such as vehicle contact

with an object or person through sensors or an emergency button on the vehicle

fail-safe — a design in which no single failure can cause an unsafe condition

guidance reference, external — information apart from the vehicle that enables the vehicle or vehicle system logic to determine the location of the vehicle relative to the intended path

guidance reference, internal — information within the vehicle that enables the vehicle or vehicle system logic to determine the location of the vehicle relative to the intended path

guided industrial vehicle system — see vehicle system, guided industrial

guided tow vehicle — see vehicle, guided tow

guidepath — an intended path for guided industrial vehicle use with automatic guidance

guidepath clearance aisle — see aisle, guidepath clearance

local operator — an operator within reach of the vehicle, its control, or safety devices

manned industrial vehicle — a vehicle with an operator and/or other person on board associated with vehicle function

nonrestricted area — area in which the guidepath is installed which is shared with personnel

passenger — a person that rides the vehicle or a unit towed by the vehicle for transportation purposes. A passenger has no responsibilities or duties associated with any function of the vehicle in any mode of operation.

pendant control — a hand-held device for vehicle control

processor monitor — a hardware device that ensures that the software program in the computer is being executed

qualified person — a person who, by possession of a recognized degree or certificate of professional standing, or who, by extensive knowledge, training, and experience has successfully demonstrated the ability to

solve or resolve problems relating to the subject matter and work

rated capacity — the load, its position, and the vehicle speed, as established by the manufacturer, at which design performance can be expected

rated load — the weight, envelope, and center of gravity, as established by the manufacturer, at which design performance can be expected

rated speed — the speed, as established by the manufacturer, at which design performance can be expected

restricted area — an area in which the guidepath is installed and from which unauthorized personnel are prohibited, including small areas of inadequate personnel clearance in an otherwise nonrestricted area

vehicle, guided tow — a vehicle which tows wheeled containers connected to, but separate from, the vehicle itself

vehicle system, guided industrial — guided industrial vehicle(s) capable of automatic operation, and all components of the installation related to the vehicle(s) (e.g. guidepaths, controls, vehicle trailers, load when on the vehicle or trailers, and other equipment when interfacing with these items)

verifiable approval — documentation from the vehicle manufacturer indicating approval of the proposed change to the vehicle

watchdog timer — see *processor monitor*

ASME B56.5 Interpretations

Replies to Technical Inquiries
July 1992 – March 1993

FOREWORD

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME B56 Committee on Powered and Nonpowered Industrial Trucks, to inquiries concerning interpretations of technical aspects of ASME B56.5, Safety Standard for Guided Industrial Vehicles.

These replies are taken verbatim from the original letters except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity. In some few instances, a review of the interpretation revealed a need for corrections of a technical nature; in these cases a corrected interpretation follows immediately after the original reply.

These interpretations were prepared in accordance with the accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when and if additional information is available which the inquirer believes might affect the interpretation. Further, persons aggrieved by this 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.

Interpretation: 5-6

Subject: ASME/ANSI B56.5-1988

Date Issued: July 10, 1992

Question: With regard to para. 8.10.4, which interpretation, if either, is correct: (1) The force to *activate* the bumper *only* should not be greater than 8 lbs. (2) The total force applied by the bumper to the obstruction should never exceed 8 lbs.

Reply: The concern with bumper force is prevention of injury to personnel. The intent of para. 8.10.4 is to restrict the forces exerted by the bumper to no more than 8 lbs. throughout the travel range.

Interpretation: 5-6R

Subject: ASME/ANSI B56.5-1988

Date Issued: March 25, 1993

Question: With regard to para. 8.10.4, which interpretation, if either, is correct: (1) The force to *activate* the bumper *only* should not be greater than 8 lbs. (2) The total force applied by the bumper to the obstruction should never exceed 8 lbs.

Reply: Statement (1) is a correct interpretation of the Standard. Statement (2) is not currently addressed by the Standard. The subject is currently under consideration by the Subcommittee.

Interpretation: 5-7

Subject: ASME/ANSI B56.5-1988

Date Issued: September 14, 1992

Question (1): With regard to para. 8.17.1(a), why is it necessary to have this labeling on an automated vehicle?

Reply (1): Some automated speed control systems do not operate in a regenerative mode (e.g. down a ramp) which can result in vehicle run-away.

Question (2): With regard to para. 8.17.1(a), are fixed grades of less than 6% considered "ramp" operations?

Reply (2): Ramps for automated vehicle applications are defined in para. 8.7.3(a) which states: "Definition: A variation in floor grade in excess of 3% and of a length where rating data variance is required shall constitute a ramp."

Question (3): With regard to para. 8.17.1(a), do vehicles manufactured in 1982 and installed in 1989 require the MAX GRADE labeling?

Reply (3): The only applicable document at the time of manufacture was ANSI B56.5-1978 Electric Guided Industrial Tow Tractors.

Question (4): If the answer to (3) is yes, then without the manufacturer available, who is qualified to test the vehicles for safe grade capability?

Reply (4): Safe grade capability can be determined only by someone having sufficient design data to perform a conclusive evaluation.

Question (5): With regard to para. 8.17.1(a), what would the test be to determine safe grade capability?

Reply (5): Safe grade capability is design dependent and can be influenced by multiple application factors which include, but are not limited to: load weight, load center of gravity, speed, turn radius, slope, and duration of grade. There is no single or simple test to determine safe grade capability for automated guided vehicles.



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