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(R) Light Utility Vehicles**Foreword**

This Standard has been formulated with the SAE as sponsor in accordance with the accepted practice and procedures of the SAE and the following scope. Establishment of the requirements relating to the elements of design, operation, and maintenance; also, the standardization relating to principal dimensions to facilitate test methods and test procedures of Light Utility Vehicles.

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

If adopted for governmental use, references to other national standards may be changed to refer to the corresponding governmental regulations. A second purpose of this standard is to provide design and performance requirements to aid in minimizing accidents and injuries associated with the operation and maintenance of Light Utility Vehicles.

The use of light utility vehicles is subject to certain hazards that cannot be eliminated by mechanical means, but only by the exercise of intelligence, care, and common sense. It is therefore essential to have competent and careful operators, who are not physically or mentally impaired, thoroughly trained in the safe operation of the equipment and the handling of the loads. It is recommended that the operator be capable of obtaining a valid motor vehicle operator's license. Serious hazards include, but are not limited to, hillside operation, overloading, instability of the load, oversize loads, poor maintenance, and using equipment for a purpose for which it was not intended or designed.

1. Scope

This SAE Standard defines requirements relating to the elements of design, operation, and maintenance of light utility vehicles. The safety specifications in this document apply to any self-propelled, operator-controlled, off-highway vehicle 1828 mm (72 in) or less in overall width, exclusive of added accessories and attachments, operable on three or more wheels, primarily intended to transport material loads or people, with a gross vehicle weight of 2500 kg (5500 lb) or less, and a maximum design speed less than 40 km/h (25 mph).

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This document is not intended to cover all terrain vehicles (ATVs) complying with ANSI/SVIA 1, American National Standard for Four Wheel All-Terrain Vehicles — equipment, configuration, and performance requirements.

1.1 Purpose and Effective Date

The purpose of this document is to promote safety in the design, application, operation, and maintenance of light utility vehicles. This document may be used as a guide by governmental authorities desiring to formulate safety rules and regulations. This document is also intended for voluntary use by others associated with manufacturing or utilizing light utility vehicles.

1.2 Effective Date

The effective date for this document is the date of publication.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. The following publications and standards contain provisions, which through reference in this text constitute provisions of this SAE Standard. At the time of publication of this standard, the contents of the published editions of the indicated references were recognized as being valid and applicable. All standards are subject to revision, and parties are encouraged to investigate the possibility of applying the most recent editions of the standards referenced below. The latest issue of SAE Publications shall apply.

2.1.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, www.sae.org.

SAE J115—Safety Signs
SAE J114—Seat belt webbing abrasion
SAE J140—Seat belt hardware test procedures
SAE J141—Seat belt hardware performance requirements
SAE J339—Seat belt hardware webbing abrasion test procedure
SAE J383—Motor Vehicle seat belt anchorages, design recommendations
SAE J384—Motor Vehicle seat belt anchorages, test procedure
SAE J843—Brake System Road Test Code-Passenger Car and Light-Duty Truck
SAE J1718—Measurement procedure for Hydrogen gas emissions
SAE J585—Tail Lamps (Rear position lamps)
SAE J586—Stop Lamps
SAE J588—Turn Signal Lamps
SAE J594—Reflex Reflectors
SAE J592—Clearance, Side Marker, and Identification Lamps
SAE J1105—Horn
SAE J268—Mirrors

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2.1.2 ACGIH PUBLICATION

Available from American Conference of Governmental Industrial Hygienists, ACGIH®, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240, USA. www.acgih.org.

2003 TLVs® and BEIs® ACGIH® Publication #0103, ISBN: 1-882417-49-6

2.1.3 ANSI PUBLICATIONS

Available from American National Standards Institute, ANSI, 25 West 43rd Street, New York, NY 10036-8002, www.ansi.org.

ANSI Z535.3—Criteria for Safety Symbols
ANSI Z535.4—Product Safety Signs and Labels

2.1.4 ISO PUBLICATIONS

Available from American National Standards Institute, ANSI, 25 West 43rd Street, New York, NY 10036-8002, www.ansi.org.

ISO 1044—Industrial Trucks - Lead Acid Traction Batteries for Electric Trucks - Preferred Voltages
ISO 3287—Powered Industrial Trucks, Control Symbols
ISO 3691—Powered Industrial Trucks - Safety Code
ISO 11684—Tractors, Machinery for Agriculture and Forestry, Powered Lawn and Garden Equipment - Safety Signs and Hazard Pictorials

2.1.5 NASA PUBLICATION

Available from National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

Anthropometric Sourcebook, Vol. 1, Anthropometry for Designers, NASA RP-1024, (NTIS N7911734), www.ntis.gov.

2.1.6 NFPA PUBLICATIONS

Available from National Fire Protection Association, NFPA, 1 Batterymarch Park, Quincy, Massachusetts USA 02169-7471, www.nfpa.org.

NFPA 30—Flammable and Combustible Liquids Code
NFPA 58—Storage and Handling of Liquefied Petroleum Gases
NFPA 505—Fire Safety & Standard for Powered Industrial Trucks-Type Designations, Areas of Use, Maintenance and Operation

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2.1.7 SVIA PUBLICATION

Available from Specialty Vehicle Industry of America, 2 Jenner Street, Suite 150, Irvine, CA 92618-3812.

SVIA 1 - Four Wheel All Terrain Vehicles- Equipment, Configuration, & Performance, www.svia.org.

2.1.8 UNDERWRITER LABORATORIES PUBLICATIONS

Available from COMM 2000 1414 Brook Drive, Downers Grove, IL 60515, www.comm-2000.com.

UL 558—Standard for Safety for Internal-Combustion-Engine-Powered Industrial Trucks

UL 583—Standard for Safety for Electronic-Battery-Powered Industrial Trucks

3. Part I—Interpretation, Terms and Definitions for Light Utility Vehicles

3.1 Interpretation and Definitions

3.1.1 MANDATORY AND ADVISORY RULES—To carry out the provisions of this document, the word shall is to be understood as mandatory and the word should as recommended.

3.1.2 TERMS—For purposes of this document, the term vehicle shall mean light utility vehicle.

3.1.3 DEFINITIONS

3.1.3.1 *Accelerator*—A device that controls the speed of a vehicle.

3.1.3.2 *Accessory*—Light utility manufacturer approved device installation on a vehicle (i.e., tire chains, lights, canopy, cab, etc.) to enhance its utility or appearance (exclusive of attachment).

3.1.3.3 *Approved Vehicle*—A vehicle that is listed or approved for fire safety purposes for the intended use by a nationally recognized testing laboratory (e.g., Underwriters Laboratories; Factory Mutual Engineering Corp.) using nationally recognized testing standards.

3.1.3.4 *Attachment*—Components designed primarily to perform a specific task and for mounting on a specific machine, utilizing the machine's power and control system. These attachments may be detachable, but are not intended to be universally adaptable to other machines (i.e., top dresser, spreader, etc.).

3.1.3.5 *Battery—Electric Vehicle*—An electric vehicle in which the power source is a storage battery(s).

3.1.3.6 *Body Restraint*—A hand hold or combination hand hold/hip restraint, anchored securely to the body or seat platform of the vehicle creating a barrier to help prevent an occupant from sliding outside of the vehicle.

3.1.3.7 *Center of Gravity (of Test Load)*—That point at which the load mass is concentrated. It is located horizontally in the center of the load-bearing surface, and vertically by its distance above the load-bearing surface.

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- 3.1.3.8 *Charged Battery*—A battery discharged to 1.75 V per cell or less, then charged until a specific gravity reading as recommended by the battery manufacturer is achieved within a tolerance of ± 0.05 specific gravity with an electrolyte temperature of $26.5\text{ }^{\circ}\text{C} \pm 0.3\text{ }^{\circ}\text{C}$ ($80\text{ }^{\circ}\text{F} \pm 0.5\text{ }^{\circ}\text{F}$).
- 3.1.3.9 *Controlling Party*—The person(s) or organization(s) responsible for the operation and maintenance of a vehicle.
- 3.1.3.10 *Electric Vehicle*—A vehicle in which the principal energy is transmitted from power sources to motor(s) in the form of electricity.
- 3.1.3.11 *Gross Vehicle Weight (GVW)*—Maximum stated weight including operating weight, material load, personnel, options, accessories, and attachments.
- 3.1.3.12 *Hand Hold*—A readily accessible device mounted securely to the vehicle that can be encircled by the fingers of one hand for the purpose of holding on. A hand hold can also function as a body restraint.
- 3.1.3.13 *Material Load*—Weight and dimension of material to be carried, excluding personnel.
- 3.1.3.14 *Occupant Protective Structure*—A structure that provides a crush protective environment for the occupants in the event of a vehicle tip-over (rotation of 90 degrees or more about the vehicle's lateral or longitudinal axis) or roll-over (rotation of 180 degrees or more about the vehicle's lateral or longitudinal axis)
- 3.1.3.15 *Occupant Protective System*—The occupant protective structure, seat belt assemblies, and may include passive restraints.
- 3.1.3.16 *Off Road*—Un-improved terrain. Surfaces which may or may not be modified by the elimination of obstructions and depressions, but not necessarily having a compaction resistance suitable to support motorized vehicles.
- 3.1.3.17 *Operating Weight*—Weight of vehicle with full fuel load, without material load or personnel load.
- 3.1.3.18 *Operator*—Trained and authorized person who controls any function of the light utility vehicle.
- 3.1.3.19 *Operator's Seat*—The seat located directly behind the steering wheel.
- 3.1.3.20 *Options*—Selectable components necessary to complete vehicle assembly (i.e., tires, batteries, etc.)

3.1.3.21 *Parking Brake*—A device to prevent the movement of a stationary vehicle.

3.1.3.22 *Rated Capacity*—The total weight of material load and personnel load for a vehicle. The total personnel load for personnel vehicles.

3.1.3.23 *Service Brake*—A device designed to bring a moving vehicle to a stop.

3.1.3.24 *Test Load*—Weight that can be added to the vehicle when combined with operating weight and those accessories and options that create the least stable condition not to exceed GVW.

- a. $GVW = FIXED + VARIABLE$
- b. $FIXED = \text{Vehicle operating weight} + \text{Operator weight}$
- c. $VARIABLE = (\text{Passenger} + \text{Option} + \text{Accessory}) \text{ weight(s)} + \text{Load weight(s)}$

3.1.3.25 *Test Vehicle*—Unless otherwise stated, the test vehicle shall conform to the Manufacturer's specifications for optimum performance. All optional and accessory items offered by the manufacturer shall be considered in performing each test, which shall be conducted with optional and accessory items installed, or not installed, so as to create the most severe test conditions.

3.1.3.26 *Travel Control*—Devices that control the speed, braking, forward, and reverse direction of the vehicle.

4. Part II—For the Controlling Party

See Appendix B.

5. Operating Safety Rules and Practices

See Appendix B.

6. Maintenance Practices

See Appendix B.

7. Part III—For the Manufacturer—Design and Construction Standards

7.1 Introduction

7.1.1 Part III sets forth safety standards for vehicles at the time of manufacture.

7.2 Nameplates, Markings, and Instructions

- 7.2.1 On every vehicle, the manufacturer shall install permanent marking(s), with the following information:
- Serial Number
 - Approximate operating weight of the vehicle without accessories or attachments in kilograms (kg), pounds (lb), or both
 - Designation of compliance with the mandatory requirements of this document
 - Type designation if in conformance with ANSI/NFPA 505 and either ANSI/UL 583 or ANSI/UL 558
 - Gross vehicle weight (G.V.W.)
- 7.2.2 Where applicable, marking authorized by an appropriate nationally recognized testing laboratory may be installed on approved vehicles.
- 7.2.3 On battery-electric vehicles, the nameplate shall also show:
- The minimum and maximum service weights of battery (s) and tray if used.
 - Nominal voltage for which the vehicle is designed. For recommended voltages, see ISO 1044.
- 7.2.4 For batteries in a lift-out tray with total combined service weight of batteries and tray exceeding 45 kg (100 lb) or, the maximum combined weight of the batteries and tray shall be legibly identified on the battery tray near the lifting means with the information shown in Figure 1:



FIGURE 1—MARKING FOR LIFT-OUT BATTERY TRAY

- 7.2.5 Each vehicle shall be supplied with a vehicle operator's manual furnished by the manufacturer. This manual shall contain instructions for setup, assembly, safe and proper operation, and routine service (separate set-up and assembly manuals are acceptable). Operator's Manuals should include, but not be limited to, information contained in Sections 4, 5, and 6 where applicable.
- 7.2.6 Product Safety Signs and Labels should be used for hazard identification in accordance with either ANSI Z535.4 or ISO 11684 or SAE J115.
- 7.2.7 Universal symbols for operator controls and other displays should be in accordance with ISO 3287.

7.3 General Requirements

- 7.3.1 The operator and passengers, in the normal operating position, shall be protected from parts of the vehicle that represent a hazard.
- 7.3.2 Vehicles shall be provided with seat(s) and body restraints (see 7.3.4) for each intended rider position.
- 7.3.3 Operator and passenger stations shall accommodate the 5th to 95th percentile man, as per the National Aeronautics and Space Administration (NASA) publication, "Anthropometric Sourcebook, Vol. I, Anthropometry for Designers," and shall be within the plan view outline of the vehicle.
- 7.3.4 A handhold shall be provided for the operator and each passenger. A steering wheel or two-hand tiller shall be considered a handhold for the operator. A handhold shall be provided for each additional intended passenger and placed in such a manner that when grasping the handhold, the occupant's hands shall be within the plan view outline of the vehicle.
- 7.3.5 The operator and passengers in the normal operating position shall be protected from particles thrown by the tires and wheels.
- 7.3.6 OCCUPANT PROTECTIVE SYSTEMS (OPS)
- 7.3.6.1 Occupant Protective Structures and seat belt assemblies shall be provided with Light Utility Vehicles that can be so configured and loaded per the manufacturer's recommendations such that the maximum operation speed (as determined per 7.7) and the lateral stability (as determined per 7.8) fall within the area defined on Figure 2a as "OPS Required".
- 7.3.6.2 Seat belts shall not be installed on Light Utility Vehicles unless they have Occupant Protection Structures.
- 7.3.6.3 Light Utility Vehicles fitted with seat belt assemblies shall conform to the following standards: SAE J114, SAE J140, SAE J141, and SAE J339. Seat belt geometry shall conform to SAE J383, and meet the test requirements of SAE J384.
- 7.3.6.4 Each seat belt anchorage shall be capable of withstanding a static tensile force of 2224 N (494 lb) at 45 degrees to the horizontal. Where suspension seats are used, the seat belt assemblies shall accommodate the ride motion of the occupants. If seat belt assemblies are attached to the seats, the seat mounting shall be capable of withstanding this force, plus a force equal to four times the force of gravity, on the mass of all applicable seat components applied 45 degrees to the horizontal in a forward and upward direction.
- 7.3.6.5 Occupant Protection Structures shall meet the requirements of Roof Crush Resistance as stated in the following sections.

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- 7.3.6.5.1 Requirements—A test device as described in 7.3.6.5.2 shall not move more than 127 mm (5 in), measured in accordance with 7.3.6.5.3.4, when it is used to apply a force of 1.5 times the unloaded vehicle weight of the vehicle or 2268 kg (5000 lb) whichever is less, to either side of the forward edge of the vehicle's roof in accordance with the procedures of 7.3.6.5.3. Both the left and right front portions of the vehicle's roof structure shall be capable of meeting the requirements, but a particular vehicle need not meet further requirements after being tested at one location.
- 7.3.6.5.2 Test Device—The test device is a rigid unyielding block with its lower surface formed as a flat rectangle 762 mm x 1829 mm (30 inches x 72 inches).
- 7.3.6.5.3 Test Procedure—Each vehicle shall be capable of meeting the requirements of 7.3.6.5.1 when tested in accordance with the following procedure.
- 7.3.6.5.3.1 Place the chassis frame of the vehicle on a rigid horizontal surface, fix the vehicle rigidly in position, close all windows, close and lock all doors, and secure any convertible top or removable roof structure in place over the passenger compartment.
- 7.3.6.5.3.2 Orient the test device as shown in Figure 2b, so that:
- Its longitudinal axis is at a forward angle (side view) of 5 degrees below the horizontal, and is parallel to the vertical plane through the vehicle's longitudinal centerline;
 - Its lateral axis is at a lateral outboard angle, in front view projection, of 25 degrees below the horizontal;
 - Its lower surface is tangent to the surface of the vehicle; and
 - The initial contact point, or center of the initial contact area, is on the longitudinal centerline of the lower surface of the test device and 254 mm (10 inches) from the forward-most point of that centerline.

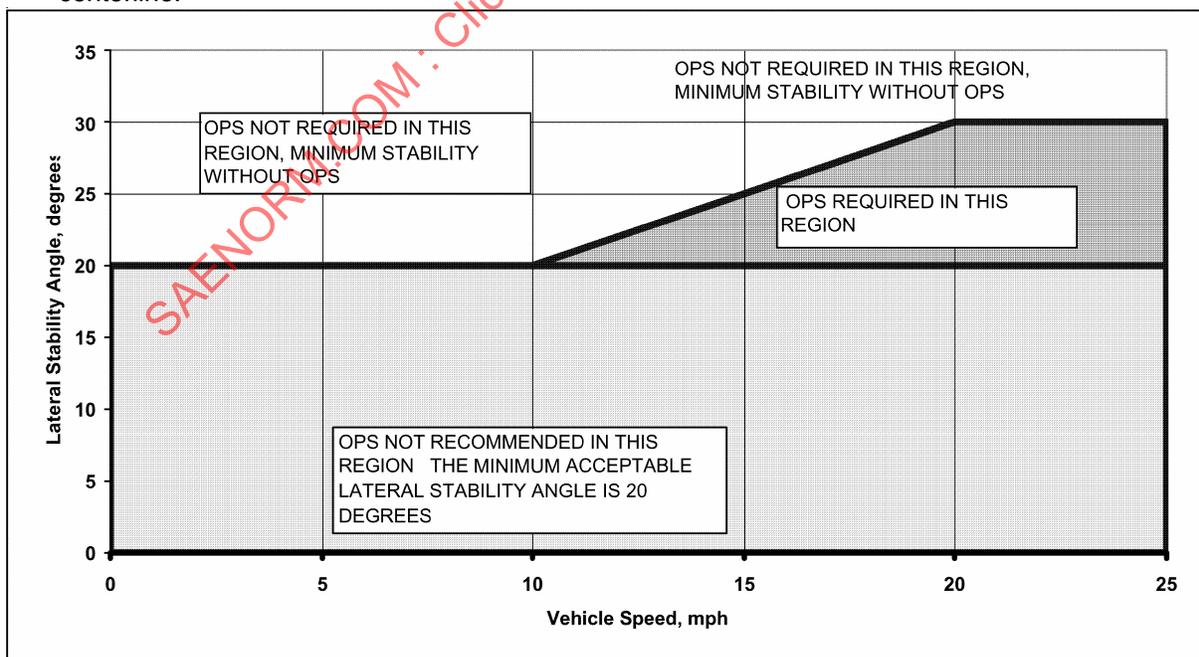


FIGURE 2—VEHICLE LATERAL STABILITY VERSUS SPEED

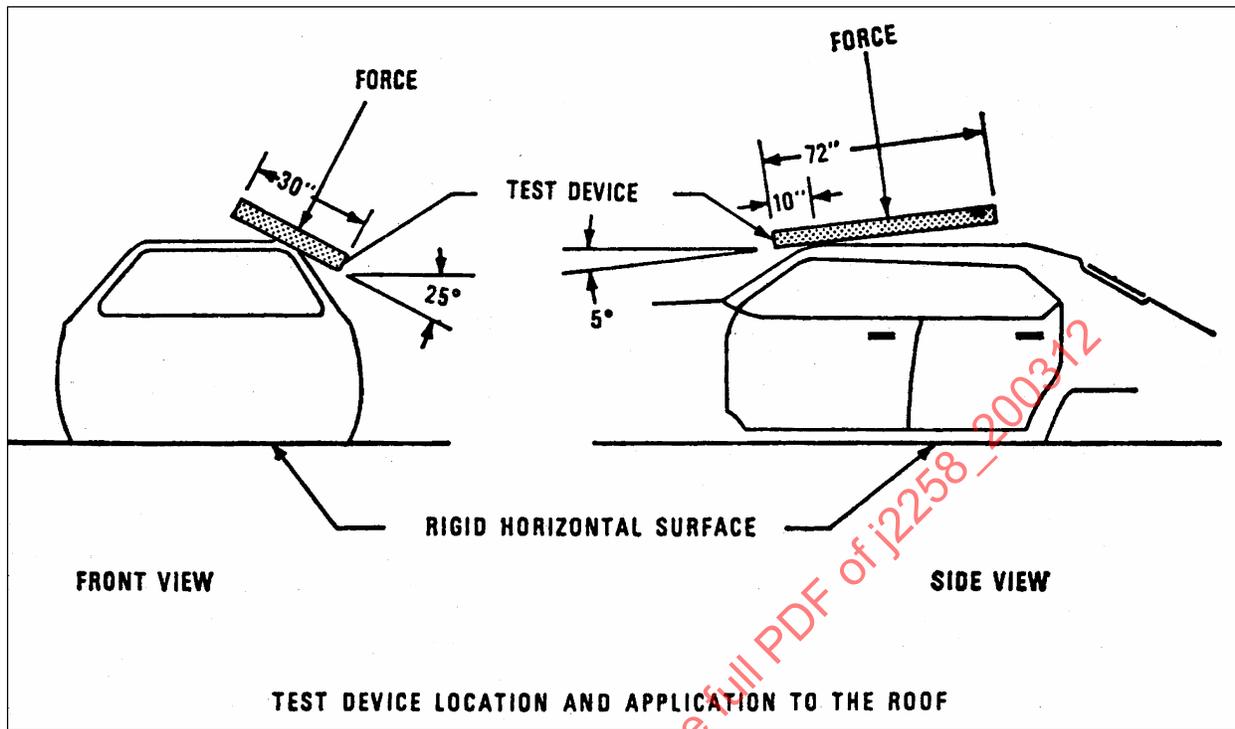


FIGURE 2B—TEST DEVICE FOR OPERATOR PROTECTIVE STRUCTURE

- 7.3.6.5.3.3 Apply force in a downward direction perpendicular to the lower surface of the test device at a rate of not more than one-half inch per second until reaching a force of 1.5 times the unloaded vehicle weight of the tested vehicle or 2268 kg (5000 lb), whichever is less. Complete the test within 120 seconds. Guide the test device so that throughout the test it moves, without rotation, in a straight line with its lower surface oriented as specified in 7.3.6.5.3.2a through 7.3.6.5.3.2d.
- 7.3.6.5.3.4 Measure the distance that the test device moves, i.e., the distance between the original location of the lower surface of the test device and its location as the force level specified in 7.3.6.5.3.3 is reached.

7.4 Steering

- 7.4.1 Vehicles employing a hand wheel or a horizontal lever (horizontal motion) or a tiller bar for steering control shall have such controls designed so the vehicle will respond as follows when moving in a forward direction: movement of the steering control in a clockwise direction shall steer the vehicle to the operator's right.
- 7.4.2 All steering controls shall be confined within the plan view outline of the vehicle or provided with guards that protect against injury to the operator and passengers during movement of the controls.

7.5 Controls

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- 7.5.1 Vehicle speed control shall increase speed when moving the control downward or forward or both.
- 7.5.2 Service brakes, if foot operated, shall be energized by moving the control downward or forward or both. Hand-operated service brakes shall be energized by moving control upward, or rearward, or both.
- 7.5.3 If a single foot pedal controls both acceleration and deceleration, depressing the pedal shall increase speed and releasing the pedal shall decrease speed.
- 7.5.4 A device shall be provided to prevent unauthorized operation of the vehicle.
- 7.5.5 Direction control shall be clearly and durably marked indicating forward and reverse directions.
- 7.5.6 A parking brake shall be provided.
- 7.5.7 Control pedals and control platforms shall have skid resistant surfaces.

7.6 Lighting and Marking

- 7.6.1 HEAD LAMPS—If so equipped, two (2) headlamps shall be mounted on the front of the vehicle and disposed symmetrically about the centerline and separated as far apart as practicable. They should be mounted no less than 381 mm (15 inches) no more than 1270 mm (50 inches) above the ground. See Tables 1 and 2. It is recommended that each lamp be a single low beam or high/low beam and comply with the requirements of either Table 1 or 2. Alternative head lamp configurations that provide lighting equivalent to two (2) of the aforementioned head lamps will be acceptable. Provision may be made for the lamps to be adjusted.
- 7.6.2 BEAM AIM FOR PHOTOMETRY—A head lamp unit that has both high beam and low beam shall be aimed by positioning the high intensity zone of the high beam at ½ degree down-vertical. The beam shall be centered by photoelectrically balancing the points, 6 degree left and 6 degrees right. The lamp shall comply with Tables 1 and 2.

A head lamp unit having only a single beam shall be aimed with the top cut-off of the beam at horizontal and centered by balancing the points 6 degree left and 6 degree right. The lamp shall comply with Table II.

TABLE 1—UPPER BEAM ⁽¹⁾⁽²⁾

Test Point (degrees)	Intensity (cd)
H-V	2000 min
1/2 degree D-V	5000 min
1/2 degree D- 3 degree R - 3 degree L	3000 min
1/2 degree D- 6 degree R - 6 degree L	1000 min
2 degree D-V	2500 min
3 degree D-V	1500 min
3 degree D- 6 degree R- 6 degree L	750 min
4 degree D-V	5000 min

TABLE 2—LOWER BEAM ⁽¹⁾⁽²⁾

Test Point (degrees)	Intensity (cd)
1/2 degree V - and above	2000 max
2 degree D-V	3000 min

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3 degree D- 4 degree R- 4 degree L	1500 min
3 degree D- 6 degree R- 6 degree L	750

- 7.6.3 TAIL LAMPS—If so equipped, tail lamp(s) should be mounted on the rear of the vehicle. If two (2) tail lamps are used, they shall be disposed symmetrically about the centerline and as far apart as practicable. They should be mounted no less than 381 mm (15 inches) nor more than 1524 mm (60 inches) above the ground. Tail lamps shall be illuminated when the headlamps are energized. Each lamp should comply with the requirements of SAE J585.
- 7.6.4 STOP LAMPS—If so equipped, stop lamp(s) should be mounted on the rear of the vehicle. If two (2) stop lamps are used, they shall be disposed symmetrically about the centerline of the vehicle. They should be mounted no less than 381 mm (15 inches) nor more than 1524 mm (60 inches) above the ground. The stop lamps shall be illuminated by activation of the vehicle service brake. A stop lamp may be combined optically with the tail lamp, and it should comply with requirements of SAE J586.
- 7.6.5 TURN SIGNALS—If so equipped, turn signal lamps should be mounted on the vehicle as follows: two (2) facing to the rear and two (2) facing to the front and as far from the longitudinal centerline of the vehicle as practicable. They should be mounted no less than 381 mm (15 inches) or more than 1524 mm (60 inches) from the ground. A turn signal lamp may be combined optically with the tail lamp and should comply with the requirements of SAE J588.
- 7.6.6 REFLEX REFLECTORS—If so equipped, Reflex reflectors should be mounted on the vehicle as follows: two (2) yellow, mounted (one on each side) as far forward as practicable; two (2) red, mounted (one on each side) as far rearward as practicable. They should be mounted no less than 381 mm (15 inches) nor more than 1524 mm (60 inches) from the ground. Each reflex reflector should comply with the requirements of SAE J594.
- 7.6.7 SIDE MARKER LAMPS—If so equipped, side marker lamps, should be mounted on each side of the vehicle, one (1) yellow as far forward as practicable and one (1) red, as far rearward as practicable. They should be mounted no less than 381 mm (15 inches) nor more than 1524 mm (60 inches) from the ground. Each side marker lamp should comply with the requirements of SAE J592.
- 7.6.8 HORN—If so equipped, the horn activating switch should be mounted so it can be easily activated with a minimum movement of the operator's hand or foot. The horn should comply with the requirements of SAE J1105.
- 7.6.9 MIRRORS—If so equipped, exterior mirrors should incorporate the requirements of SAE J268.

7.7 Speed Tests

7.7.1 TEST CONDITIONS

- Horizontally flat surface, 0.5% grade (0.3 degrees) maximum
- Straight course
- Concrete or asphalt surface of sufficient track length to allow the test vehicle to reach maximum speed before measurements begin
- Concrete or asphalt surface that is dry and free from loose material or surface contamination with a minimum coefficient of friction of 0.8 between tire and surface
- The test vehicle shall be loaded with one operator weighing no less than 77 kg (170 lb) or more

than 82 kg (180 lb)

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7.7.2 TESTS—The vehicle shall be operated in one direction of travel on the test course and then the other. The results shall then be averaged.

NOTE—The vehicle direction of travel selection means must not be changed during the test.

7.7.3 TEST ACCEPTANCE—The maximum average speed from 7.7.2 shall be less than 40 km/h (25 mph).

7.8 Stability Tests

7.8.1 GENERAL TEST CONDITIONS AND REQUIREMENTS

- a. A test platform shall be rigid, flat, and constructed to be an adjustable slope, single plane (tilt table) with a surface finish providing a minimum of 1.0 coefficient of friction. The platform surface shall be large enough to support all wheels of the vehicle to be tested.
- b. Tire inflation on all wheels shall be in accordance with the vehicle manufacturer's minimum specifications or recommendations.
- c. Prior to the addition of test loads, the vehicle to be tested shall be readied to reflect its operating weight and shall include all options and accessory items which, when installed, will decrease the stability of the vehicle.
- d. The test loads shall be placed on each load bed of the vehicle, and secured thereto such that each center of gravity is directly above the geometric center of its load bed. The vehicle shall be weighted in such a manner as to simulate the least favorable speed and stability condition and not to exceed the manufacturer's stated gross vehicle weight. The minimum height of the center of gravity for each test load shall be determined by Figure 3.
- e. A weight, no less than 90 kg (200 lb) or more than 95 kg (211 lb) shall be secured to each seat, representing the operator and each passenger that will decrease the stability of the vehicle. If seats are adjustable, they shall be adjusted to that position representing the least stable condition of stability in each test. The center of gravity of the weight(s) is to be 152 mm (6 in) above the lowest point of the operator supporting surface and 254 mm (10 in) forward of the seat back. If a seat back is not used, then 254 mm (10 in) will be measured from the position of the back of a person when seated normally.

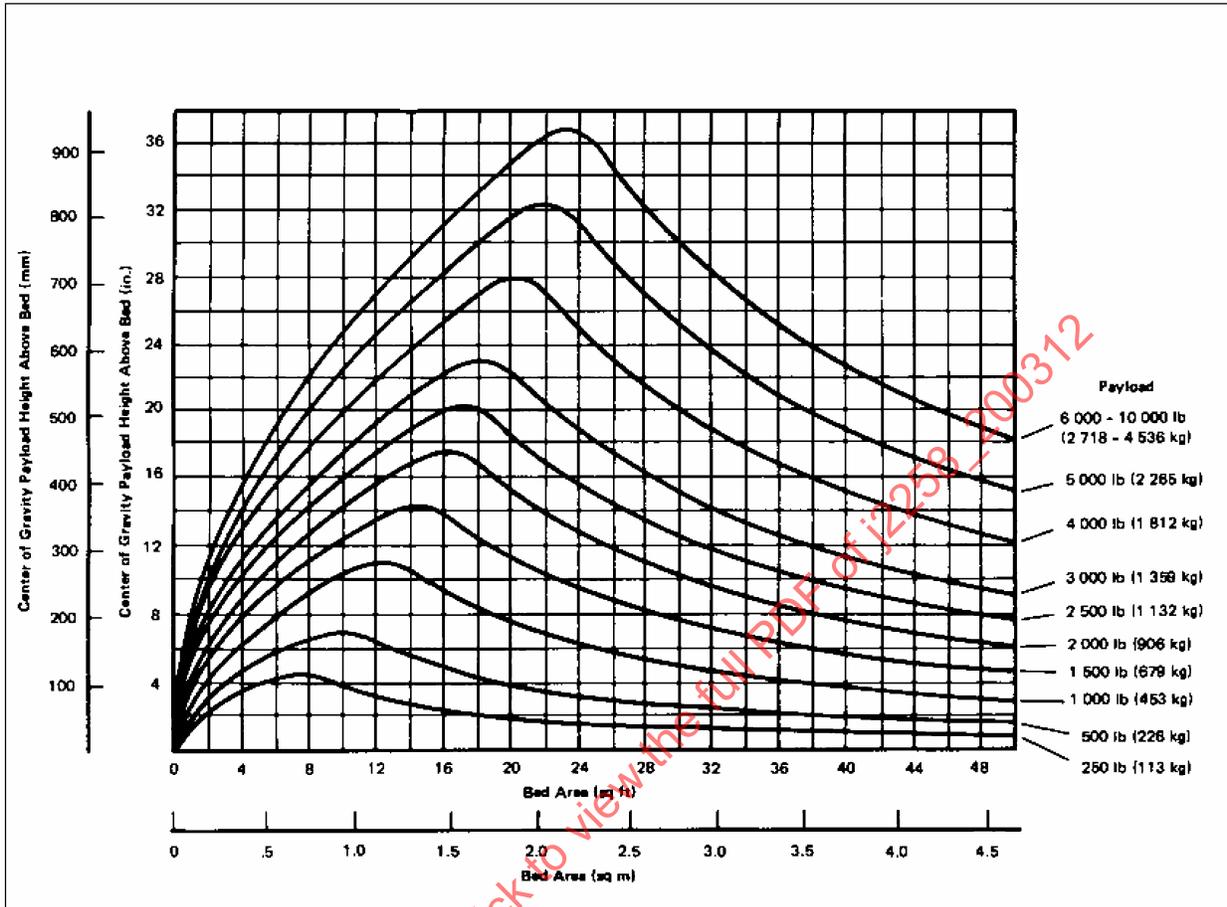


FIGURE 3—CENTER OF GRAVITY PAYLOAD HEIGHT ABOVE BED

7.8.2 LATERAL STABILITY TEST

a. Requirements

1. The position of the vehicle on the test platform shall be maintained by parking brakes or similar means, but not by use of wheel chocks.
2. Stability determination and measurements shall be taken under static conditions.

b. Procedure—The vehicle with test loads in place shall be put on the tilt platform in accordance with Figures 4 or 5 (depending on type and number of supporting wheels).

1. The steerable wheels of the machine shall be placed to simulate the least stable condition. The machine shall be so positioned on the tilt table that a line through the center of the footprint of the two lowest tires will be parallel to the tilt axis of the table. The machine shall be tested with its left side downhill and again with its right side downhill.
2. The stability of the vehicle shall be determined directly by tilting the platform to the stability angle determined from Figure 2.
3. Tilt platform back to level.
4. Recheck the vehicle test condition and position of all loads to ensure that they still conform to the test requirements.
5. Recheck the tire inflation of all tires to ensure that they still conform to the test requirements.

The test is to be conducted with one side of the vehicle facing the platform tilt axis and repeated with the other side facing the platform tilt axis.

c. Test Acceptance—Acceptance of the lateral stability test shall require that at least one of the supporting tire or tires on the uphill side remain in contact with the surface or the vehicle slides. Failure shall have occurred when all the vehicle's uphill tires lift off the platform.

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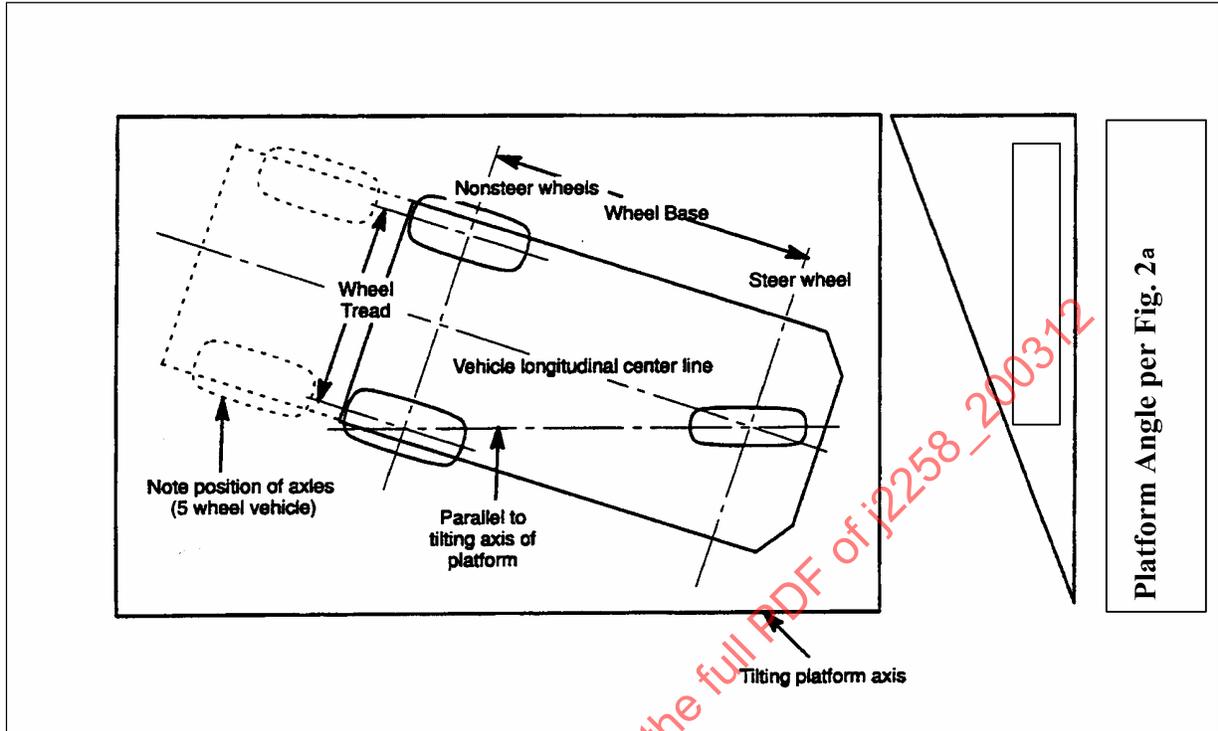


FIGURE 4—VEHICLE PLACEMENT ON LATERAL TILTING PLATFORM

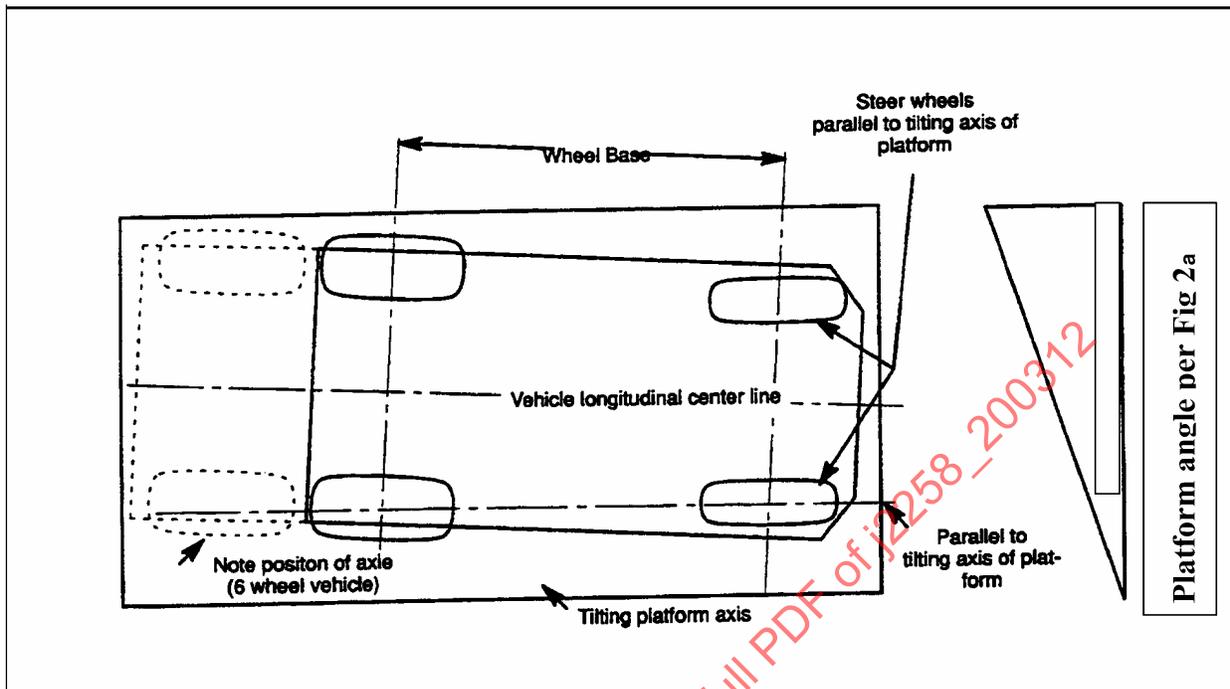


FIGURE 5—VEHICLE PLACEMENT ON LATERAL TILTING PLATFORM

7.8.3 LONGITUDINAL STABILITY TESTS

a. Requirements

1. The position of the vehicle on the test platform shall be maintained by locking all braked wheels, but not by use of wheel chocks.
2. Stability determination and measurements shall be taken under static conditions.

b. Downgrade Test

1. Procedure—The loaded vehicle shall be placed on the tilting platform such that the longitudinal centerline is perpendicular to the platform tilt axis (See Figure 6). The forward end of the vehicle will be facing the platform tilt axis. Tilt the platform to a 46.6% (25 degrees) gradient and repeat items listed in 7.8.2. (b) (3), (4), (5).
2. Test Acceptance—The vehicle will have failed the test when all wheels uphill from the vehicle pivot axis lift off when tested in accordance with the previous standards or the vehicle slides.

c. Upgrade Test—Same as 7.8.3. (b) (1) and (2) except that the rear end of the vehicle will be facing the platform axis of tilt (See Figure 7).

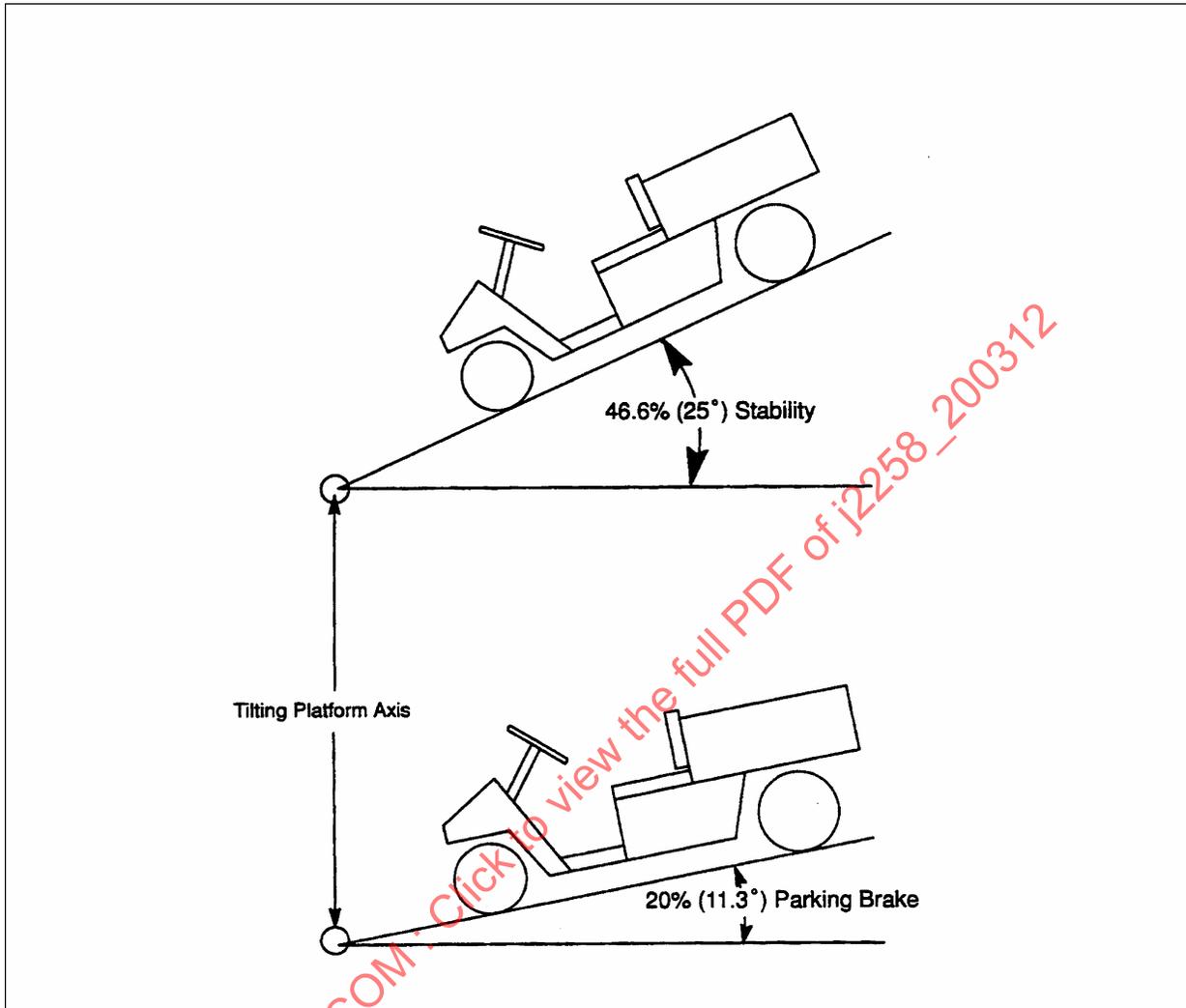


FIGURE 6—VEHICLE PLACEMENT, LONGITUDINAL PLATFORM DOWNHILL INDICATED

7.9 Brakes

7.9.1 SYSTEM PROOF LOAD TEST

A proof load indicated by (a), (b), or (c), shall be applied to the center of the pedal, lever, or grip for a minimum of 5 min. There shall be no permanent deformation nor breakage of brake system components.

- a. Foot Pedal = 1125 N (250 lb) minimum
- b. Hand Lever = 675 N (150 lb) minimum
- c. Hand Grip (Squeeze) = 450 N (100 lb) minimum

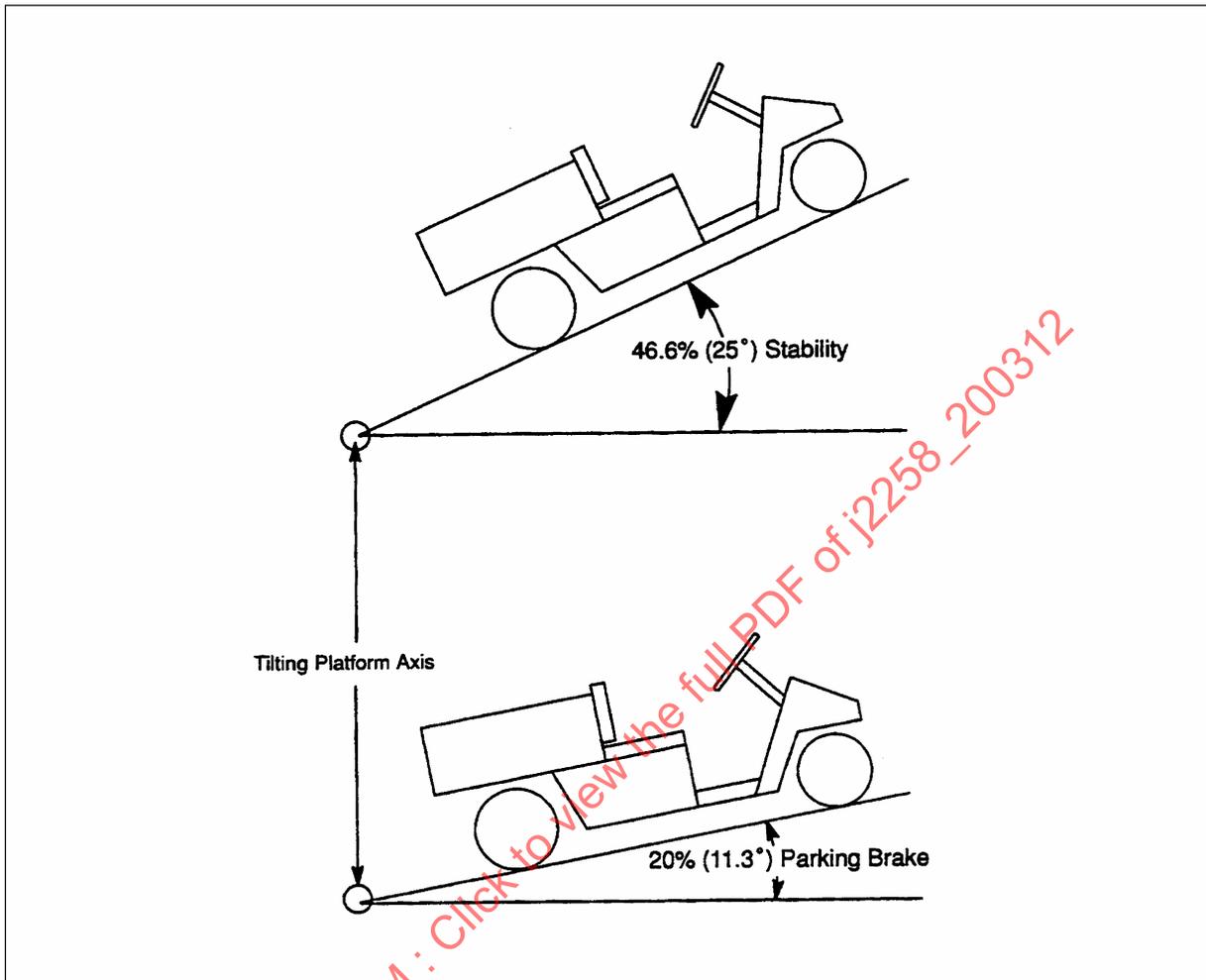


FIGURE 7—VEHICLE PLACEMENT, LONGITUDINAL PLATFORM, UPHILL INDICATED

7.9.2 SERVICE BRAKE PERFORMANCE

a. Test conditions shall be as follows:

1. Horizontally flat surface, 0.5% grade (0.3 degrees) maximum.
2. Straight course.
3. Concrete or asphalt surface that is dry and free from loose material or surface contamination with a minimum coefficient of friction of 0.8 between tires and surface.
4. Sufficient track length to allow the vehicle to reach maximum speed before measurements begin.
5. The vehicle shall be configured and loaded such that it creates the most severe braking conditions which could be at less than gross vehicle weight.
6. Burnishing brakes is permissible following the manufacturer's approved procedure.

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b. The test shall be conducted as follows:

1. The test vehicle shall be operated at its maximum speed attainable in the configuration providing the most severe conditions for braking, and the brake(s) then applied with a foot pedal force no more than 555 N (125 lb), applied to the center of the service brake pedal.
2. For hand grip (squeeze) operated brakes, the application force, applied at the midpoint of the lever, shall not exceed 225 N (50 lb).

c. Test Acceptance—The test vehicle shall stop the following distances from the point of application of the brake(s) in the forward direction per the formula:

$$\begin{aligned}\text{Stopping Distance (in meters)} &= 0.015V^2 \text{ (V in km/h, vehicle speed)} \\ \text{(in feet)} &= 0.125V^2 \text{ (V in mph)}\end{aligned}\quad (\text{Eq. 1})$$

The test vehicle shall stop from the point of application of the brake(s) in the reverse direction according to the formula:

$$\begin{aligned}\text{Stopping Distance (in meters)} &= 0.018V^2 \text{ (V in km/h)} \\ \text{(in feet)} &= 0.150V^2 \text{ (V in mph)}\end{aligned}\quad (\text{Eq. 2})$$

7.9.3 SERVICE BRAKE FADE

a. Test Conditions—The test vehicle shall be towed in the forward direction with brake(s) applied to produce a drag load determined by the following formula:

$$\begin{aligned}\text{Drag load} &= \text{free rolling towing force} + (0.342) \times \text{loaded vehicle weight} \\ \text{DL} &= \text{frtf} + (0.342) \times \text{lvw}\end{aligned}\quad (\text{Eq. 3})$$

This drag load shall be maintained within $\pm 15\%$ for 61 m (200 ft). Towed vehicle speed shall be between 40% and 50% of maximum level ground vehicle speed.

b. Test—The test shall be conducted as follows:

1. The test vehicle shall be operated at its maximum speed and the brake(s) then applied with a foot pedal force no more than 555 N (125 lb), applied to the center of the service brake pedal. For hand grip (squeeze) operated brakes, the application force at the midpoint of the lever shall not exceed 225 N (50 lb).
2. This test shall be performed before the brake linings have cooled more than 14 °C (25 °F) from the maximum temperature, as measured per SAE J843d, obtained during the tow period.

c. Test Acceptance—The test vehicle shall stop the following distances from the point of application of the brake(s) in the forward direction per the formula:

$$\begin{aligned}\text{Stopping Distance (in meters)} &= 0.018V^2 \text{ (V in km/h)} \\ \text{(in feet)} &= 0.150V^2 \text{ (V in mph)}\end{aligned}\quad (\text{Eq. 4})$$

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7.9.4 SERVICE BRAKE FADE RECOVERY

- a. Test Conditions—They shall be the same as given in 7.9.2.
- b. Test—The service brake test described in 7.9.3 (b) shall be repeated after cooling the brakes to ambient temperature.
- c. Test Acceptance—They shall be the same as given in 7.9.2 (c).

7.9.5 PARKING BRAKE

- a. Test shall be conducted with application force as per (1), (2), or (3):
 1. Foot—555 N (125 lb) maximum
 2. Hand Lever—333 N (75 lb) maximum
 3. Hand Grip (Squeeze)—225 N (50 lb) maximum
- b. Test Conditions
 1. The vehicle shall be configured and loaded such that it creates the most severe conditions; this could be less than maximum gross vehicle weight.
 2. The test vehicle shall be positioned on an inclined plane having a 20% (11.3 degree) grade with a minimum coefficient of friction of 1.0 between tires and surface, with its longitudinal centerline perpendicular to the pivot axis of the inclined plane.
- c. Test—With the parking brake(s) engaged, the vehicle shall be positioned with its:
 1. Front end on the downhill side (See Figure 6).
 2. Rear end on the downhill side (See Figure 7).
- d. Test Acceptance—The parking brake(s) shall hold the vehicle on the inclined plane having a 20% (11.3 degree) grade. Vehicle shall not move more than 76 mm (3 in) in 1 h.

8. Notes

8.1 Marginal Indicia

The change bar (I) located in the left margin is for the convenience of the user in locating areas where revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE LIGHT UTILITY VEHICLE SUBCOMMITTEE OF THE
SAE SPECIAL PURPOSE VEHICLE, ENGINE AND EQUIPMENT COMMITTEE

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APPENDIX A GLOSSARY OF COMMONLY USED WORDS AND PHRASES

Accelerator—A device that controls the speed of a vehicle.

Accessory—Light utility manufacturer approved device installation on a vehicle (i.e., tire chains, lights, canopy, cab, etc.) to enhance its utility or appearance (exclusive of attachment).

Approved Vehicle—A vehicle that is listed or approved for fire safety purposes for the intended use by a nationally recognized testing laboratory (e.g., Underwriters Laboratories; Factory Mutual Engineering Corp.) using nationally recognized testing standards.

Attachment—Components designed primarily to perform a specific task and for mounting on a specific machine, utilizing the machine's power and control system. These attachments may be detachable, but are not intended to be universally adaptable to other machines (i.e., top dresser, Spreader, etc.).

Battery—Electric Vehicle—An electric vehicle in which the power source is a storage battery(s).

Body Restraint—A hand hold or combination hand hold/hip restraint, anchored securely to the body or seat platform of the vehicle creating a barrier to help prevent an occupant from sliding outside of the vehicle.

Center of Gravity (of Test Load)—That point at which the load mass is concentrated. It is located horizontally in the center of the load bearing surface, and vertically by its distance above the load bearing surface.

Charged Battery—A battery discharged to 1.75 V per cell or less, then charged until a specific gravity reading as recommended by the battery manufacturer is achieved within a tolerance of ± 0.05 specific gravity with an electrolyte temperature of $26.5\text{ }^{\circ}\text{C} \pm 0.3\text{ }^{\circ}\text{C}$ ($80\text{ }^{\circ}\text{F} \pm 0.5\text{ }^{\circ}\text{F}$).

Controlling Party—The person(s) or organization(s) responsible for the operation and maintenance of a vehicle.

Electric Vehicle—A vehicle in which the principal energy is transmitted from power sources to motor(s) in the form of electricity.

Gross Vehicle Weight (GVW)—Maximum stated weight including operating weight, material load, personnel, options, accessories, and attachments.

Hand Hold—A readily accessible device mounted securely to the vehicle that can be encircled by the fingers of one hand for the purpose of holding on.

Material Load—Weight and dimension of material to be carried, excluding personnel.

Operating Weight—Weight of vehicle with full fuel load, without material load or personnel load.

Operator—Trained and authorized person who controls any function of the light utility vehicle.

Operator's Seat—The seat located directly behind the steering wheel.

Options—Selectable components necessary to complete vehicle assembly (i.e., tires, batteries, etc.).

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Parking Brake—A device to prevent the movement of a stationary vehicle.

Rated Capacity—The total weight of material load and personnel load for a vehicle. The total personnel load for personnel vehicles.

Service Brake—A device designed to bring a moving vehicle to a stop.

Test Load—Weight that can be added to the vehicle when combined with operating weight and those accessories and options that create the least stable condition not to exceed GVW.

GVW = FIXED + VARIABLE

FIXED = Vehicle operating weight + Operator weight

VARIABLE = (Passenger + Option + Accessory) weight(s) + Load weight(s)

Test Vehicle—Unless otherwise stated, the test vehicle shall conform to the manufacturer's specifications for optimum performance. All optional and accessory items offered by the manufacturer shall be considered in performing each test, which shall be conducted with optional and accessory items installed, or not installed, so as to create the most severe test conditions.

Travel Control—Devices that control the speed, braking, forward, and reverse direction of the vehicle.

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APPENDIX B

B.1 Part II—For the Controlling Party

B.1.1 Maintenance and Operations

B.1.1.1 INTRODUCTION

B.1.1.1.1 Like other machines, light utility vehicles can cause injury if improperly used or maintained. Part II contains broad safety practices applicable to vehicle operations. Before operation, the controlling party shall follow such additional specific safety practices as may reasonably be required for safe operation.

B.1.1.1.2 *Safety Survey*—The controlling party shall perform a safety survey of their premises periodically, and as conditions warrant, identify areas where vehicles should not be operated and to identify possible hazards.

- a. *Steep Grade*—In areas where steep grades exist, vehicle operation should be restricted to the designated vehicle's pathways where possible, and shall be identified with a suitable warning giving the following information: "Warning, steep grade, descend slowly."
- b. *Wet Areas*—Wet areas could cause a vehicle to lose traction and could affect steering, stability and braking.
- c. *Sharp Turns, Blind Corners, Bridge Approaches*—Sharp turns, blind spots, bridge approaches, and other potentially hazardous areas shall be identified with a suitable warning to the operator of the nature of the hazard and stating the proper precautions to be taken to avoid the hazard.
- d. *Loose Terrain*—Loose terrain could cause a vehicle to lose traction and could affect steering, stability, and braking.

B.1.1.1.3 *Utility Vehicle/Pedestrian Interference Areas*—Areas where pedestrian and vehicle traffic could interfere should be avoided by rerouting the vehicle or the pedestrian traffic to eliminate the interference. If elimination of the interference is not possible or is highly impractical, signs shall be erected warning pedestrians and vehicle operators of traffic conditions and to use caution.

B.1.1.1.4 The controlling party shall train vehicle operators to adhere strictly to the operating instructions stated in vehicle operator's manual and those additional operating instructions provided by controlling party.

B.1.1.1.5 The controlling party shall survey specific operating conditions and environment, establish safety practices, and train vehicle operators to comply with these practices.

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- B.1.1.2** OPERATION—Experience has shown that vehicles which comply with the provisions stated in 7.8 are stable when properly operated in accordance with specific safety rules and practices established to meet actual operating terrain and conditions. However, improper operation, faulty maintenance, or poor housekeeping may contribute to a condition of instability and defeat the purpose of the standard. Some conditions which could affect stability are failure of the operator to follow safety practices, surface conditions, grade, speed, loading, braking, turning, improper loads, towing, attachments, dynamic forces, and the judgment exercised by the vehicle operator.
- B.1.1.3** NAMEPLATES, MARKINGS, CAPACITY, AND MODIFICATIONS
- B.1.1.3.1* The controlling party shall maintain in a legible condition all nameplates, warnings, and instructions which are supplied by the vehicle manufacturer.
- B.1.1.3.2* The controlling party shall not perform any modification or addition which affects capacity or safe operation, or make any change not in accordance with the vehicle manual(s) without the vehicle manufacturer's prior written authorization. Where authorized modifications have been made, the controlling party shall ensure that capacity, operation, warning, and maintenance instruction plates, tags, or decals are changed accordingly.
- B.1.1.3.3* As required under B.1.1.3.1 or B.1.1.3.2, the vehicle manufacturer shall be contacted to secure new nameplates, warnings, or instructions which shall then be affixed in their proper place on the vehicle.
- B.1.1.4** FUEL HANDLING
- B.1.1.4.1* The controlling party shall supervise the handling of liquid fuels (when used) to be certain that it is in accordance with appropriate sections of ANSI/NFPA 505 and ANSI/NFPA 30 or as required by local ordinance.
- B.1.1.4.2* The controlling party shall supervise the handling of liquefied petroleum gas fuels (when used) to be certain it is in accordance with appropriate sections of ANSI/NFPA 505 and ANSI/NFPA 58 or as required by local ordinance.
- B.1.1.5** CHARGING STORAGE BATTERIES
- B.1.1.5.1* The controlling party shall require battery-charging procedures to be in accordance with appropriate sections of ANSI/NFPA 505, ISO 3691, or local ordinance and meet any other requirements such as OSHA.
- B.1.1.5.2* The controlling party shall periodically review procedures to be certain that appropriate sections of ANSI/ NFPA 505 or local ordinance and OSHA are strictly complied with, and shall familiarize vehicle operators with it.

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B.1.1.6 LIGHTING FOR OPERATING AREAS

B.1.1.6.1 The controlling party, in accordance with his responsibility to survey the environment and operating conditions, shall determine if the vehicle requires lights and, if so, shall equip the vehicle with appropriate lights in accordance with the vehicle manufacturer's recommendations.

B.1.1.7 WARNING DEVICE(S)

B.1.1.7.1 The controlling party shall make periodic inspections of the vehicle to be certain that the sound-producing and visual device(s), if so equipped, are maintained in good operating conditioning condition.

B.1.1.7.2 The controlling party shall determine if operating conditions require the vehicle to be equipped with additional sound-producing and/or visual devices compatible with the vehicle manufacturer's recommendations, and be responsible for providing and maintaining such devices, in accordance with the vehicle manufacturer's recommendations.

B.1.1.8 SAFETY INTERLOCKS

B.1.1.8.1 The controlling party shall make periodic inspections of the vehicle to be certain that the safety interlock system, if so equipped, is operating properly.

B.2 Operating Safety Rules and Practices

B.2.1 Operator Qualifications

B.2.1.1 Only persons who are trained in the proper operation of the vehicle shall be authorized to operate the vehicle. Operators shall be qualified as to visual, auditory, physical, and mental ability to safely operate the vehicle according to Section 5 and all other applicable parts of this document and vehicle operator's manual.

B.2.2 Operator's Training

B.2.2.1 The controlling party shall develop and conduct an operator training program.

B.2.2.2 Successful completion of the operator training program by the operator shall be required before operation of the vehicle. The program shall be presented in its entirety to all new operators and not condensed for those claiming previous experience.

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B.2.2.3 The controlling party should include, as a minimum, in the operator training program the following:

- a. Instructional material provided by the vehicle manufacturer, including vehicle operator's manual
- b. Emphasis on safety of passengers, vehicle operator, and other persons
- c. Safe loading practice, including securing material loads
- d. General safety rules contained within this document and the additional specific rules determined by the controlling party in accordance with this document, and why they were formulated
- e. Introduction of equipment, control locations, and functions, and explanation of how they work when used properly and the consequences of improper use; explanation of surface conditions, grade, and other conditions of the environment which could affect vehicle operation
- f. Operator competency evaluations

B.2.3 Operator Responsibility

B.2.3.1 Read and follow operator's manual.

B.2.3.2 Do not operate vehicle under the influence of drugs or alcohol.

B.2.3.3 Safeguard the pedestrians at all times. Do not drive vehicle in a manner that could endanger other persons.

B.2.3.4 Riding on the vehicle by persons other than the operator is authorized only on seat(s) provided by the vehicle manufacturer. All parts of each person's body shall remain within the plan view outline of the vehicle while the vehicle is in motion.

B.2.3.5 When a vehicle is to be left unattended, stop vehicle, apply the parking brake, turn off the control or ignition circuit, and remove the key if provided. Block the wheels if vehicle is on an incline.

B.2.3.6 Maintain a safe distance from potential hazards.

B.2.3.7 Use only approved vehicles in hazardous locations, as defined in the appropriate safety standards.

B.2.3.8 Report all accidents involving personnel, building structures, and equipment.

B.2.3.9 Do not add to, or modify, the vehicle.

B.2.3.10 Slow down or stop, as conditions dictate, and activate a sound-producing warning device, if so equipped, at intersections and when visibility is obstructed at other locations.

B.2.3.11 Ascend or descend grades slowly, avoid turning if possible; normally travel straight up and down.