# ASME B56.5-2004

(Revision of ASME B56.5-1993)

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

AN AMERICAN NATIONAL STANDARD



The American Society of Mechanical Engineers

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

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# CONTENTS


Foreword ..... iv
Committee Roster ..... v
B56 Series Introduction ..... vi
Summary of Changes ..... viii

**Part I Introduction** ..... 1
1 Scope ..... 1
2 Purpose ..... 1
3 Interpretation ..... 1

**Part II For the User** ..... 3
4 General Safety Practices ..... 3
5 Installation ..... 4
6 Operation ..... 5
7 Maintenance ..... 5

**Part III For the Manufacturer** ..... 7
8 Design and Construction Standards ..... 7

**Part IV Automated Functions of Manned Industrial Vehicles** ..... 12
9 Manufacturer and User Practices ..... 12

**Mandatory Appendices**
I References ..... 15
II Glossary of Commonly Used Words and Phrases ..... 16




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(04)

# FOREWORD

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 came 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 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.

The 2004 edition incorporates changes made in the ASME B56.5a-1994 supplement, as well as additional revisions. It was approved for issuance as an American National Standard on February 23, 2004.

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.



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# 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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**S. J. Simpson,** *Vice Chair*
**R. Mohamed,** *Secretary*

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# POWERED AND NONPOWERED INDUSTRIAL TRUCKS

(04)

# B56 SERIES INTRODUCTION

## 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.

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 and Automated Functions of Manned Industrial Vehicles
B56.6 Rough Terrain Forklift 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
B56.11.4 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
B56.11.7 Liquefied Petroleum Gas (LPG) Fuel Cylinders (Horizontal or Vertical) Mounting — Liquid Withdrawal — for 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)

B56 volumes that have been withdrawn:

B56.7 Industrial Crane Trucks
B56.11.3 Load Handling Symbols for Powered Industrial Trucks
3287 Powered Industrial Trucks: Symbols for Operator Controls and Others Displays

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 Standards, especially those based on actual experience in their



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application, shall be submitted to the Secretary of the B56 Committee, American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990.

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).



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# ASME B56.5-2004
# SUMMARY OF CHANGES

Following approval by the ASME B56 Committee and ASME, and after public review, ASME B56.5 was approved by the American National Standards Institute on February 23, 2004. ASME B56.5-2004 includes all revisions and corrections introduced in ASME B56.5a-1994 as well as the following changes, identified by **(04)**:

| *Page* | *Location* | *Change* |
|---|---|---|
| iv | Foreword | Revised |
| vi | Introduction | Editorially revised |
| 1 | 1 | First para. revised |
| 2 | 3.4 | Revised in its entirety |
| 3 | 4.2 | Revised in its entirety |
| 9 | 8.10 | (1) Paragraph 8.10.3 revised in its entirety<br>(2) Paragraph 8.10.4 revised and redesignated as 8.10.3.1 |
| 12 | 9.2.7 | Added |
| 15 | Mandatory Appendix I | Revised |
| 16 | Mandatory Appendix II | Definitions for *alteration* and *modification* added |

## SPECIAL NOTE

The Interpretations to ASME B56.5 are included at the end of this edition as a separate section for the user's convenience. The interpretations are not part of this edition or of the standard itself.



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

# Part I
# Introduction

## (04) 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. It also applies to vehicles originally designed to operate exclusively in a manned mode but which are subsequently modified to operate in an unmanned, automatic mode, or in a semiautomatic, manual, or maintenance mode.

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.

## 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. The 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 International, Three Park Avenue, New York, NY 10016. 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



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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.

### (04) 3.4 Metric Conversions

The values stated in metric units are to be regarded as the standard. U.S. Customary units are maintained in the Users Section (in parenthesis) as information for those not familiar with metric units. The conversion to U.S. Customary is a direct (hard) conversion from the SI units.



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# 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.

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

### (04) 4.2 Modifications, Nameplates, Markings, Capacity, and Stability

**4.2.1** Except as provided in para. 4.2.2, no modifications or alterations to a guided industrial vehicle, which may affect the capacity, stability, or safe operation of the vehicle, shall be made without the prior written approval of the original vehicle manufacturer or its successor thereof. When the vehicle manufacturer or its successor approve a modification or alteration, appropriate changes shall be made to capacity plates, decals, tags, and operation and maintenance manuals.

**4.2.2** In the event that the vehicle manufacturer is no longer in business and there is no successor in interest to the business, the user may arrange for a modification or alteration to a guided industrial vehicle, provided however, the user shall

*(a)* arrange for modification or alteration to be designed, tested, and implemented by an engineer(s) expert in guided industrial vehicles and their safety;

*(b)* maintain a permanent record of the design, test(s), and implementation of the modification or alteration;

*(c)* make appropriate changes to the capacity plate(s), decals, tags, and operation and maintenance manuals; and

*(d)* affix a permanent and readily visible label on the vehicle stating the manner in which the vehicle has been modified or altered together with the date of the modification or alteration, and the name of the organization that accomplished the tasks.

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

**4.2.4** 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.

**4.2.5** The user shall consider that changes in load(s), load position(s), or dimension(s), coupling types(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.

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

**4.2.7** 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



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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 manuevering.

**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 450 mm (1.5 ft) 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 closing 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) Nonemergency 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 Nonemergency 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.



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**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 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



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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 maintenace of equipment.

### 7.4 Documentation of Maintenance Activities

Records of maintenance activities performed should be kept.



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# Part III
# For the Manufacturer

## 8 DESIGN AND CONSTRUCTION STANDARDS

### 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 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)* the test cycle is made up of the following:

*(a)* one 61 m run with trailer load as per para. 8.2.5(a)(2)

*(b)* one 61 m run with trailer load as per para. 8.2.5(a)(3)

*(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

*(b)* In addition to the test in para. 8.2.5(b), 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 61 m run carrying full rated load

*(b)* one 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:



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*(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 drawbar 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 capcity, and nominal voltage.

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

*(i)* rated speed (speed of vehicle for purpose of rating).

*(j)* if nonbattery-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 75 mm when using an external guidance reference (e.g., guide wire) or by more than 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 300 mm, the stability requirements of ASME B56.1 shall apply. For vehicles with lift of 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 stopped, 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.



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### 8.9 Warning Devices

**8.9.1** Prior to initiation of vehicle movement or remote reactivition 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.

### (04) 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

**8.10.3.1 Bumpers.** If used as an emergency sensing device, a bumper shall be fail-safe in its operation and mounting and shall not exert a force greater than 134 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.

**8.10.3.2 Noncontact Sensing Devices.** If used as the primary emergency device, such device shall be fail-safe in its operation and mounting and shall stop the vehicle travel prior to contact between the vehicle structure and the object detected.

**8.10.3.2.1 Test Pieces.** The following test pieces shall be detected in the main direction of travel:

*(a)* a test piece with a diameter of 200 mm and a length of 600 mm lying at any angle to and anywhere on the path of the vehicle. For maximum activation force, see para. 8.10.3.1.

*(b)* a test piece with a diameter of 70 mm and a height of 400 mm set vertically anywhere fully within the path of the vehicle. For maximum activation force, see para. 8.10.3.1.

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

### 8.11 Vehicle Nonemergency Controls and Devices

**8.11.1 Vehicle Nonemergency Devices.** When actuated, vehicle nonemergency 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



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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 nonemergency sensing devices, bumpers shall not exert a force greater than 134 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.

*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 required 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 38 mm high.

*(b)* Vehicles capable of fully automatice operation shall have a label clearly visible, that states, CAUTION: AUTOMATIC VEHICLE, in letters at least 38 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 38 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.



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**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 batteries and tray exceeding 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)* 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.

## 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 troublshooting 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.



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# Part IV
# Automated Functions of Manned Industrial Vehicles

## 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 Modification, 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 positions(s) or dimensions(s), coupling types(s) or positions(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).

**9.2.7 Multivehicle Systems.** The manufacturer of the fully automated vehicles and the user shall consider the potential hazards of mixed vehicle traffic, where fully automated vehicles interface in a system where manned and/or partially automated manned vehicles are also operating. Some examples of these areas are, but not limited to, aisles, passageways, intersections, and doorways. **(04)**

### 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.



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### 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 describe 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 equipment.

*(e)* other pertinent information to operate and maintain reliability of all the system equipment.



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# MANDATORY APPENDIX I
# REFERENCES

(04)

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 B56.1-2000 including B56.1a-2001, Safety Standard for Low Lift and High Lift Trucks

ASME B56.8-1993 including B56.8a-1994, Safety Standard for Personnel and Burden Carriers

ASME B56.9a-1992, Safety Standard for Operator Controlled Industrial Tow Tractors

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

ANSI/NFPA 505-1992, Fire Safety Standard for Powered Industrial Trucks — Type Designations, Areas of Use, Maintenance, and Operation

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269

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

Publisher: American National Standards Institute, Inc. (ANSI), 25 West 43rd Street, New York, NY 10036

The following are related documents:

ANSI/NFPA 30-1993, Flammable and Combustible Liquids Code

ANSI/NFPA 58-1992, Storage and Handling of Liquefied Petroleum Gasses

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269

ANSI/IES RP7-1990, Practice for Industrial Lighting (not a safety standard)

ANSI Z94.0-1989, Terminology (not a safety standard)

ANSI Z535.1-1998, Safety Color Code

ANSI Z535.2-1998, Environmental and Facility Safety Signs

ANSI Z535.3-1998, Criteria for Safety Symbols

ANSI Z535.4-1998, Product Safety Signs and Labels

Publisher: American National Standards Institute, Inc. (ANSI), 25 West 43rd Street, New York, NY 10036



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(04)

# MANDATORY APPENDIX II
# GLOSSARY OF COMMONLY USED WORDS AND PHRASES

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

*alteration:* any change to equipment, including its parts, components, and/or subsystems, other than maintenance, repair, or replacement.

*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 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, when moving a load at a uniform rate.

*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.

*modification:* see *alteration*.

*nonrestricted area:* area in which the guidepath is installed which is shared with personnel.

*passenger:* a person who 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 by extensive knowledge, training, and experience, has sucessfully 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.



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*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.*



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# ASME B56.5 INTERPRETATIONS

## Replies to Technical Inquiries
## July 2002 through September 2004

### FOREWORD

This publication includes all 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 and Automated Functions of Manned 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.

The 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.



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**Interpretation: 5-9**

Subject: ASME B56.5-1993; para. 8.10, Vehicle Emergency Controls and Devices

Date Issued: July 2, 2002

Question: Does a programmed emergency stop, meeting the requirements of ASME B56.5-1993, para. 8.10, Vehicle Emergency Controls and Devices and para. 8.10.4, Bumpers meet the requirements of an emergency stop?

Reply: A programmed emergency stop cannot exist by definition. Appendix II of B56.5 defines "emergency stop" as "one that occurs for unprogrammed events such as vehicle contact with an object or person through sensors or an emergency button on the vehicle." Programmed stops are covered by the provisions of para. 8.11.

**Interpretation: 5-10**

Subject: ASME B56.5a-1994, para. 1, Scope

Date Issued: July 2, 2002

Question: Does the scope of B56.5 include an unmanned, self-propelled vehicle that is designed to move materials where both the drive and the nondriven axles are fitted with flanged wheels? These flanged wheels ride on standard 105 LB rails that are anchored to the floor.

Reply: No. The scope specifically identifies the standard as not being applicable to mechanically restrained vehicles. The product described is mechanically restrained as to guide path.

The standard may be used as guidance for determining safety aspects of the system and for operation and maintenance, but it is not a controlling standard for this industrial vehicle.

**Interpretation: 5-11**

Subject: ASME B56.5-1993, paras. 8.4.2, 8.7.4, 8.14.1, Design and Construction

Date Issued: September 16, 2004

Question: Part III, Section 8, of ASME B56.5 pertains to the design and construction of "unmanned guided industrial vehicles." ASME B56.5, paras. 8.4.2, 8.7.4, and 8.14.1 all make reference to ASME B56.8. This appears to be a conflict. From Part I, Section 1 of ASME B56.8, the last sentence states that "unmanned automatic guided vehicles" are not included in ASME B56.8. Please clarify this conflict for unmanned automatic guided vehicles being designed under Part III, Section 8 of ASME B56.5. Does the design also need to meet the applicable requirements of ASME B56.8 when this Standard states they do not?

Reply: The provisions of B56.8 are required as specified in B56.5 for a burden carrier-type AGV.

The B56.5 standard recognizes that there are styles of AGV's that include, but are not limited to, burden-carrying products. The committee responsible for the standard realized the need for some of the same requirements identified in the various truck type standards. They also recognized that the real expertise for things such as stability, rested with the subcommittees for these other truck types. Therefore, rather than repeat the requirements in the B56.5 standard, and run the risk of being out of step with potential change by the other subcommittee, they referenced the other truck type standards stating that those requirements must be met as well as those in B56.5. So while, for instance, the scope of B56.8 states that AGV's are not covered by that standard, the B56.5 states that for a burden carrier-type AGV, both B56.5 and the referenced sections of B56.8 are applicable.



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