

# American National Standard

*for Personal Transport Vehicles –  
Safety and Performance Specifications*





**ANSI/OPEI Z135-2020**  
Revision and redesignation of  
ANSI/ILTVA Z135-2012

American National Standard  
**for Personal Transport Vehicles –  
Safety and Performance Specifications**

Sponsor

**Outdoor Power Equipment Institute**

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# American National Standard

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## **Foreword** (This foreword is not part of American National Standard ANSI/OPEI Z135-2020.)

This is the third edition (second revision) of *American National Standard - Personal Transport Vehicles - Safety and Performance Specifications*, ANSI/OPEI Z135-2020. The first edition of the standard was published in 2004. The first two editions were developed under the auspices of the International Light Transportation Vehicle Association (ILTVA). This revision was prepared by the OPEI Z130.1 / Z135 Golf Car and PTV Committee, as part of OPEI's continuing work on standards.

A summary of the principal changes included in this revision follows:

- Several definitions were added or revised;
- The vehicle identification number requirements were revised;
- Safety warnings were revised to specify warnings for both occupants and operators;
- Lighting and Markings, Horns and Mirrors, and General Configuration requirements were revised;
- Previous fuel system requirements were replaced with the requirement to comply with ANSI/OPEI B71.10.

The standard contains no normative annexes. The standard contains one informative annex, Annex A, Rationale.

Consensus for this standard was developed by use of the Canvass Method, as well as through public consultation in ANSI Standards Action.

Suggestions for improvement of the standard are welcome. They should be sent to the Outdoor Power Equipment Institute, 1605 King Street, Alexandria, VA 22314, or via e-mail to info@opei.org.

The persons listed below were recognized as having an interest in the standardization of Personal Transport Vehicles and were included on the consensus body. Additional stakeholders were recognized as having an interest, however OPEI was unable to make contact with these stakeholders, or they declined to participate. Inclusion in this list does not necessarily imply that all organizations concurred with the submittal of the proposed standard to ANSI.

Geoff Stewart, Chair  
(Club Car, LLC)

### **Z130.1-2020 Consensus Body**

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# American National Standard

# for Personal Transport Vehicles – Safety and Performance Specifications

## PART I: INTRODUCTION

### 1 Scope and purpose

#### 1.1 Scope

This standard provides safety and performance specifications relating to personal transport vehicles (PTVs), driven by electric motors or internal combustion engines to be operated on designated roadways, or within a closed community where permitted by law or by regulatory authority rules.

This standard does not apply to:

- golf cars, which are covered by ANSI/OPEI Z130.1 (formerly ANSI/ILTV A Z130.1);
- personnel and burden carriers, which are covered by ANSI/ITSDF B56.8;
- low speed vehicles, which are covered by SAE J2358;
- autonomous vehicles;
- hybrid electric vehicles (powered by a combination of an internal combustion engine and a battery with an electric motor);
- vehicles designed for the transportation of persons with disabilities.

The effective implementation date of this standard shall be two (2) years after the publication date and shall apply to all products built after that date. Newly manufactured PTVs may also comply with the requirements of this standard any time after the publication date.

NOTE – The units in this standard are given in metric. English units are included in parentheses for information only.

#### 1.2 Purpose

The purpose of this standard is to promote safety in the design, manufacture, maintenance and operation of PTVs. This standard may be used as a guide by regulatory authorities desiring to formulate safety rules and regulations. This standard is also intended for voluntary use by others associated with manufacturing, maintaining or utilizing PTVs.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication of this standard, the editions indicated were valid. However, all publications and standards are subject to revision and obsolescence. Accordingly, users are encouraged to investigate the possibility of applying the most recent editions of the standards referenced herein.

ANSI Z535.1, *Safety colors*

ANSI Z535.3, *Criteria for safety symbols*

ANSI Z535.4, *Product safety signs and labels*

ANSI/OPEI Z130.1, *Golf cars – Safety and performance specifications*

ANSI/NFPA 30, *Flammable and combustible liquids code*

ANSI/NFPA 58, *Storage and handling of liquefied petroleum gases*

ANSI/OPEI B71.10, *Off-road ground-supported outdoor power equipment – Gasoline fuel systems – Performance specifications and test procedures*

NASA-STD-3000, Revision B, July 2003, *Man-systems integration standards, Volume I, Section 3, Anthropometry and biomechanics*<sup>1</sup>

ISO 3864, *Graphic symbols – Safety colours and safety signs – Part 1: Design principals for safety signs and safety markings*

US Environmental Protection Agency Urban Dynamometer Drive Cycle (UDDS)

SAE J1718, *Measurement of hydrogen gas emission from battery-powered passenger car and light truck during battery charging*

SAE ICS 1000, *Recreational off-road vehicle product identification numbering system*

SAE J1163, *Determining seat index point*

SAE J585, *Tail lamps (rear position lamps) for use on motor vehicles less than 2032 mm in overall width*

SAE J586, *Stop lamps for use on motor vehicles less than 2032 mm in overall width*

SAE J588, *Turn signal lamps for use on motor vehicles less than 2032 mm in overall width*

SAE J592, *Clearance, side marker and identification lamps*

SAE J594, *Reflex reflectors*

SAE J377, *Performance of vehicle traffic horns*

SAE J2358, *Low speed vehicles*

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<sup>1</sup> Available from National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

### 3 Definitions

For purposes of this standard, the following definitions apply:

- 3.1 **accessory:** A manufacturer-approved device installed on the PTV to enhance its usability and functionality.
- 3.2 **adequate clearance:** The clearance necessary to avoid damage to components during use.
- 3.3 **authorized persons:** Persons determined by the controlling party to be knowledgeable about PTVs and capable of operating them for their intended use consistent with these safety standards and regulatory authority rules governing PTV operation.
- 3.4 **braking system:** A system used to slow, prevent, or stop the movement of the PTV.
- 3.5 **center of gravity of the test load:** The point at which the load mass is concentrated, located horizontally in the center of the load-bearing surface and vertically by its distance above the surface.
- 3.6 **closed community:** A private residential area, resort or other private facility, the facility's ingress and egress being controlled by its owners or an association representing the owners or its members.
- 3.7 **controlling party:** The person responsible for the management and maintenance of a PTV.
- 3.8 **fire hazard:** Any condition that presents the possibility of creating a fire by ignition of a combustible material.
- 3.9 **fire protection equipment:** Equipment used to prevent, control or extinguish a fire in accordance with state and local fire protection codes.
- 3.10 **fuel system:** All tanks, lines, hoses, pumps, filters, connections, caps and fittings and other components necessary to store and carry fuel from the fuel tank to the engine.
- 3.11 **fully charged batteries:** A battery or battery set that has been charged using the manufacturer's approved charger and charging algorithm where the charging cycle terminated normally, and that can achieve over 80% state of rated ampere-hour capacity at 27°C (80.6°F).
- 3.12 **hand hold:** A device connected to the vehicle that can be encircled by the fingers of one hand for the purpose of improving personal stability.
- 3.13 **headlamp:** A lighting device mounted on the front of the vehicle to provide illumination ahead of the vehicle.
- 3.14 **hip restraint:** A device, anchored securely to the PTV, creating a barrier or impediment to help keep the occupant within the PTV.
- 3.15 **horn:** An audible warning device used to signal the presence of the vehicle.
- 3.16 **insulated tools:** Those tools that are covered with a non-conducting material to prevent an inadvertent electrical short circuit and to protect the user from the dangers of electrical shock.
- 3.17 **newly manufactured:** Either a completely new vehicle or a vehicle modified to meet the definition of a PTV where it did not do so prior to the modification.
- 3.18 **occupant:** Any person occupying the PTV.
- 3.19 **occupant protective structure (OPS):** A frame or other structural enclosure for the protection of occupants of PTVs.

- 3.20 occupant test weight:** A test weight approximately 305 mm (12 in) square and weighing 91 kg (200 lb)  $\pm$  2% with the center of gravity at the geometric center of the weight. The vertical height of the test weight center of gravity should be between 125 mm (5 in) and 177.8 mm (7 in).
- 3.21 operator:** The occupant controlling the operation of the PTV from the operator's seat.
- 3.22 operator seat:** The seat located directly behind the steering wheel.
- 3.23 parking brake:** A device that, when properly engaged, prevents movement of the parked vehicle.
- 3.24 PIN:** A 17-digit Product Identification Number for off-road recreation vehicles governed by the Society of Automotive Engineers.
- 3.25 PTV:** A self-propelled vehicle with a minimum of 4 wheels, capable of a maximum level ground speed of less than 32 km / h (20 mi / h), with a manufacturer's maximum gross vehicle weight rating (GVWR) of up to 1,814 kg (4,000 lbs) operating on designated roadways or property where permitted by law, or the applicable regulatory authority.
- 3.26 rear view mirror:** A device having a reflecting surface used to provide a view to the rear of a vehicle.
- 3.27 reflex reflector:** A device used on a vehicle to indicate its presence by reflecting light.
- 3.28 regulatory authority:** The person(s) establishing the rules for use of PTVs, e.g., a closed community or local, state or federal governing authority, as applicable.
- 3.29 reverse warning device:** A sound-producing device to alert of reverse or pending reverse operation.
- 3.30 roll-over:** A rotation of the PTV of at least 90° along the longitudinal axis in any direction from its normal upright position.
- 3.31 service brake:** The primary braking system of the PTV used to reduce the speed or stop movement of the PTV.
- 3.32 shall:** Indicates a mandatory requirement.
- 3.33 should:** Indicates a permissive condition (a recommendation).
- 3.34 side marker lamp:** A lamp used to indicate the presence and orientation of a vehicle by marking its overall length.
- 3.35 speed control device:** An actuator used by the operator to vary or fix the rate of travel of the PTV.
- 3.36 stop lamp:** A red lamp that provides steady light to the rear of the vehicle, activated when the brake is applied, to indicate the intention of the operator of the vehicle to diminish speed or stop.
- 3.37 stopping distance:** The distance traveled between the point of service brake application and where the PTV comes to rest.
- 3.38 tail lamp:** An energized red lamp that provides rear marking of the vehicle.

- 3.39 **test vehicle:** A PTV used for testing which conforms 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.
- 3.40 **tilting platform:** A platform that is rigid, flat and constructed to be a single plane, with adjustable slope.
- 3.41 **turn signal:** A flashing lamp indicating the vehicle operator's intention to change direction.
- 3.42 **wiring system assemblies:** All wires, terminals, and connectors required to conduct electrical current to the motor, starter/generator or any other electrical devices.

## PART II: MAINTENANCE AND OPERATIONS

It is recommended that Part II be reprinted in the manufacturer's operation and service manuals to encourage safe operation and practices at the regulatory authority's facility or within the regulatory authority's jurisdiction.

### 4 General safety practices

#### 4.1 Introduction

Like other vehicles, improper use or maintenance of PTVs may result in personal injury or death. This Part II contains broad safety practices recommended for safe PTV operations. Before operation, the controlling party should establish such additional specific safety practices as may be reasonably required for safe operations, for the intended use of the vehicle and applicable environment.

PTVs that comply with the provisions stated in Part III of this standard are reasonably safe when properly operated in accordance with the safety and operation warnings affixed to every PTV. The safe operation is enhanced when the PTVs are operated within a specific set of operation instructions, safety rules and practices established to meet actual operating terrain and conditions.

#### 4.2 Grades

Excessive speed while descending grades adversely affects the stability of the PTV and its ability to stop. Hazardous grades shall be identified with a suitable warning at a point preceding the initiation of the slope for example, "Warning, steep hill, slow down now". All slopes should generally be considered potentially hazardous especially when a turn occurs on the down slope or the slope exceeds 10% (6°) on an unpaved surface or 20% (11°) on a paved surface. Avoid parking on steep hills.

#### 4.3 Slippery terrain

Extreme caution should be used when driving on slippery terrain. For example, wet grassy areas or ice may cause a PTV to lose traction and may adversely affect operator control.

#### 4.4 Turns

All turns shall be negotiated at a reduced speed. Approach turns with caution particularly on grades. Negotiating a turn can affect the stability and control of a PTV, causing loads and passengers to shift. Avoid improperly banked curves to prevent negative super elevation.

#### 4.5 Loose terrain

Extreme caution shall be used when driving in areas of loose terrain. For example, loose terrain, or sand or gravel, can cause a PTV to lose traction and may affect steering, braking and stability. Areas of loose terrain shall be repaired if possible, or closed off to prevent PTV operation or identified by a suitable warning that PTVs should not be operated in those areas.

#### 4.6 Mixed use areas

Areas where PTVs could or do interact with pedestrians, bicycles, or motor vehicles, should be avoided, if possible. If avoidance of the interaction is not possible or is highly impractical, warning signs shall be erected. Additionally, convex mirrors, barriers, lighting or other measures may be used in these areas.

#### 4.7 Golf course operation

If operating a PTV on a golf course, it shall comply with ANSI/OPEI Z130.1.

#### 4.8 Modifications

Modifications made to PTVs that are not approved by the original equipment manufacturer may adversely affect the safe operation and performance of the vehicle. For modifications made

by a party other than the original equipment manufacturer, the controlling party shall (i) arrange for the modification to be designed, tested and implemented by an engineer expert in PTVs and their safety; (ii) maintain a permanent record of the design test(s) and implementation of the modification; (iii) make appropriate changes to the capacity, plate(s), decals, and operation and maintenance manuals; and (iv) affix a permanent and readily visible label on the PTV stating the PTV has been modified with the date of the modification and the name of the organization that accomplished the modification. The controlling party shall not perform, or allow to be performed, any modification or addition to the vehicle that affects capacity or safe operation, or make any change not in accordance with the original equipment manufacturer's operations and service manuals, without the original equipment manufacturer's prior written authorization.

Whether or not modifications have been authorized by the original equipment manufacturer, if modifications are made, the controlling party making the modifications becomes the original equipment manufacturer of the modified vehicle and has the responsibility to ensure that capacity, operation, warning, maintenance instruction plates, tags, and/or decals are changed accordingly.

## **5 Maintenance**

### **5.1 Introduction**

PTVs may become hazardous if maintenance is neglected or improperly performed. Proper maintenance shall be performed by trained personnel in accordance with the manufacturer's recommendations.

### **5.2 Preventive maintenance**

A regularly scheduled inspection and preventive maintenance program in accordance with the manufacturer's recommendations should be established. Such a program will be a valuable tool in providing the PTV operator with a safe, properly operating PTV.

#### **5.2.1 Personnel**

Only qualified, trained and authorized personnel shall be permitted to inspect, adjust and maintain PTVs.

#### **5.2.2 Parts and materials**

Manufacturer's recommended replacement parts and materials should be used.

#### **5.2.3 Maintenance and repair safety procedures**

All repair and maintenance shall be performed in accordance with the manufacturer's recommended maintenance and safety procedures as outlined in the manufacturer's operation and service manuals. For example:

- a) Each vehicle should be removed from service if repair or maintenance is needed;
- b) Follow manufacturer's instructions for immobilizing PTVs before beginning any maintenance;
- c) Block chassis before working underneath PTV;
- d) Before disconnecting any part of the fuel system, drain the system and turn all valves to the "off" position to prevent leakage or accumulation of flammable fuels;
- e) Avoid fire hazards and have fire protection equipment available;
- f) Before performing any maintenance on an electric PTV, disconnect the electrical system in accordance with the manufacturer's instructions;
- g) Use only properly insulated tools when performing maintenance;
- h) Periodically inspect and maintain braking system, steering mechanisms, warning devices, governors, safety decals and all other safety devices and maintain them in

- a safe operating condition. Do not modify these devices unless instructed to do so by the manufacturer;
- i) After each maintenance or repair, have the PTV driven by qualified and trained personnel to ensure proper operation and adjustment; perform validation checks in an area that is free of vehicular and pedestrian traffic;
  - j) Record all work performed in a maintenance record log by date, name of person performing maintenance, and type of maintenance. The controlling party should periodically inspect maintenance log to ensure accuracy and completeness of entries.

#### **5.2.4 Safety labels**

The controlling party shall maintain in a legible condition all Danger, Warning and Caution labels (collectively and individually “safety labels”), nameplates, serial numbers, and instructions that are supplied by the manufacturer.

The manufacturer shall be contacted to secure new nameplates, warnings, or safety labels, as necessary, which shall be affixed in their proper place on the PTV as designated in the owner’s manual.

### **6 Fuels handling and storage/battery charging**

#### **6.1 Ventilation**

Maintenance and storage areas shall be properly ventilated to avoid fire hazards in accordance with applicable fire codes and ordinances.

Ventilation for internal combustion engine PTVs shall be provided to remove flammable vapors, fumes and other flammable materials. Consult applicable fire codes for specific levels of ventilation.

Because of the highly volatile nature of hydrogen gas and its propensity to rise and accumulate at the ceiling in pockets, ventilation for electric-powered PTVs shall be provided to remove the accumulation of flammable hydrogen gas emitted during the charging process. The controlling party shall consult applicable fire and safety codes for the specific ventilation levels required. See the *ILTVA Golf Car Safety Storage Guidelines* (available at [www.opei.org](http://www.opei.org) or by e-mail request to [info@opei.org](mailto:info@opei.org)) and SAE J1718, *Measurement of Hydrogen Gas Emission from Battery-Powered Passenger Car and Light Truck during Battery Charging*.

#### **6.2 Battery charging facilities**

The controlling party shall require battery changing and charging facilities and procedures to be in accordance with applicable ordinances or regulations.

#### **6.3 Fuel storage**

The controlling party shall supervise the storage and handling of liquid fuels in accordance with ANSI/NFPA 30.

Storage and handling of liquefied petroleum gas fuels shall be in accordance with ANSI/NFPA 58.

#### **6.4 Auditing**

The controlling party shall periodically inspect charging and storage areas or facilities and review procedures to be certain that the requirements in this clause are being followed.

## **7 Operating safety rules and practices (Operator and passenger qualifications)**

It is recommended that only authorized persons who are qualified by the controlling party be allowed to operate a PTV. Qualifications may include training, proof of insurance, minimum age requirement or other appropriate standards or regulatory requirements.

It is the responsibility of the operator to ensure that all occupants comply with the safety warnings.

## PART III: MANUFACTURER'S REQUIREMENTS

### 8 General requirements

#### 8.1 Identification Number

- 8.1.1 The manufacturer shall legibly inscribe a unique serial number on every PTV. It shall be on the main frame of the vehicle or a location that is not typically removed or separated from the main frame of the vehicle. It shall be in a location protected from debris and damage.
- 8.1.2 The primary location of the serial number shall be described in the Owners or Instructional Manual.
- 8.1.3 At the option of the manufacturer, the manufacturer may also attach a PIN that conforms to SAE ICS-1000. The PIN may serve as the serial number.
- 8.1.4 The serial number, PIN (if used) and manufacturer's name shall also be displayed on the steering column of the vehicle or in the vicinity of the steering column if installation on the steering column is not practical.

#### 8.2 Safety warnings

##### 8.2.1 General

###### 8.2.1.1 Operator warnings

Safety labels shall be affixed to the PTV and shall be available to the field of the operator's vision. The safety labels shall conform to ANSI Z535.1, Z535.3, and Z535.4 or ISO 3864 and shall convey the following minimum information:

- Use the signal word "Warning," "Caution" or "Danger" as applicable;
- Operate from driver's seat by authorized persons only and only in designated areas;
- This vehicle is restricted to \_\_\_\_\_ occupants (manufacturer to specify the number of occupants);
- Do not operate the vehicle until all occupants are fully seated;
- Remain fully seated and hold on when in motion;
- Keep entire body inside vehicle;
- Drive slowly in turns;
- Drive slowly straight up and down slopes;
- Set parking brake before leaving vehicle;
- Place vehicle control in "Neutral," if so equipped, and turn main power "off" when not in use; and
- Do not operate PTV when under the influence of alcohol or drugs, or when distracted.

###### 8.2.1.2 Occupant warnings

Safety labels shall be affixed to the PTV and shall be available to the field of the occupants' vision. The safety labels shall conform to ANSI Z535.1, Z535.3, and Z535.4 or ISO 3864 and shall convey the following minimum information:

- Use the signal word "Warning," "Caution" or "Danger" as applicable;
- This vehicle is restricted to \_\_\_\_\_ occupants (manufacturer to specify the number of occupants);
- Remain fully seated and hold on when in motion;
- Keep entire body inside vehicle;
- Do not occupy PTV when under the influence of alcohol or drugs, or when distracted; and
- Keep seat belts fastened while the vehicle is in operation (for vehicles with seat belts).

### **8.2.2 Nameplates, markings, safety warnings and operating instructions**

On every vehicle, the manufacturer shall inscribe a permanent durable, corrosion-resistant nameplate or marking with the unique serial number, manufacturer name, model name/code, date code and contact information.

On every electric vehicle, the manufacturer shall inscribe a permanent durable, corrosion-resistant nameplate or marking with the nominal system voltage and load capacity.

On every internal combustion engine-powered vehicle, the manufacturer shall inscribe a permanent durable, corrosion-resistant nameplate or marking with the fuel type and load capacity.

On every vehicle, the manufacturer should inscribe the tire size, tire rating and recommended tire pressure.

Legible safety warnings and operating instructions shall be affixed to the vehicle, and shall be sufficiently durable to resist environmental stresses.

### **8.3 Instructional manuals**

Each manufacturer shall make available manuals that provide:

- Operating instructions; and
- A schedule of the required maintenance and storage, as appropriate, and information as provided in Part II.

Manufacturers shall make replacement manuals available for a minimum of 10 years after the vehicle manufacture date.

### **8.4 Operational controls**

The controls shall be visible to, and accessible by, the operator from the designated operator's position.

#### **8.4.1 Steering mechanism**

When traveling in a forward direction, rotating the steering wheel in a clockwise direction shall cause the PTV to turn to the right and when rotated in a counterclockwise direction, the PTV shall turn to the left, when viewed from the operator's seat.

#### **8.4.2 Foot-operated controls**

Foot-operated controls shall include a slip-resistant surface.

##### **8.4.2.1 Speed control devices**

Speed control devices shall require force to be activated.

##### **8.4.2.2 Service brake control**

The service brake pedal or control shall be located in a conventional manner for right-foot or hand operation.

#### **8.4.3 Parking brake**

A parking brake shall be provided.

#### **8.4.4 Directional control (forward and reverse)**

The operational position of the forward and reverse control(s) shall be clearly marked.

#### **8.4.5 Reverse warning device**

Every PTV shall be equipped with a reverse warning device capable of 60 dBA minimum at the operator's ear level and functional at all times when the directional control is in the reverse position.

#### **8.4.6 Main power switch**

The PTV shall be provided with a main power switch. When the switch is in the "Off" position, or the key or other device that activates the switch is removed, the motive power circuit shall be inoperative. If the switch uses a key, it shall be removable only in the "Off" position.

### **8.5 Lighting and Markings**

#### **8.5.1 Headlamps**

##### **8.5.1.1 General**

Headlamps are required. Two (2) headlamps shall be mounted on the front of the vehicle, disposed symmetrically about the centerline and separated as far apart as practicable. They shall be mounted no less than 559 mm (22 in) and no more than 1372 mm (54 in) above the ground. Alternative headlamp configurations that provide lighting equivalent to two (2) of the aforementioned headlamps as positioned above, will be acceptable.

##### **8.5.1.2 Headlight beam aim for photometry**

A headlamp unit that has both high beam and low beam shall be aimed by positioning the high intensity zone of the high beam at 0.5 degree down-vertical. The beam shall be centered by photoelectrically balancing the points, 6 degrees left and 6 degrees right. The lamp shall comply with Tables 1 and 2.

A headlamp 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 degrees left and 6 degrees right. The lamp shall comply with Table 2.

**Table 1 – PTV headlamp photometric specification  
– Upper beam**

Test Point (deg)	Intensity (cd)
H-V	2000 min
½ degree D-V	5000 min
½ degree D- 3 degrees R- 3 degrees L	3000 min
½ degree D- 6 degrees R- 6 degrees L	1000 min
2 degrees D-V	2500 min
3 degrees D-V	1500 min
3 degrees D- 6 degrees R- 6 degrees L	750 min
4 degrees D-V	5000 max

**Table 2 – PTV headlamp photometric specification  
– Lower beam**

Test Point (deg)	Intensity (cd)
½ degree V - and above	2000 max
2 degrees D-V	3000 min
3 degrees D- 4 degrees R- 4 degrees L	1500 min
3 degrees D- 6 degrees R- 6 degrees L	750 min

Notes for Tables 1 and 2: A tolerance of one degree shall be allowed at each test point.

KEY: H = horizontal, V = vertical, D = down, R = right, L= left

#### **8.5.2 Reflex reflectors**

Reflex reflectors shall 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; and two (2) red, mounted on the rear, as far from the vehicle centerline as practicable. They should be mounted no less than 381 mm (15 in) and no more than 1524 mm (60 in) from the ground. Each reflex reflector should have a minimum area of 1290 mm<sup>2</sup> (2 in<sup>2</sup>).

Each reflex reflector should comply with SAE J594 or SAE-A-01-DOT.

#### **8.5.3 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 in) and no more than 1524 mm (60 in) from the ground.

Each side marker lamp should comply with SAE J592.

#### **8.5.4 Stop lamps**

A stop lamp(s) shall 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 in) and no more than 1524 mm (60 in) from 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.

A stop lamp(s) should comply with SAE J586.

#### **8.5.5 Tail Lamps**

Two tail lamps shall be mounted on the vehicle facing to the rear and as far from the longitudinal centerline of the vehicle as practicable. They should be mounted no less than 381 mm (15 in) and no more than 1524 mm (60 in) from the ground. Tail lamps shall be illuminated when the headlamps are energized.

A tail lamp may be combined optically with the turn signal lamp.

Tail lamps should comply with SAE J585.

#### **8.5.6 Turn Signals**

If so equipped, turn signal lamps should be mounted on the vehicle as follows: two (2) facing to the rear, 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 in) and no more than 1829 mm (72 in) from the ground.

A turn signal lamp may be combined optically with the tail lamp.

Turn signals should comply with SAE J588.

## 8.6 Horns and mirrors

### 8.6.1 Horn

A horn shall be mounted on the vehicle to give an audible signal. The activating switch for the horn shall be mounted so it can easily be activated with minimum movement of the operator's hand or foot. The horn shall comply with the requirements of SAE J377.

### 8.6.2 Mirrors

A rear view mirror system is required. The rear view mirror shall comply with SAE J268.

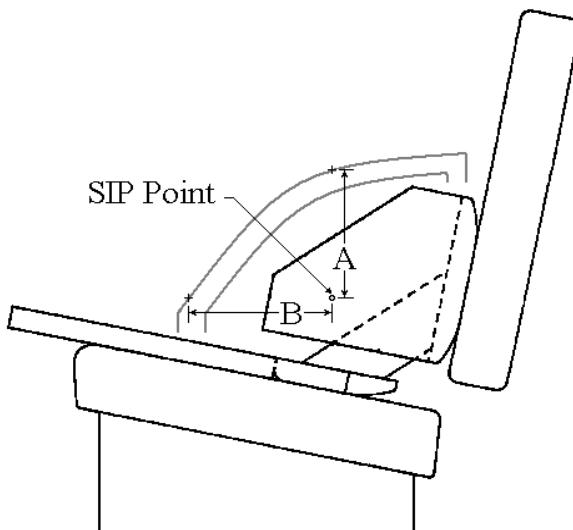
## 8.7 General configuration

**8.7.1** Adequate leg room shall be provided. "Adequate leg room" is that which will accommodate persons falling in the 5% to 95% male range of the appropriate measurements contained in NASA-STD-3000.

**8.7.2** The PTV shall provide a seating arrangement, including a seat back for each intended occupant.

**8.7.3** A hand hold shall be provided for each intended occupant seating position. A steering wheel may function as a hand hold for the operator. A hip restraint may function as a hand hold.

**8.7.4** A hip restraint shall be provided for each intended outermost occupant seating position. The profile view of the hip restraint shall encompass the triangular area defined by the SIP point as specified in SAE J1163 and two restraint reference points defined in this clause. On the passenger side the first restraint reference point shall be 88.9 mm (3.5 in) vertically (A) above the SIP point and the second reference point shall be 152.4 mm (6.0 in) horizontally (B) forward of the SIP point. On the driver side the first restraint reference point shall be 38.1 mm (1.5 in) vertically (A) above the SIP point and the second reference point shall be 50.8 mm (2.0 in) horizontally (B) forward of the SIP point. See Figure 1. For seats where the SIP measurement fixture does not interface with the seat back, the manufacturer shall increase the height of the fixture to allow for interface of the fixture and seat back.



**Figure 1 – First and second restraint reference points**

- 8.7.5** Surfaces normally exposed to occupants or bystanders shall be free of sharp edges and projections.
- 8.7.6** The floor area shall have a slip-resistant surface or shape.
- 8.7.7** All hazardous parts shall be identified, shielded, or located in such a position as to avoid inadvertent contact with the occupants or bystanders.
- 8.7.8** If so equipped, seat belts shall comply with the requirements of SAE J2358. Seat belts shall not be installed without an OPS. An OPS should comply with SAE J2358. The windshield requirements set fourth in SAE J2358 do not apply to PTVs.

## **8.8 Mechanical performance**

### **8.8.1 Maximum PTV speed**

#### **8.8.1.1 Test conditions**

Test conditions shall be as follows:

- Horizontally level surface, 1.0% grade ( $0.6^\circ$ ) maximum;
- Straight course;
- Concrete or asphalt surface of sufficient track length to allow the test vehicle to reach maximum steady state speed before measurements begin;
- Concrete or asphalt surface that is dry and free from loose material or surface contamination with a coefficient of static friction between tire and surface sufficient to prevent wheel slippage;
- Test vehicle shall be loaded with one operator and ballast, if necessary, with a combined weight of no less than 77 kg (170 lb) or more than 91 kg (200 lb);
- The test vehicle shall be configured in accordance with manufacturer's recommendations to achieve maximum speed;
- Electric vehicles shall have fully charged batteries.

#### **8.8.1.2 Test**

The test vehicle shall be operated with the directional control in forward at maximum speed under the conditions stated in 8.8.1.1. This test shall be first run forward in one direction and subsequently run forward in the opposite direction (within 30 min), along the level surface, and the maximum steady state speed achieved in both runs shall be averaged.

#### **8.8.1.3 Test acceptance**

The average speed shall be less than 32 km / h (20 mi / h).

### **8.8.2 Maximum vehicle acceleration**

#### **8.8.2.1 Test conditions**

Test conditions shall be as stated in 8.8.1.1.

#### **8.8.2.2 Test**

The test vehicle shall be accelerated at maximum rate from stop position to maximum speed, under the conditions stated in 8.8.1.1. This test shall be run in one direction and the opposite direction along the flat surface (within 30 min), and the results of both runs shall be averaged.

#### **8.8.2.3 Test acceptance**

Test vehicle peak acceleration rate shall not exceed 0.5 g, i.e.,  $4.9 \text{ m} / \text{s}^2$  ( $16 \text{ ft} / \text{s}^2$ ) for intervals exceeding 0.2 seconds.

### **8.8.3 Static stability**

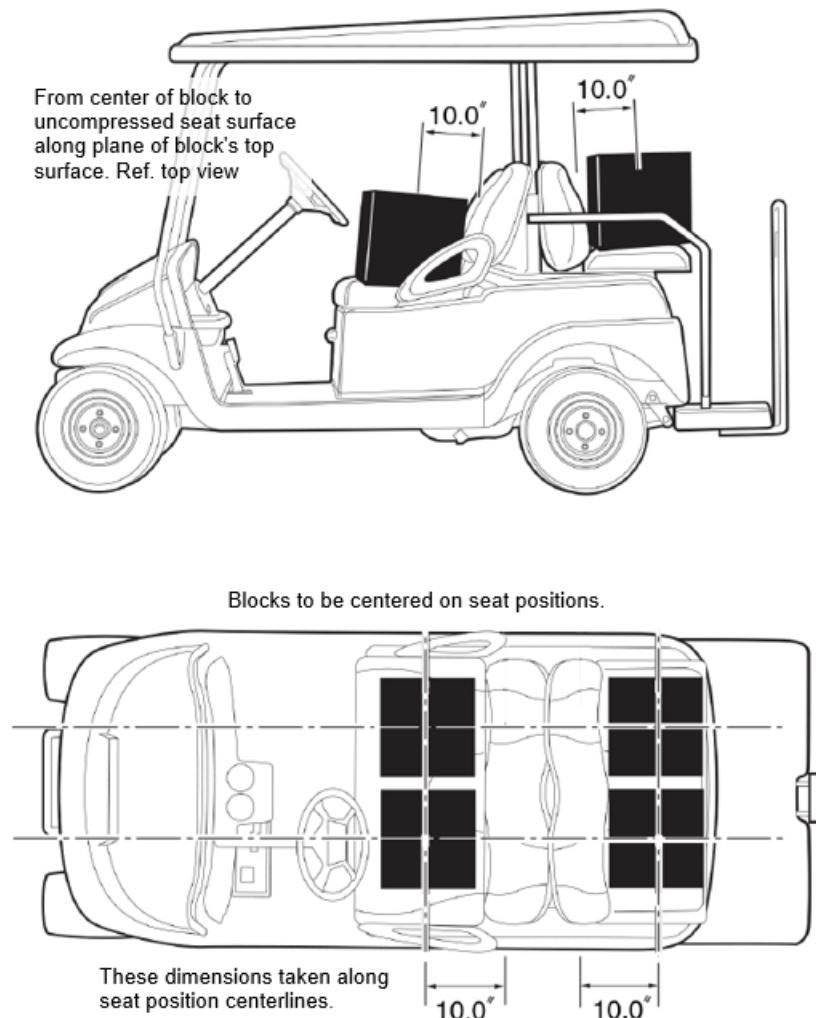
The test vehicle shall be configured in accordance with manufacturer's recommendations to achieve the most severe conditions for stability including manufacturer-approved accessories.

#### **8.8.3.1 Longitudinal stability**

##### **8.8.3.1.1 Test conditions**

Test conditions shall be as follows:

- A tilting platform shall be used;
- The tilting platform shall have a friction surface that achieves a coefficient of friction of one (1.0) minimum;
- The tilting platform surface shall be large enough to support all tires of the test vehicle;
- An occupant test weight shall be secured to the centerline of each intended seat, representing the operator and each passenger as specified. See Figure 2. If seats are adjustable, they shall be adjusted to that position representing the least stable condition to stability in each test. The center of gravity of the weight is to be 152 mm (6 in) above the lowest point of the operator- or passenger-supporting surface and 254 mm (10 in) ahead of the seat back; and
- A cargo test weight(s) shall be placed on each cargo load bearing area and secured in the geometric center of the load bearing area with a center of gravity of the test load at one half of the bed side wall height except with a minimum cg height of 127 mm (5 in). Cargo test weights shall be equivalent to the manufacturer's rated load capacity of each cargo area.

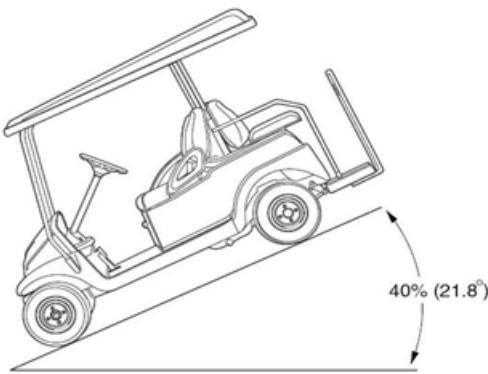


**Figure 2 – Positioning of occupant test weights**

#### **8.8.3.1.2 Test**

The test vehicle shall be supported by all tires with the braking wheels locked, on an adjustable tilting platform of no less than 40% grade ( $21.8^\circ$ ) to the horizontal (see Figure 3). The test vehicle shall be positioned on the tilting platform with its longitudinal centerline perpendicular to the intersection line of the tilting platform and the horizontal plane in each of the following orientations:

- Front end on the downhill side;
- Rear end on the downhill side.



**Figure 3 – Longitudinal test position**

#### **8.8.3.1.3 Test acceptance**

Acceptance of the longitudinal stability test shall require that the supporting tires on the uphill side remain in contact with the surface or the PTV slides under test conditions expressed in 8.8.3.1.2. Failure shall have occurred when all of the PTV's uphill tires lift off the platform before the platform exceeds the stability angle determined from Figure 3.

#### **8.8.3.2 Lateral stability**

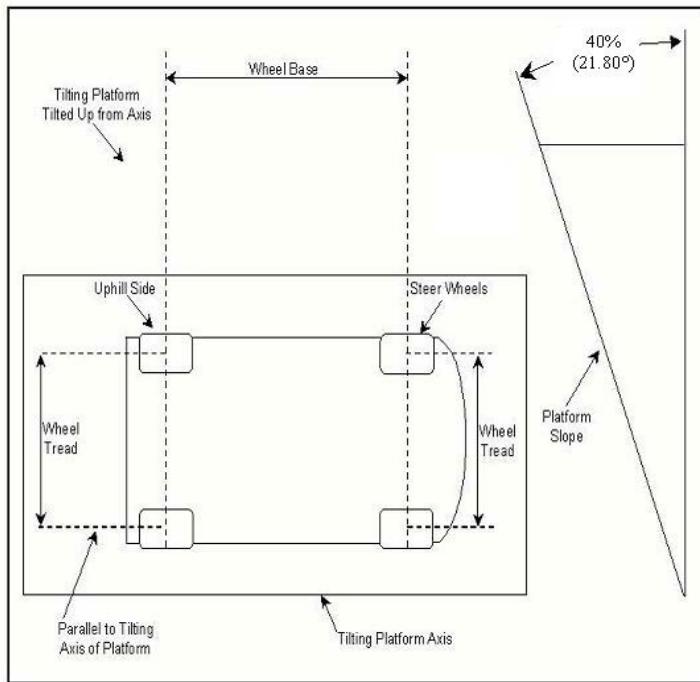
##### **8.8.3.2.1 Test conditions**

Test conditions shall be the same as given in 8.8.3.1.1

##### **8.8.3.2.2 Test**

The test shall be conducted as follows:

- a) The position of the test vehicle on the tilting platform shall be maintained by the parking brake.
- b) The vehicle with test load shall be placed on the tilting platform in accordance with Figure 4.
- c) The steerable tires of the test vehicle shall be positioned (Figure 4) such that a line from the center of contact of the lower rear tire to the center of contact of the steerable tire nearest to the tilting platform axis is parallel to the tilting axis of the platform.
- d) The steerable tires on the test vehicle shall be turned to be parallel to the tilting axis of the platform. The steering wheel may be restrained to prevent wheel movement during the test.
- e) The stability of the test vehicle shall be determined directly by tilting the platform to a 40% grade (21.80°).



**Figure 4 – Vehicle placement on lateral tilting platform (four wheel)**

#### 8.8.3.2.3 Test acceptance

Acceptance of the lateral stability test shall require that the supporting tires on the uphill side remain in contact with the surface, or that the vehicle slides under the test conditions expressed in 8.8.3.1.1. Failure shall have occurred when both of the vehicle's uphill tires lift off the platform before the platform exceeds the stability angle determined from Figure 4.

#### 8.8.4 Brake systems

##### 8.8.4.1 Service brake performance

###### 8.8.4.1.1 Test conditions

Test conditions shall be the same as in 8.8.1.1, except that in addition to the operator, the vehicle shall be loaded with the equivalent test weights in their respective designated positions as prescribed in 8.8.3.1.1 and the coefficient of friction shall be between 0.8 and 1.1 as determined by the following procedure:

- a) The test vehicle shall be loaded as specified in 8.8.3.1.1.
- b) The static weight on the braked tires shall be measured.
- c) The test vehicle shall be placed on the surface to be used in the braking tests.
- d) The front of the test vehicle shall be connected to a tow vehicle provided with a means for measuring the tow force.
- e) The test vehicle's brake shall be engaged such that the braked tires do not roll when the vehicle is towed.
- f) The test vehicle shall be pulled forward by the tow vehicle until it moves at least 254 mm (10 in) forward and the maximum tow force shall be recorded. The measurement shall be repeated for a total of three trials.
- g) The average of the three maximum tow forces shall be taken.

- h) If the average maximum tow force divided by the total weight on the braked tires is less than 0.8 or greater than 1.1, then the braking tests may not be run.
- i) The same service brake components shall be used for all tests.

#### **8.8.4.1.2 Test**

The test shall be conducted as follows:

- a) A constant load of 1112 N (250 lbf) shall be applied perpendicular to the geometric center of the brake pedal pad in the direction of application for a minimum of 5 minutes.
- b) After release of force on brake pedal, the test vehicle shall be run to its maximum operating speed and the brake then applied with a foot pedal force of no more than 556 N (125 lbf) when applied to the center of the service brake pedal.
- c) Burnished brakes are permissible following the manufacturer's approved procedure.

#### **8.8.4.1.3 Test acceptance**

There should be no permanent deformation of any component in the braking system after the application of the 1112 N (250 lbf) proof load.

The average deceleration of the test vehicle from the point of brake application to the point the vehicle comes to rest, shall be at a minimum of 0.33g.

Alternatively, the test vehicle shall stop within a distance from the point of brake application per the formula:

$$\begin{aligned} \text{Stopping Distance} & \quad (\text{in meters}) = 0.012V^2 \quad (\text{V in km / h}) \\ & \quad (\text{in feet}) = 0.100V^2 \quad (\text{V in mi / h}) \end{aligned}$$

#### **8.8.4.2 Service brake fade**

##### **8.8.4.2.1 Test conditions**

The test condition shall be the same as given in 8.8.4.1.1. The test vehicle shall be towed in the forward direction with the brake applied to produce a drag load determined by the following formula:

$$\text{Drag load} = \text{TFfr} + (0.342) \text{TVW},$$

where:

TFfr = towing force; free rolling;

TVW = test vehicle weight;

0.342 = downhill component of a 20° slope.

This drag load shall be maintained within 15% for 150 m (500 ft). The towing speed shall be between 40 and 50 percent of maximum level ground speed.

##### **8.8.4.2.2 Test**

The test shall be conducted as follows:

- a) The test vehicle shall be operated at maximum operating speed; the brake shall then be applied with a foot pedal force not to exceed 556 N (125 lbf) applied to the center of the brake pedal.
- b) For vehicles equipped with friction brakes, this test shall be performed before the brake linings have cooled more than 14°C (25°F) from the maximum temperature obtained during the tow period.
- c) Prior to test performance, burnished brakes are permissible.
- d) For vehicles equipped with alternative braking systems there shall be no adjustment or servicing of the brake system during the test. Test shall be performed with fully charged batteries.

#### **8.8.4.2.3 Test acceptance**

The average deceleration of the test vehicle from the point of brake application to the point the vehicle comes to rest, shall be at a minimum of 0.28g. Vehicles with regenerative braking must pass this test irrespective of battery state of charge.

Alternatively, the test vehicle shall stop within a distance from the point of brake application per the formula:

$$\begin{aligned} \text{Stopping Distance} &\quad (\text{in meters}) = 0.0144V^2 \quad (\text{V in km / h}) \\ &\quad (\text{in feet}) = 0.120V^2 \quad (\text{V in mi / h}) \end{aligned}$$

#### **8.8.4.3 Service brake fade recovery**

##### **8.8.4.3.1 Test conditions**

The test conditions shall be the same as those given in 8.8.4.1.1.

##### **8.8.4.3.2 Test**

The service brake test described in 8.8.4.1.2 shall be repeated after the braking system returns to ambient temperature.

##### **8.8.4.3.3 Test acceptance**

The test acceptance shall be the same as set forth in 8.8.4.1.3.

#### **8.8.4.4 Parking brake**

##### **8.8.4.4.1 Test conditions**

Test conditions shall be as follows:

- The test vehicle shall be loaded as specified in 8.8.3.1.1;
- The test vehicle shall be positioned on a 30% grade (16.7°) with its longitudinal centerline perpendicular to the intersection line of the 30% grade surface and the horizontal plane.

##### **8.8.4.4.2 Test**

With a maximum 556 N (125 lbf) force applied to the pedal to engage the parking brake or with a maximum 334 N (75 lbf) force applied to a hand-operated lever brake, the vehicle shall be positioned with its:

- Front end on the downhill side; and
- Rear end on the downhill side.

#### **8.8.4.4.3 Test acceptance**

The vehicle shall not move more than 76 mm (3 in) in one hour.

### **8.9 Battery installation**

#### **8.9.1 Ventilation**

The battery or batteries shall be located to minimize accumulation of battery gases within the vehicle.

## **9 Electric-powered PTVs**

### **9.1 Wiring systems**

#### **9.1.1 Grounding**

Wiring system assemblies, including accessories, options, or field-installed items, shall not be grounded to the vehicle chassis.

#### **9.1.2 Routing**

Wiring system assemblies shall be routed and contained within the PTV in such a manner as to provide adequate clearance to prevent damage from vibration, abrasion or heat-generating components and to avoid obstacles or projections that the vehicle may encounter during normal operation.

#### **9.1.3 General**

The wiring system shall have adequate capacity for the expected electrical loads.

#### **9.1.4 System Voltage**

Adequate guarding shall be provided to prevent exposure to nominal system voltages above 60V DC or 30V AC.

### **9.2 Heat-generating components**

Heat-generating components shall be mounted and contained within the PTV in such a manner as to prevent injury to occupants and damage to other vehicle components.

#### **9.2.1 Test conditions**

A test vehicle with fully charged batteries shall be set up and locked in such a manner as to prevent movement of the vehicle or rotation of the vehicle traction tires when the accelerator control is set at its maximum speed position.

Tests may be conducted indoors or in a covered area protected against the direct rays of the sun. Wind velocity in the test area shall not exceed an average of 8 km / h (5 mi / h). The temperature of the ambient air shall not be less than 19°C (65°F) or more than 30°C (86°F), and shall not vary more than 5.5°C (10°F) between maximum and minimum throughout the test period.

#### **9.2.2 Test**

The test shall be conducted as follows:

- a) Power shall be applied to the drive motor by means of the speed control device being set at the maximum speed position and held for 10 seconds.
- b) Immediately afterwards, the accelerator shall be placed at twenty percent (20%) of full pedal stroke past the point the system is energized and held for 30 minutes.

### **9.2.3 Test acceptance**

There shall be no incidents of fire and all electrical components shall remain contained within the test vehicle.

Any heat transfer through the test vehicle shall not produce an external surface temperature accessible to persons outside or on the vehicle in excess of 60°C (140°F) on metal surfaces and 85°C (185°F) on nonmetal surfaces.

## **9.3 Chargers for vehicles**

Chargers shall comply with UL, IEC, CSA or other required national or applicable safety certifications.

The vehicle drive system shall not be operable when the charger system is connected to the vehicle from an external power source.

## **9.4 Impact containment**

### **9.4.1 Test conditions**

Test conditions shall be as follows:

- Where applicable, remove acid from discharged lead acid batteries and rinse with water to minimize acid-related accidents during testing. Refill cells with water. If batteries other than lead acid are used, precautionary measures should be taken to minimize potential hazards.
- Horizontally flat surface, 1.0% grade (0.8°) maximum;
- Straight course;
- Sufficient track length to allow test vehicles to reach average maximum speed as specified in 8.8.1.3;
- An unyielding, flat concrete or steel barrier with sufficient strength to fully resist the impact of the test vehicle at the test speed. The barrier shall be wider than the vehicle.

### **9.4.2 Test**

A test vehicle shall be propelled into the barrier at maximum speed in the forward direction and at maximum speed in the reverse direction.

### **9.4.3 Test acceptance**

The battery or batteries shall not become a projectile that presents a hazard to the occupants.

## **9.5 Roll-over containment**

### **9.5.1 Test conditions**

Test conditions shall be as follows;

- Where applicable, remove acid from discharged batteries and rinse with water to minimize acid-related accidents during testing. Refill cells with water. If batteries other than lead acid are used, precautionary measures should be taken to minimize potential hazards;
- The test shall be conducted on a concrete or asphalt surface.

### **9.5.2 Test**

The test vehicle shall be tilted by elevating one side up to the point just past the point of neutral stability and released so the test vehicle completes at least one quarter revolution (90°) in a lateral direction on its own accord. The test shall be repeated in the opposite lateral direction. Either the same vehicle or a different vehicle may be tested for each direction.

### 9.5.3 Test acceptance

After each test, the battery or batteries and their contents shall be contained within the test vehicle battery compartment. Leakage from battery vent system, if present, is permissible.

## 10 Internal combustion powered vehicles

### 10.1 Wiring systems

#### 10.1.1 Grounding

Wiring systems assemblies may be grounded to the PTV chassis, providing the electrical system is twelve (12) volts nominal or less.

#### 10.1.2 Routing

Wiring system assemblies shall be routed and contained within the PTV in such a manner as to provide adequate clearance from heat-generating components and to avoid obstacles or projections that the vehicle may encounter during normal operation.

### 10.2 Heat-generating components

Heat-generating components shall be mounted and contained within the PTV in such a manner as to prevent injury to occupants and damage to other PTV components.

#### 10.2.1 Test conditions

Test conditions shall be as follows:

- Tests may be conducted indoors or in a covered area protected against the direct rays of the sun. Wind velocity in the test area shall not exceed an average of 8 km / h (5 mi / h). The temperature of the ambient air shall not be less than 18°C (65°F) or more than 30°C (86°F), and shall not vary more than 5.5°C (10°F) between maximum and minimum throughout the test period;
- Operating temperatures measured at any one time shall be related to the ambient temperature of the air at the same time and location;
- The test vehicle weight (TVW) shall be such that it creates the most severe conditions;
- The test vehicle shall be configured in accordance with manufacturer's recommendations to achieve the most severe conditions for heat, including manufacturer-approved accessories.

#### 10.2.2 Test

The test shall be conducted as follows:

- a) Operate the test vehicle to obtain steady state engine oil temperature. Steady state may be achieved by operating the test vehicle for one cycle of the UDDS. Steady state may also be achieved by driving the vehicle for a minimum of 30 minutes on flat ground with stops at least every 200 yards until the engine oil temperature does not fluctuate more than 5% over a 5 minute period.
- b) Immediately operate for 183 m (200 yards) under steady load. Steady load is defined by the following formula:

$$\text{Steady load} = \text{TFfr} + (0.342) \text{ TVW}$$

where:

TFfr = towing force; free rolling;

TVW = test vehicle weight;

0.342 = downhill component of a 20° slope.

- c) Stop the vehicle and record temperature measurements on the surfaces described in 10.2.3 until temperature rise has reached the peak point. Peak point shall be considered achieved when the temperature begins to diminish.

### **10.2.3 Test acceptance**

Any heat transferred through the test vehicle shall not produce an external surface temperature accessible to persons outside or on the vehicle in excess of 60°C (140 °F) on metal surfaces or 85°C (185 °F) on nonmetal surfaces.

## **10.3 Fuel systems**

### **10.3.1 General**

Fuel systems shall comply with the requirements of ANSI/OPEI B71.10.

### **10.3.2 Fuel shut-off**

Fuel systems shall have a fuel shut-off mechanism between the tank and engine. An electronic fuel injector may serve as a fuel shut-off mechanism.

### **10.3.3 Impact containment**

#### **10.3.3.1 Test conditions**

Test conditions shall be as follows:

- Horizontally flat surface, 1.0% grade (0.8°) maximum;
- Straight course;
- Sufficient track length to allow test vehicles to reach maximum speed as specified in 8.8.1.3;
- An unyielding, flat concrete or steel barrier with sufficient strength to fully resist the impact of the test vehicle at maximum speed;
- Fuel tank and battery(s) shall be filled to recommended capacity with water.

#### **10.3.3.2 Test**

A test vehicle shall be propelled into the barrier at maximum speed in the forward direction and at maximum speed in the reverse direction.

#### **10.3.3.3 Test acceptance**

The fuel tank shall be contained within the test vehicle and maintain its integrity.

### **10.3.4 Roll-over containment**

#### **10.3.4.1 Test conditions**

Test conditions shall be as follows:

- The fuel tank and battery(ies) shall be filled to recommended capacity with water;
- The test shall be conducted on a concrete or asphalt surface.

#### **10.3.4.2 Test**

The test vehicle shall be tilted by one side up to the point just past the point of neutral stability and released so the test vehicle completes at least one quarter turn (90°) in a lateral direction on its own accord. The test shall be repeated in the opposite lateral direction. Either the same vehicle or a different vehicle may be tested for each direction.

#### **10.3.4.3 Test acceptance**

After each test, the fuel tank shall be contained within the test vehicle and maintain its integrity.

**Annex A**  
(informative)

**Rationale**

Section 8.7.8 – The Committee recognizes SAE J2358 as an existing standard for low-speed vehicles. Additional study is required to develop the appropriate OPS requirements for PTVs. Other OPS may provide adequate protection for PTVs.