American National Standard

for Commercial Turf Care Equipment – Safety Specifications

ANSI B71.4-2004

Approved American National Standard

ANSI

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ANSI B71.4-2004
Revision and redesignation
of ANSI/OPEI B71.4-1999

American National Standard

for Commercial Turf Care Equipment - Safety Specifications

Secretariat

Outdoor Power Equipment Institute, Inc.

Approved February 24, 2004

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard ANSI B71.4-2004.)

This standard is a revision of *American National Standard for Commercial Turf Care Equipment - Safety Specifications*, ANSI/OPEI B71.4-1999. The first edition of this standard was approved and published by the American National Standards Institute in 1980. It has been revised four times since initial publication, including this revision.

The present revision was prepared by the Outdoor Power Equipment Institute (OPEI) Subcommittee on Commercial Turf Care Equipment as part of OPEI's continuing work on standards.

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

- Addition of definition and requirements for Stand-on Machines and Sulky units
- Changes to the temperature requirements for hot surfaces
- Changes to the safety sign requirements to allow for no-text signs
- Addition of stability requirements for machines with grass catchers
- Harmonization of pressurized components requirements with ISO Standards
- Changed stability requirements for zero-turn machines with ROPS
- Harmonization of thrown objects text criteria with ISO/CEN standards

Consensus for this standard was achieved by the use of the Canvass Method.

There are four annexes in this standard. Annexes A, B, C, and D are informative and are not considered part of this standard.

Suggestions for improvement of the standard will be welcome. They should be sent to the Outdoor Power Equipment Institute, 341 South Patrick Street, Alexandria, VA 22314.

The following organizations recognized as having an interest in the standardization of safety requirements for power lawn mowers, land and garden tractors, and lawn tractors were contacted prior to the approval of this revision of the standard. Inclusion in the list does not necessarily imply that the organization concurred with the submittal of the proposal to ANSI.

American Consulting
American Nursery & Landscape
American Society of Agricultural Engineers
Deere & Company
McCanse Consulting
SGS US Testing Company, Inc.
Texas Tech University
Textron Golf, Turf & Specialty
The Toro Company
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American National Standard

for Commercial Turf Care Equipment – Safety Specifications

1 Scope

The safety specifications in this standard apply to powered pedestrian-controlled, towed, and ride-on machines intended for marketing as commercial turf care equipment and that are customarily used by hired operators. Equipment covered may consist of two or more components that are functionally connected and may be produced by different manufacturers. Each functional component shall conform to each section of this standard as it logically applies. Additionally, this standard applies to all aftermarket parts, attachments and accessories provided by the original equipment manufacturer and others. Any manufacturer of aftermarket parts, attachments and accessories is responsible for ensuring compliance to this standard.

These specifications are not intended to apply to:

- turf care equipment that is designed primarily for personal use by a consumer in or around a permanent or temporary household or residence;

- equipment that is designed primarily for agricultural purposes; and

- equipment that is designed primarily for cutting grass and other growth on highways and is designed for operation with agricultural/industrial tractors.

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, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI Z535.4-2002, *Product safety signs and labels*

ANSI/ASAE S279.10-OCT98, *Lighting and marking of agricultural equipment on highways*

ANSI/SAE J517-FEB98, *Hydraulic hose*

ANSI/SAE J1163-AUG97 (RMAY00), *Determining seat point index*

ANSI/SAE J1362-JUL97, *Graphical symbols for operator controls and displays on off-road self-propelled work machines*

ANSI/UL 73-1998, *Standard for safety for motor-operated appliances*

ASAE S217.11-DEC91, *Three-point free-link hitch attachment of implements to agricultural wheeled tractors* [1)]

ASAE S278.6-DEC84, *Attachment of implements to agricultural wheel tractors equipped with quick attaching coupler for three-point free-link hitch*

ASAE S318.11-MAR95, *Safety for agricultural field equipment*

1) ASAE standards are available from the American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085-9569.

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ASAE S320.1-MAY98, *Category "0" three-point free-link attachment for hitching implements to lawn and garden riding tractors*

ASAE S348.2-FEB94, *One-point tubular sleeve attachment for hitching implements to lawn and garden ride-on tractors*

ASTM G23, *Recommended practice for operating light- and water-exposure apparatus (carbon-arc type) for exposure of nonmetallic materials* [2)]

ASTM G26, *Recommended practice for operating light-exposure apparatus (xenon-arc type) with and without water for exposure of nonmetallic materials*

ISO 3767-1:1998, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 1: Common symbols* [3)]

ISO 3767-2:1991, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 2: Symbols for agricultural tractors and machinery*

ISO 3767-3:1995, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Symbols for operator controls and other displays – Part 3: Symbols for powered lawn and garden equipment*

SAE J156-JUN94, *Fusible links*[4)]

SAE J533-APR96, *Circuit breakers*

SAE J554-AUG87, *Electric fuses (cartridge type)*

SAE J715-JUN93, *Three-point free-link hitch attachment of implements to agricultural wheeled tractors*

SAE J909-JUN93, *Three-point hitch, implement quick-attaching coupler, agricultural tractors*

SAE J1127-JAN95, *Battery cables*

SAE J1128-JAN95, *Low-tension primary cable*

SAE J1284-APR88, *Blade-type electric fuses*

SAE J1292-OCT81, *Automotive, truck, truck tractor, trailer, and motor coach wiring*

SAE J2031-MAY95, *High-tension ignition cables*

3 Definitions

3.1 agricultural equipment: Agricultural tractors, self-propelled machines, implements, and combinations thereof designed primarily for use in agricultural operations.

3.2 attachment: A component designed primarily to perform a specific task and for mounting on a specific machine, normally utilizing the machine's or a self-contained power and control system. These attachments may be detachable, but are not intended to be universally adaptable to other machines.

3.3 battery low-voltage circuit: An open circuit with a peak potential of 42.0 volts supplied by a primary battery, by a standard Class 2 transformer, or by a suitable combination of a transformer and a fixed impedance that, as a unit, complies with all performance requirements for Class 2 transformers. (See 2.4 of ANSI/UL 73.)

3.4 commercial turf: Grass and similar vegetative materials that are primarily intended for ornamental, recreational, and beautification purposes, that are customarily maintained by hired operators.

3.5 durable label: A label for the purpose of warning, instruction, or identification that shall meet or exceed the requirements of 4.2.3 of this standard.

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2) ASTM standards are available from the ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

3) ISO standards are available from the American National Standards Institute, 25 West 43rd Street, New York, NY 10036.

4) SAE standards are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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3.6 equipment

3.6.1 towed: Implements that are pulled from the drawbar of a propelling machine, and are usually equipped with wheels for transport.

3.6.2 semi-mounted: Implements that are partially mounted and carried by the propelling machine, and are partially carried on their own wheels during operation and transport.

3.6.3 mounted: Implements that are mounted directly to the propelling machine, and are carried by the propelling machine during transport.

3.7 flail power rake: A power rake that raises thatch or debris from the turf by a multiplicity of free-swinging knives that rotate about an axis parallel to a mowing plane.

3.8 front blade enclosure: That portion of the blade enclosure between lines extending forward and outward at 50 degrees (maximum) angles to the longitudinal centerline of the mower from the center of the blade on single-blade mowers, or from the center of the outboard blades on multiblade mowers. (See figure 10.)

3.9 functional component: A working mechanism of an attachment or implement designed to perform a specific task, such as the rotary blades of rotary mowers or the reel and shear bar of reel mowers.

3.10 guard (or shield): A barrier that minimizes inadvertent personal contact with hazards created by machinery parts or other items. A removable guard or shield is a guard or shield that can be removed without the use of tools and will not prevent machine operation.

3.11 guarded by location: When a potential hazard is guarded, it is covered by other parts or components on the machine or, because of its remote location, inadvertent contact by the operator or another person is minimized during normal operation or servicing.

3.12 ground-driven components: Components that are powered by the turning portion of a wheel as the implement travels over the ground.

3.13 hit: Test projectile passing completely through all the layers of the target test material.

3.14 horizontal angle of discharge opening: Angle in the horizontal plane of the blade formed by the two lines tangent to the blade tip circle (in the direction of blade rotation) and intersecting the opposite surfaces of the discharge opening. For multiblade mowers, this angle is the maximum angle formed by any two tangent lines considering all blade circles. (See figure 10.)

3.15 implement: A tool, apparatus, or device that is universally adaptable to ride-on turf tractors and forms part of the total equipment necessary to perform an activity or an operation.

3.16 inadvertent contact: Contact between a person and machinery hazard, or other type of hazard, resulting from the person's unplanned actions during normal operation.

3.17 jackknifing: Sulky articulation that results in either:

- prevention of further operation in the reverse direction;
- entrapment of the operator; or
- sufficient displacement of the operator to cause loss of control.

3.18 lever steer machine: A machine in which steering, traction drive engagement, traction speed control or braking, or a combination thereof, may be combined and controlled by a hand-operated lever(s).

3.19 lift-off: A test condition in which a strip of steel 1 mm (0.039 in) thick and 50 mm (2 in) wide can be pulled from or moved under any tire with a force of 9 N (2 lbf) or less.

3.20 machinery hazard: A source of potential injury created by machinery that can cause serious injury upon contact or by entanglement of personal apparel. These hazards include, but are not limited to, the pinch points of power-driven gears, run-on points of belts and chains, and projections on rotating parts.

3.21 master clutch: A clutch that interrupts power from the engine and simultaneously controls both travel and the power takeoff.

3.22 moving traction element: The exposed power-driven components that transmit the tractive power from the vehicle or machine to the ground (such as drive wheels and tires or track).

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3.23 mowers

3.23.1 flail: A mower that cuts by impact with a multiplicity of free-swinging knives that rotate about an axis parallel to the mowing plane.
3.23.2 mulching: A rotary mower that has a fixed or optional configuration without openings in the blade enclosure, above the plane of the blade, for discharge of grass clippings.

3.23.3 power turf: A turf-mowing machine that has an engine or a motor as a power source. It may be either a pedestrian-controlled unit, a ride-on unit, or an attachment for a pedestrian-controlled or ride-on turf tractor.
3.23.4 reel (powered or ground-driven): A turf-mowing machine with one or more cutting blades rotating about an axis parallel to the mowing plane, that provides a shearing action with a stationary shear bar.
3.23.5 rotary: A power mower in which one or more elements cuts or shears by impact while rotating about an axis perpendicular to the mowing plane.

3.24 normal operating position: The space within the operator zone that is occupied by the operator while using turf equipment.

3.25 operator-presence control (OPC): A control designed so that it will automatically interrupt power to a drive when the operator's actuating force is removed.

3.26 power takeoff (PTO) and power takeoff auxiliary (PTO Aux):

- power takeoff: An external shaft on the rear of a tractor that provides rotational power to implements or attachments.

- power takeoff auxiliary: An external shaft on a tractor, other than the rear PTO, that provides rotational power to implements or attachments that are usually front mounted, under mounted, or side mounted.

3.26.1 continuous-running power takeoff: Power to operate both the transmission and the power takeoff is transmitted through a master clutch. Both operate only when the master clutch is engaged. Auxiliary means are provided for stopping the travel of the tractor without stopping the power takeoff. The continuous-running power takeoff ceases to operate any time the master clutch is disengaged.
3.26.2 independent power takeoff: Power to operate the transmission and power takeoff is transmitted and controlled through independent drive clutches. Travel of the machine may be started or stopped by operation of the transmission clutch without affecting operation of the independent power takeoff.
3.26.3 transmission-driven power takeoff: Power to operate both the transmission and the power takeoff is transmitted through a master clutch, which serves primarily as a traction clutch. The power takeoff operates only when the master clutch is engaged. The transmission-driven power takeoff ceases to operate any time the master clutch is disengaged.

3.27 parking brake system: A system used to hold one or more brakes or braking means continuously in an applied position.

3.28 propelling machine: A tractor or self-propelled machine.

3.29 shall: The word "shall" is to be understood as a requirement.

3.30 should: The word "should" is to be understood as a recommendation

3.31 safety sign: A durable label used to convey safety information that meets the requirements for safety signs as specified in ANSI Z535.4 for format and color and the additional requirements of 4.2.3 of this document. Safety pictorials, such as shown in Annex C, may be used to supplement or replace text messages on safety signs.

3.32 service brake system: The designated primary brake system used for decelerating and stopping a machine.

3.33 target material: An uncoated, 350-lb, double-wall or single-wall corrugated cardboard.

3.34 target penetration: Rupture of all layers of a 350-lb corrugated target.

3.35 target strike: Rupture of the front layer and no rupture of the back layer of a 350-lb corrugated target.

3.36 test operator: A person weighing approximately 91 kg (200 lb) and having an approximate height of 188 cm (74 in) and with a reach as shown in figures 1 and 2.

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3.37 tractors
3.37.1 ride-on turf: A self-propelled ride-on machine, designed for commercial turf work, that is generally designed for mowing turf, is capable for use with implements or attachments, has all implements or attachments separate from the tractor, and has provisions for lifting mounted implements or attachments.
3.37.2 pedestrian-controlled: A machine, normally controlled by an operator walking with the unit, designed to power and propel a variety of attachments.

3.38 units
3.38.1 ride-on: A self-propelled machine that is ridden and is primarily designed for a single purpose using an integrally mounted and controlled attachment.
3.38.2 pedestrian-controlled: A machine, either pushed or self-propelled, normally controlled by an operator walking with the unit.
3.38.3 stand-on: A self-propelled ride-on machine that is normally controlled by an operator standing on the unit, generally designed for mowing turf and performing other commercial turf work.

3.39 vertical angle of opening: The angle formed in a vertical plane between the horizontal plane and an unobstructed straight line tangent to the blade tip circle extending, in the direction of rotation, to a vertical extremity of the opening. For a multiblade mower, this vertical angle of opening is to be determined for each blade. (See figure 10.)

4 General requirements

All evaluation and tests shall be conducted with the machine set up to manufacturers' specifications and operating configurations unless otherwise specified. Tests in this standard apply only to a configuration of attachments/implements/accessories approved by their respective manufacturers.

4.1 Guarding and shielding

Inadvertent contact with machinery hazards shall be minimized during normal mounting, starting, operating, or dismounting of the equipment by guarding or shielding, if these hazards are not guarded by location. Inadvertent contact may be determined by a 95th-percentile adult male operator using the finger probe requirement of 4.4.5 to determine if a hazardous area is adequately protected. The probe is used to check hazardous conditions during normal starting, operating, mounting, and dismounting of the equipment. Probing shall be restricted to those areas that may be contacted during these specified activities.

4.1.1 The following are some of the potential hazard areas:

a) Moving traction elements;

b) Rotating engine components;

c) Pinch points of gears and the run-on point where a belt or chain contacts a shoe, sprocket, or idler;

d) Outside faces of pulleys, sheaves, sprockets, and gears on drives that rotate when the engine is running with all clutches disengaged;

e) Rotating parts with projections such as exposed bolts, keys, or set screws;

f) Revolving shafts, except smooth (without keyways and splines) shaft ends protruding less than one-half the diameter of the rotating element;

g) Ground-driven components, if operating personnel are exposed to them while drives are in motion;

h) Hot surfaces (engine, hydraulic, transmission, etc.) that exceed a temperature of 90°C (194°F) for nonmetallic surfaces, or 80°C (176°F) for metallic parts, while operating at 21°C (70°F);

i) Power takeoff (PTO) shafts; and

j) Function components (see clause 8).

4.1.2 Any guards or shields should remain effective when subjected to a force exerted by a 113-kg (250-lb) individual leaning or falling against it. This applies only to those forces that could be expected during normal operation or maintenance. In assessing whether guards or shields meet this requirement, it should be determined how the 113-kg (250-lb) individual could exert the maximum force on the guards or shields to be checked based on the position of the individual to the guard or shield. The individual should assume that position and exert that force against the guard or shield. The same approach should be used for determining the adequacy for falling (or

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stepping) on a guard or shield. The effectiveness of a guard is determined by its ability to prevent inadvertent contact with a potential hazard as described in 4.1.1.

4.1.3 Equipment with access doors and shields that can be opened or removed while components continue to rotate more than seven (7) seconds after the power is disengaged shall have:

a) visible or audible indication of rotation; and

b) a suitable safety sign near the opening.

Visible indication of rotation, or movement of hazardous machinery components, shall be seen by the person opening an access door or shield before the access door or shield is opened. Audible indication of rotation or movement shall be detectable at the point of access to the hazardous area.

4.1.4 Access doors and shields that must be opened for normal servicing shall be easily opened and closed.

4.1.5 The operator's manual shall state that the machine shall not be operated without guard(s)/shield(s)/cover(s) in place.

4.1.6 If a guard is constructed of woven fabric or any material that may be subject to wear or deterioration, a notice shall be provided in the operator's manual, stating that it requires frequent inspection and replacement with parts of equal quality.

4.2 Labels and instructions

4.2.1 Control Identification

4.2.1.1 Controls whose function is not obvious shall have the function, direction, and/or method of operation clearly identified with a durable label or mark. When appropriate symbols, as described in ANSI/SAE J1362, ISO 3767-1, 3767-2, or 3767-3, exist, they should be used for control identification. Detailed instruction on the operation of all controls shall be provided in the operator's manual.

4.2.1.2 General safety sign requirements

4.2.1.2.1 A safety sign with the following safety practices or a similar set of messages shall be provided on the machine. The label should be visible to an operator in the operator's position, if possible:

(a) Read the operator's manual;

(b) Do not operate the machine without guards, shields, and safety devices in place and working;

(c) Do not operate the machine when children and/or others are around; and

(d) Do not operate this machine unless you are trained.

Pictorials may be used to convey the above messages. Additional statements and/or pictorials of safety practices are allowed.

4.2.1.2.2 Safety pictorials, such as shown in Annex C, may be used to supplement or replace product safety information. If used, appropriate explanatory text shall be included in the operator's manual.

4.2.1.2.3 If a safety sign is located on a removable guard or shield, a safety sign shall be located under the removable item, indicating the machine must not be operated without the guard or shield in place.

4.2.2 Identification

4.2.2.1 Machine identification

The machine shall be provided with identification giving the name of the manufacturer or supplier; model number or serial number, or both; and the name and address of a U.S. source of replacement parts. Machine identification shall be expected to remain on the machine during the period the machine is capable of being used. Types of machine identification deemed acceptable are provided below.

4.2.2.2 Machine identification label

Machine identification shall be in the form of labels, silk screening, nameplates, or other forms and shall meet the following requirements:

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- Labels shall form a durable bond with the base material surface and show no appreciable loss of adhesion during weathering exposure. The edges of the labels shall not curl. Labels shall not lose legibility nor suffer appreciable loss of adhesion when exposed to occasional contact with fuel or oil. The label shall meet the weathering requirements of 4.2.3.1;
- Embossed, indented, cast, or molded identification meeting the requirements of 4.2.3.1 shall be considered to be sufficient as meeting the requirements of the subclause;
- Metal nameplates more that 0.48 mm (0.019 in) thick with embossed or etched lettering, and fastened with rivets or equivalent fastening means, shall be considered sufficient as meeting the requirements of the subclause.

4.2.3 Label durability requirements

4.2.3.1 General

Required labels shall meet the following label durability requirements. Required labels are considered to have a reasonable life if the sign has good color and legibility for a period of at least five years. Exterior durability is based on vertical exposure tests for weatherability in the extreme climate of the United States, or a 2000-hour carbon-arc test in accordance with ASTM G23, or a 2000-hour xenon-arc test in accordance with ASTM G26. Other test methods may be used, providing the method ensures equal or superior sign durability.

4.2.3.2 Additional requirements

Labels shall form a durable bond with the base material surface and shall show no appreciable loss of adhesion or legibility during weathering exposure or exposure to spilled fuel or oil. When processed and applied in accordance with the label manufacturer's recommendations, labels shall be weather resistant in accordance with 4.2.3.1 and, following normal cleaning procedures, shall show no appreciable fading, discoloration, cracking, crazing, blistering, or dimensional change. Labels shall not curl at the edges.

4.2.3.3 Types considered durable

4.2.3.3.1 Embossed, indented, cast, or molded labels shall be considered sufficient to meet the requirements of 4.2.3.1.

4.2.3.3.2 Metal plates more than 0.48 mm (0.019 in) thick with embossed or etched lettering, and fastened with rivets or equivalent fastening means, shall be considered sufficient to meet the requirements of 4.2.3.1.

4.2.3.3.3 Silk screening or other types of marking, when used, shall meet the applicable requirements of 4.2.3.1 and 4.2.3.2.

4.2.4 Operation, service, and maintenance instructions

4.2.4.1 General requirements

Specific written instructions shall be provided with the equipment describing the proper operation of the machine, personal safety, and maintenance procedures. The manual shall contain instructions such as those presented in figure 3. The instructions in figure 3 are not all-inclusive. Instructions provided in the manual should be tailored to the specific machine, as all of figure 3 may not pertain to a particular machine.

4.2.4.2 Stored-energy devices

Stored-energy devices such as, but not limited to, pressurized fluid systems (for example, engine cooling systems and hydraulic accumulators) and spring-loaded mechanisms that can be disconnected or disassembled in a manner that may release energy or material in a hazardous manner (which is not obvious when disconnecting or disassembling a system or component) should have an appropriate safety sign on or near the device. The sign shall include instructions for de-energizing and for proper disassembly, or include a reference to instructions provided in the operator's manual.

4.2.4.3 Hydraulic devices

The operator's, service, and maintenance manuals shall contain

a) information that hydraulic fluid escaping under pressure may have sufficient force to penetrate skin and cause serious injury, and that if foreign fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this form of injury, or gangrene may result;

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b) a warning to keep body and hands away from pinholes or nozzles that eject hydraulic fluid under high pressure, and to use paper or cardboard and not hands to search for leaks;

c) information explaining how to safely relieve all pressure in the system before disconnecting the lines or performing work on the system; and

d) a warning to make sure all hydraulic fluid connections are tight and all hydraulic hoses and lines are in good condition before applying pressure to the system.

4.2.4.4 Pressurized components

Where hoses, lines and other pressurized components are operating at a maximum working pressure greater than 5000 kPa (700 psi) or at temperatures greater than 50°C (120°F), and are located within 500 mm (20 in) of the operator zone, they shall be located or shielded so that, in the event of a rupture, the fluid cannot be discharged directly on to the operator when in the normal operating position.

4.3 Requirements for low-voltage electrical components

4.3.1 Insulated cables

All insulated cables shall meet the requirements of SAE J1127 and J1128 and the recommended practices of SAE J1292, where applicable.

4.3.2 Battery installation

The compartment for a vented storage battery shall have openings to provide ventilation and drainage. Drainage of acid from the battery in any of the normal operating positions shall not contact parts that will be affected to the extent that a hazard will be created. The compartment need not be a complete enclosure, but must be designed so that the described drainage hazards are avoided.

4.3.3 Overload protection

Circuits, except starting motor and ignition circuits, shall have appropriate overload protective devices on the battery feed side of switches, except that in two-wire nongrounded systems, the overload protection may be located in either line. Overload protective devices shall comply with requirements of SAE J156, J533, J554, or J1284.

4.3.4 Terminals and uninsulated electrical parts

Protection shall be provided against short-circuiting of terminals and uninsulated electrical parts during normal refueling, lubrication, and servicing. Terminals and electrical parts other than those having zero potential to ground shall be insulated if they are located within the reach of the extended body and hand of a 95th-percentile adult male operator standing unassisted in the position where he would most usually perform refueling, lubrication, and servicing. Terminals beyond reach, and those covered by guards that do not need to be removed for normal servicing, are required to be insulated only in accordance with the insulation requirements of electrical specifications otherwise referred to in this standard.

4.3.5 High-tension ignition cables

All high-tension ignition cables shall meet the requirements of SAE J2031.

4.4 Operator zone

4.4.1 Operator position

The operator position zones are shown in figures 1 and 2.

4.4.2 Engine exhaust

Provision shall be made so that the engine exhaust is directed away from the operator zone.

4.4.3 Moving components

Any moving components in the operator zone shall not cause injury to or unstable displacement of the operator, during normal operation.

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4.4.4 Batteries, fuel systems, oil reservoirs, and coolant systems

Batteries, fuel systems, oil reservoirs, and coolant systems shall be constructed and located or sealed to prevent spillage into the normal operator position when the machine (serviced to recommended maximum fluid levels) is tilted for one minute to the maximum angles specified in 5.4.8 and 6.3.5.

4.4.5 Finger probe requirements

The probe shown in figure 4 shall be used to determine accessibility of hazardous components to the operator while in the normal operating zone. The finger probe shall not contact any machinery hazard or other hazard while being inserted into any opening of a guard or protective device from the operator zone. The probes shall be inserted with a force of 111 N (25 lbf). The area to be probe-tested shall be extended beyond the operator zone depicted in figures 1 and 2 by the distance that the upper body of a 95th-percentile adult male operator may articulate until restrained by a steering wheel, handle bar, or other barrier. This extension is allowed, provided the operator remains seated on riding mower or standing in a normal position to operate a pedestrian-controlled mower.

4.5 Operator's controls

Controls shall accommodate the 5th to the 95th percentile adult male operator, who is dressed appropriately for the weather in which the machine is being operated, unless stated otherwise.

4.5.1 The location and range of movement of operating controls (except engine starting) necessary for machine control shall remain within the confines of the operator zone as shown in figures 1 and 2, and shall be convenient to the operator. On pedestrian-controlled units, the parking brake may be set and released by foot, provided the service brake is engaged by hand from within the pedestrian-controlled operator zone.

The operating range of less frequently used controls may be extended by allowing the operator's body to move within the confines of the operator zone while the operator is sitting (ride-on machines) or standing with both feet on the ground (pedestrian-controlled units). (For example, the operator can lean forward and contact the steering control or handle bars while in any operating position.)

4.5.2 Foot-operated controls shall be of size, spacing, and configuration for proper operation. A slip-resistant means shall be provided to minimize the possibility of the operator's foot losing contact with the controls.

4.5.3 Hand-operated controls shall provide a minimum hand clearance of 25 mm (1.0 in) between controls throughout the operating range, except for similar-function cluster controls that are intended to be operated simultaneously by the same hand, controls requiring stabilization by means of hand support, or controls requiring less than 10 N (2.2 lbf) to activate.

4.5.4 A shutoff device shall be provided to stop operation of the engine (motor). This device shall require manual and intentional activation in order to restart the engine (motor). A key switch, or similar device, shall be provided on all electric-powered and electric-start units to prevent unauthorized operation of the unit.

4.5.5 For ride-on units, ride-on turf tractors, and pedestrian-controlled tractors, the engine shall not start unless:

- all drives to functional components are disengaged, and
- the traction drive, when provided, is disengaged or in neutral.

4.5.6 For pedestrian-controlled units, the engine shall not start unless the traction drive, when provided, is disengaged. Such means shall not be required on units equipped with traction-drive operator-presence controls.

4.5.7 The direction of motion for hand-operated and foot-operated engine speed controls shall be as follows:

a) *Pull-type hand-operated controls:* Towards the operator to increase engine speed;

b) *Other hand-operated types:* Generally forward or upward to increase engine speed; and

c) *Foot-operated controls:* Generally forward or downward to increase engine speed. The foot control, when released, shall automatically return to its idle position or shall be overridden by the service brake.

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4.5.8 Operator-presence controls

4.5.8.1 Ride-on units and ride-on turf tractors

A means shall be provided that will automatically stop the implement/attachment when the operator leaves the normal operator position. If stopping time exceeds seven (7) seconds, audible or visual indications of component movement shall be provided. If the operator returns to the operator's position before the implement/attachment has stopped, the implement/attachment may automatically resume operation. Implement/attachment starting shall require intentional reactivation by means other than the operator-presence control after stopping.

A means shall be provided that automatically stops or disengages the traction drive when the operator leaves the normal operator position.

4.5.8.2 Pedestrian-controlled units and pedestrian-controlled tractors

A means shall be provided that will automatically stop the implement/attachment after the operator deactivates the control. If stopping time exceeds seven (7) seconds, audible or visual indications of component movement shall be provided. Such means shall prevent the implement/attachment from operating unless the operator continuously activates this means. If the operator returns to the operator's position before the implement/attachment has stopped, the implement/attachment may automatically resume operation.

For restarting the implement/attachment, two separate actions shall be required. If these actions are to be carried out by using the same control, i.e., a double action device, the actions shall be distinct in order to prevent accidental "switch-on." On self-propelled units, the driving mechanism of the machine traction drive shall be switched on and off independently of the implement/attachment control.

A means shall be provided that automatically stops or disengages the traction drive when the operator leaves the normal operator position. If the operator returns to the operator's position before the traction drive has stopped, the traction drive may automatically resume operation.

4.5.8.3 The operator-presence control described in 4.5.8.1 shall be operable under all normal operating conditions including, but not limited to, slopes and rough operating terrain. The operator shall be able to shift body weight and position without inadvertent and unnecessary stopping of the implement/attachment or interruption of the engine ignition.

4.5.8.4 A bypass means may be provided to allow stationary operation of the PTO with the operator not in the operator's position. Such means shall return to the operator-presence mode as described in 4.5.8.1 or 4.5.8.2 when the operator returns to the operator position.

4.5.8.5 Ride-on machine additional requirements (Not applicable to pedestrian-controlled machines)

4.5.8.5.1 The mower shall be positioned on a 15-degree test slope with its longitudinal axis perpendicular to the slope with an operator on the mower. The operator for this test shall have a weight of 48 kg to 53 kg (105 lb to 125 lb) and a height of 1.5 m to 175 m (59 in to 64 in). The seat shall be adjusted for the operator. With the operator positioned against the seat buttock support, the operator shall be able to operate the following controls through their full operating range:

- steering;
- traction drive (transmission speed selector, traction drive disengaging means, or both);
- PTO drive (mower drive); and
- service brake.

The operator's spine shall remain generally vertical in a lateral plane. The machine shall be checked in both directions. The drives and engine shall remain operational without having to exert other than the normal contact with the operator-presence control.

4.5.8.5.2 If the operator-presence control described in 4.5.8.1 is a seat sensor, then the sensor shall undergo the following test procedure:

a) Place the machine on a surface level within one (1) degree;

b) Place an operator with physical dimensions as described in 4.5.8.5.1 or seat index point (SIP) device (as described in ANSI/SAE J1163), without the weights, on the seat cushion and slide the device rearward to contact the seat back. The SIP device should be centered on the cushion in the normal operator's position;

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c) If the SIP device is used, add weights as indicated by the vertical arrow in figure 1 of ANSI/SAE J1163 to bring the total mass of the device to 27 kg to 30 kg (60 lb to 66 lb), and adjust the device to a level position; and

d) The operator shall lean or the SIP device shall be tipped 15 degrees to the right and to the left without slipping, or until further lateral movement is restricted. The test operator or SIP device shall be held stationary for at least five (5) seconds. The drives and the engine shall remain continuously operational.

5 Pedestrian-controlled units

5.1 Operator's controls - self-propelled

5.1.1 Traction-drive control(s)

5.1.1.1 Hand-operated traction-drive control(s) shall be provided.

5.1.1.2 The traction-drive control(s) shall move generally in the direction of intended travel or away from the operator, except for operator-presence traction-drive controls, which may operate in any direction to engage the drive.

5.1.1.3 If the traction drive is independent of operator-presence control(s), the reverse function of the traction-drive control(s) shall require continuous actuation in the direction of travel and shall automatically return to neutral when released.

5.1.2 Ground speed and direction controls

5.1.2.1 The transmission speed selector lever and the shifting pattern shall be identified in accordance with 4.2.3.

5.1.2.2 Hand-operated forward-to-reverse (nonvariable-speed) directional control levers shall have a Neutral position.

5.1.2.3 Hand-operated combination direction and variable-speed ratio control lever(s) shall have a device that holds the lever(s) in the neutral position. Provision shall be made for a detectable change when passing through or into neutral.

5.1.3 Steering control

5.1.3.1 If a steering wheel is provided, clockwise rotation shall effect a right turn and counterclockwise rotation shall effect a left turn, when the vehicle is moving forward.

5.1.3.2 If a hand-controlled clutch or brake steering, or both, is provided, the right control shall effect a right turn and the left control shall effect a left turn.

5.1.3.3 If independent wheel controls (including brake, clutch, steering, and/or direction) are provided, they shall meet one of the following requirements:

- If controlled by dual controls, the control farthest to the right shall control the right wheel and the one farthest to the left shall control the left wheel; or
- If controlled by a single control, a clockwise movement of the control about its axis shall effect a clockwise turn of the machine about its axis, and the counterclockwise movement shall effect a counterclockwise turn.

5.1.3.4 If independent wheel variable speed and direction control steering is provided, and:

- If controlled by dual controls, the control farthest to the right shall control the right wheel and the one farthest to the left shall control the left wheel; or
- If controlled by a single control, a clockwise movement of the control about its axis shall effect a clockwise turn of the machine about its axis, and a counterclockwise movement shall effect a counterclockwise turn.

5.1.3.5 The steering mechanism shall not lock and prevent steering control during vehicle operation.

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5.2 Braking requirements and tests

5.2.1 General requirements

A separate braking means is not required to meet the requirements of this standard. Those machines not requiring an additional service or parking brake system, or means other than the braking provided in the drive system, shall also be tested in accordance with 5.2.3 and 5.2.5.

Burnishing brakes is permissible following the manufacturer's approved procedure.

5.2.2 Service brake requirements

A means shall be provided for stopping the machine's motion in both forward and reverse directions if a force of more than 222 N (50 lbf) is required to hold the machine on a 16.7-degree (30%) slope, and if the machine will move down the slope faster than 0.04 m/s (0.15 ft/s), when the traction drive is in neutral, the traction clutch is disengaged, and the engine is turned off.

5.2.3 Service brake test

5.2.3.1 Test conditions

The test surface shall be a dry, smooth, level surface (not to exceed a ±1% grade), with tractive conditions equivalent to a 16- to 36-grit abrasive material.

5.2.3.2 Test procedure

The machine shall be tested twice, once in its maximum forward speed and once in its maximum reverse speed. When testing a machine equipped with separate clutch and brake controls, the clutch shall be disengaged simultaneously with brake engagement.

5.2.3.3 Test acceptance

The braking means shall stop the machine from its maximum forward and reverse speeds in a distance not more than 0.19 meter for each kilometer per hour (1 foot for each mile per hour).

5.2.4 Parking brake requirements

5.2.4.1 A parking brake shall be provided on machines having a service brake. If a parking brake is not required, the machine shall have a safety sign stating that the machine shall not be parked on a slope unless chocked or blocked. Traction drives, such as high-ratio worm-gear drives, that will not free-wheel in neutral or that have a mechanical transmission lock, shall not require a label if they will hold the machine as specified in 5.2.5.

5.2.4.2 The parking brake may be in combination with the service brake.

5.2.4.3 A hand-operated parking brake control, when provided, shall be moved rearward or upward to engage or set.

5.2.4.4 An automatically operated parking brake, when provided, shall be activated when the operator-presence control is released.

5.2.4.5 The parking brake shall hold the machine stationary in either an uphill or downhill direction on a 16.7-degree (30%) slope when tested in accordance with 5.2.5. The force required to engage and lock this means shall not exceed 222 N (50 lbf) for a hand-grip or 330 N (75 lb) for a hand-lever.

5.2.5 Parking brake test

5.2.5.1 Test equipment

A 16.7-degree (30%) test slope with a tractive condition equivalent to that of a 16- to 36-grit abrasive material shall be provided.

5.2.5.2 Test conditions

The transmission shall be in neutral, the traction clutch shall be disengaged, and the engine shall be off.

5.2.5.3 Test procedure

The machine shall be positioned on the test slope with its parking brake engaged and locked. The machine shall be tested both with its front downhill and with its rear downhill.

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5.2.5.4 Test acceptance

The machine shall not move more than 610 mm (24 in) in 1 hour.

5.3 Handle structure

5.3.1 Fastening

The machine handle shall be secured to prevent unintentional uncoupling while in operation.

5.3.2 Position of upstop

A positive upstop shall be provided that does not allow the rearmost part of the handle to come closer than 432 mm (17 in) horizontally to the closest path of the functional component(s) during normal operation.

5.3.3 Upstop bypass

If an upstop bypass is provided that allows the handle to hinge forward beyond the upstop for storage or to swing over the mower to allow reversing the direction of travel without turning the mower around, then the upstop shall automatically reset to meet the requirements of 5.3.2 when the handle is placed in the normal operating position.

5.3.4 Folding handles

A handle shortened for storage by folding may be manually locked into its operating position and shall meet the requirements of 5.3.1, 5.3.2, and 5.3.3 when at its operating length.

5.4 Sulky units

For testing purposes, a pedestrian-controlled mower with sulky attachment is considered as a ride-on unit.

5.4.1 Types of sulkies

The following are types of sulkies:

I. Two wheels with close pivot (less than 152 mm (6 in) from machine), stand-on;
II. Single wheel with extended pivot (more than 152 mm (6 in) from machine), stand on;
III. Two wheels with extended pivot (more than 152 mm (6 in) from machine), stand on;
IV. Two caster wheel, stand-on;
V. Skid plate, stand-on;
VI. Single caster wheel, sit down;
VII. Two caster wheels, sit down;
VIII. Two steerable wheels, sit down;
IX. Two wheels with close pivot (less than 152 mm (6 in) from machine), sit down; and
X. Combinations of any of the above

5.4.2 Guards and shielding

Pedestrian-controlled mowers with sulky attachments shall comply with 4.1.

5.4.3 Operator Zone

Pedestrian-controlled mowers with sulky attachments shall comply with 4.4.

5.4.4 Operator Controls

Pedestrian controlled mowers with sulky attachments shall comply with 4.5.1 through 4.5.3 and 4.5.8.5.1.

5.4.4.1 Machine Controls

The machine controls shall remain within the operator zone as defined in figures 1 or 2.

5.4.4.2 Pitch (up and down movement of sulky relative to the fore/aft axis of the machine)

The operator shall be able to reach the controls and operate the machine up to the pitch limitations of the machine with sulky, or ±30 degrees, whichever is less (figure 20).

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5.4.4.3 Roll (up and down movement of sulky relative to the side-to-side axis of the machine)

The operator shall be able to reach the controls and operate the machine up to the pitch limitations of the machine with sulky, or ±20 degrees, whichever is less (figure 21).

5.4.4.4 Yaw (clockwise and counterclockwise movement of sulky relative to the machine)

The operator shall be able to reach the controls and operate the machine up to the yaw limitations of the machine with sulky, or ±90 degrees, whichever is less (figure 22). If Yaw exceeds ±90 degrees, a safety sign with a pictorial shall be required on the sulky warning of the hazard and directing the operator to dismount the sulky for operation in the reverse direction. If a signal word is used, it shall be “Danger”. The safety sign shall conform to the legibility requirements of 8.2.1(a).

5.4.5 Steering control

5.4.5.1 Steering wheel

If so equipped, pedestrian-controlled mowers with sulky attachments shall comply with 5.1.3.1.

5.4.5.2 Hand-controlled brake or clutch

If so equipped, pedestrian-controlled mowers with sulky attachments shall comply with 5.1.3.2.

5.4.5.3 Wheel brake controls

If so equipped, pedestrian-controlled mowers with sulky attachments shall comply with 5.1.3.3.

5.4.5.4 Independent-variable speed control

If so equipped, pedestrian-controlled mowers with sulky attachments shall comply with 5.1.3.4.

5.4.5.5 Steering lockup

If so equipped, pedestrian-controlled mowers with sulky attachments shall comply with 5.1.3.5.

5.4.6 Operator position

Pedestrian-controlled mowers with sulky attachments shall comply with 6.2.

5.4.7 Braking

5.4.7.1 Service

Pedestrian-controlled mowers with sulky attachments shall comply with 6.4.1 and 6.4.2.

5.4.7.2 Park

Pedestrian-controlled mowers with sulky attachments shall comply with 6.4.3.

5.4.8 Stability

Pedestrian-controlled mowers with sulky attachments shall comply with 6.3 with the following exception:

The longitudinal test acceptance, as defined in 6.3.5.2, with the sulky end positioned downhill shall be a minimum of 20 degrees (36.4% slope).

5.4.9 Slope control test

Pedestrian controlled mowers with sulky attachments shall comply with 6.1.4. For types II, III, and V, the operator shall dismount sulky before conducting the test.

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5.4.10 Reverse operations

5.4.10.1 Procedure

The machine shall be operated in the reverse direction and turns shall be executed in the clockwise and counterclockwise directions in such manner that turn limiters, if so equipped, are contacted. If the machine and sulky can exceed ±90 degrees in “yaw”, the operator should dismount the sulky to complete the procedure.

5.4.10.2 Test acceptance

The sulky shall not jackknife into the machine, no entrapment of the operator shall be allowed, the operator shall be able to reach all controls while remaining within the operator zone, and there shall not be sufficient displacement of the operator to cause loss of machine control and/or injury to bystanders.

5.4.11 Sulky attachment operating instructions

Specific written instructions shall be provided with the equipment describing the proper operation of the machine, personal safety, and maintenance procedures. The manual shall contain instructions such as those presented in figure 3. The instructions in figure 3 are not all inclusive. Those provided in the manual may be tailored to the specific machine.

6 Ride-on units, ride-on turf tractors, and attachments

6.1 Operator’s controls

6.1.1 Brake controls

6.1.1.1 A service brake control shall be provided. If the control is foot-actuated, the direction of stopping motion shall be generally forward or downward, or both, except a foot-actuated combination directional and variable-speed control should comply with 6.1.3.5. A brake control may be combined with other controls used for stopping a machine, such as the traction drive control, clutch, gear or speed selector, parking brake with service brake, etc.

6.1.1.2 Separate service brake pedals, if provided, for independent right-hand and left-hand brake control shall have the capability of providing combined or equalized control, or both.

6.1.1.3 For lever steer machines, lever motion in a direction opposite that of machine travel shall be interpreted as engagement of the service brakes.

6.1.2 Traction-drive controls (Clutches)

6.1.2.1 If a foot pedal control is provided, it shall be actuated by the operator's left foot, with the direction of motion generally forward or downward, or both, for disengagement. Operator presence (normally off) controls shall not be included in this requirement.

6.1.2.2 If a hand-operated control is provided, it shall be moved toward the operator (generally rearward or downward, or both) for disengagement, and can be either right- or left-hand operated.

6.1.2.3 If a foot-operated combination traction-drive and brake control is used, its direction of motion shall be forward or downward, or both, to cause traction drive disengagement and brake engagement, and can be either right- or left-foot operated.

6.1.2.4 Provisions shall be made to retain control of combination traction drive/brake control-type machines during the transition zone of brake disengagement to traction drive engagement, in accordance with the slope control test described in 6.1.4.

6.1.2.5 If a foot-operated operator-presence traction-drive control is provided, it shall be activated by the operator's right foot with the direction of motion generally downward and forward for engagement. The operator-presence control shall be outboard of the service brake pedal. The foot control, when released, shall automatically return to the nonengaged position. Devices used to hold operator presence traction drive controls in an engaged position shall be overriden by the service brake or manual return of the control to neutral (disengage).

6.1.3 Ground speed and directional control (Other than engine speed)

6.1.3.1 The transmission speed selector control(s) shall be conveniently located and the shifting pattern(s) shall be clearly and permanently identified.

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6.1.3.2 If a hand-operated forward-to-reverse (non-variable-speed) directional control lever is provided, it shall be moved forward for forward vehicle motion and generally rearward for rearward vehicle motion. If a neutral position is provided, provision shall be made for a second motion or a detectable change in actuating force when passing through neutral.

6.1.3.3 If a hand-operated variable-speed control is provided, it shall be moved generally forward or upward, or both, to increase speed.

6.1.3.4 A neutral position shall be provided for hand-operated combination directional and variable-speed-ratio control lever(s). Starting from the neutral position, the lever(s) shall be moved forward, or away from the operator, for forward travel and increasing forward speed, and shall be moved generally rearward or toward the operator, for rearward travel and increasing rearward speed. Provision shall be made for a second motion or a detectable change in actuating force when passing through neutral. See also 6.1.3.6.

6.1.3.5 For a foot-actuated combination forward/reverse and variable-speed control, increased displacement of the pedals shall produce increased speed in either direction. Provisions shall be made for a neutral with second motion or a detectable change in actuating force when passing through neutral. When actuating forces are released from this control, the machine shall come to a stop; except when a cruise control is used, the application of the service brake shall release the cruise control. The control(s) shall be operated by the right foot as follows:

a) If a single pedal is used, it shall produce forward motion with a forward or downward toe motion on the pedal and rearward motion with rearward or downward heel motion;

b) If two pedals are used and are located side by side, both pedals shall be operated by the right foot. Forward or downward motion on the outer pedal shall produce reverse motion; forward or downward motion on the inner pedal shall produce forward motion; and

c) If two pedals are used and are located fore and aft, forward and downward motion on the rearward pedal shall produce reverse motion; forward or downward motion on the forward pedal shall produce forward motion.

6.1.3.6 Directional control mechanisms that cause forward and reverse propulsion as well as forward and reverse speed control shall have a neutral position that is passive, in that the operator shall actuate the control out of the neutral position. These controls shall be adjustable to reestablish the neutral position and the operator's manual shall describe the readjustment procedure.

6.1.3.7 If a manually operated differential lock is provided, it shall be moved forward or downward for engagement.

6.1.4 Slope control test

6.1.4.1 General requirements

The slope control test shall only be conducted on combination traction drive/brake control type machines as stated in 6.1.2.4. The slope control test shall be conducted on a ride-on unit with its attachment in the most severe test condition and without ballast other than that specified by the manufacturer as required equipment. For turf tractors, two tests shall be conducted as follows:

a) With its attachment/implement in its most severe test condition and without ballast other than that specified by the manufacturer as required equipment; and

b) Without attachment/implement, or ballast specified by the manufacturer for use with the attachment/implement.

6.1.4.2 Test equipment

A 10-degree slope shall have a surface with a static coefficient of friction not less than 0.6 to the tire tread, as determined by any suitable method.

6.1.4.3 Test conditions

The test shall be conducted as follows:

a) The machine shall be pointed directly uphill, except as noted in 6.1.4.4.3;

b) The test operator shall be in the operating position;

c) The engine or motor shall be running at maximum operating speed; and

d) The PTO shall be off.

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6.1.4.4 Test procedure

6.1.4.4.1 The machine shall be driven up the slope for a distance sufficient to provide at least 1220 mm (48 in) of slope surface behind the machine's downhill wheels.

6.1.4.4.2 The machine shall be stopped and the transmission (or traction drive) shifted into neutral (or disengaged).

6.1.4.4.3 The machine shall be allowed to roll freely downhill for a distance not less than 1220 mm (48 in) and shall be braked to a stop, using the service braking means only (if the front wheels are the braked wheels, this part of the test shall be run with the machine on the slope facing directly downhill; if the machine's front and rear wheels are braked wheels, the test shall be performed first with the machine on the slope facing directly downhill, then with the machine facing directly uphill.)

6.1.4.4.4 If the machine's transmission or traction drive does not enable it to roll, then the machine shall be driven downhill for a distance not less than 610 mm (24 in) but not more than 1220 mm (48 in) and braked to a stop, using the service braking means only.

6.1.4.4.5 The transmission or traction drive shall be placed in the travel mode necessary to cause the machine to move uphill, the clutch or neutral return (if provided) shall then be engaged, and the machine shall be driven uphill at least 610 mm (24 in).

6.1.4.5 Test acceptance

6.1.4.5.1 The transmission or traction drive shall be capable of being shifted into and out of the neutral or disengaged position.

6.1.4.5.2 Loss of directional control shall not occur when the machine is braked to a stop or when the machine is driven back uphill.

6.1.4.5.3 After being stopped following its travel downhill, the machine shall not roll back more than 305 mm (12 in) before being driven uphill.

6.1.5 Attachment-drive (power-takeoff) control

6.1.5.1 If a hand-operated attachment-drive control is provided, its movement shall be in accordance with 6.1.2.2. If push-pull electrical controls are used for the actuation of an attachment drive, the control movement shall be "out" for engagement and "in" for disengagement.

6.1.5.2 The combination traction-drive control and continuous-running or transmission-drive power takeoff controls shall be in accordance with 6.1.2.1 and 6.1.2.2.

6.1.5.3 If a foot-pedal attachment-drive control is provided, its movement shall conform to 6.1.2.1.

6.1.5.4 If the disengagement of the attachment-drive control is combined with either foot-pedal or hand-operated controls, the direction of disengagement motion shall be consistent with the requirement of the control with which the attachment drive control is combined. For example, when combined with the lift control, the attachment-drive control shall disengage when the attachment is raised.

6.1.6 Lift controls

6.1.6.1 If a hand-operated control is provided, the direction of motion shall be generally away from the operator or downward to lower the implement or attachment, and toward the operator or upward to raise the implement or attachment. For controls that are located beside the operator and whose motion is parallel to the vehicle's longitudinal axis, the direction of motion shall be generally forward to lower the implement and generally rearward to raise the implement

6.1.6.2 If a single-pedal foot control is provided, the direction of motion of the forward part of the pedal shall be generally downward to lower the implement or attachment and generally upward to raise the implement or attachment.

6.1.6.3 If a two-pedal control is provided, the direction of motion shall be generally forward or downward for actuation and the function of each pedal shall be identified in accordance with 4.2.1.1.

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6.1.7 Steering controls

6.1.7.1 If a steering wheel control is provided, a clockwise rotation shall effect a right turn and a counterclockwise rotation shall effect a left turn when the vehicle is moving forward. If the steering control also controls the speed and direction of travel, it shall also conform to 6.1.3.2.

6.1.7.2 If a single lever is used for steering, a lateral motion of the lever to the right shall effect a right turn and a lateral motion to the left shall effect a left turn. If the single lever also controls the speed and direction of travel, it shall conform to 6.1.3.2.

6.1.7.3 If two levers are provided for steering by controlling the speed and direction of the driving elements, the right-hand lever shall control the right-hand element and the left-hand lever shall control the left-hand element. Starting from the neutral position, the levers shall be moved generally forward or away from the operator for forward travel and increasing forward speed, and generally rearward or toward the operator for rearward travel and increasing rearward speed.

6.1.7.4 The steering mechanism shall not lock and prevent steering control during vehicle operation.

6.2 Operator position

6.2.1 Steps and handholds or other means, if provided, on ride-on machines, propelling machines, and attachments, to facilitate entry and exit from the operating position and for servicing, shall conform to ASAE S318.11.

6.2.2 Guard rails shall be provided for walkways and platforms that are more than 610 mm (24 in) above the ground. Guard rails shall have a top rail that is not less than 900 mm (35.4 in) or greater than 1050 mm (41.3 in) above the walkway or platform, with another rail approximately midway between the platform and the top rail.

6.2.3 A slip-resistant means shall be provided for steps, walkways, and platforms.

6.3 Stability requirements and tests for ride-on units and ride-on turf tractors

6.3.1 General requirements for stability tests

Stability tests shall be conducted under static conditions. For ride-on units, the test shall be conducted with its attachment in its most severe test condition and without ballast other than that specified by the manufacturer as required equipment. For turf tractors, two tests shall be conducted as follows:

a) With its attachment/implement in its most severe test condition and without ballast other than that specified by the manufacturer as required equipment; and

b) Without attachment/implement or ballast specified by the manufacturer for use with the attachment/implement.

Machines with grass catcher attachments shall meet the requirements of 6.3.5.4. Zero-turn machines with mid-mounted mowers and an operator-protective device (OPS, ROPS, etc.) shall meet the requirements of 6.3.5.5.

6.3.2 Test equipment

A variable-slope tilt table with a friction surface equivalent to a 16- to 36-grit abrasive material shall be provided.

6.3.3 Test conditions

6.3.3.1 A weight of 91 kg (200 lb), securely fastened to the seat, shall be used to simulate an operator. The center of gravity of weight shall be 150 mm (6 in) above the lowest point of the operator-supporting surface of the seat and 250 mm (9.8 in) forward of the seat back. If a seat back is not used, the forward measurement of 250 mm (9.8 in) shall be measured from the back of an actual operator when seated on the unit. If the seat is adjustable, forward and rearward stability shall be checked with the seat in its highest operating position and most forward and rearward, respectively.

A standing operator shall be simulated by a 91-kg (200-lb) weight with a center of gravity located 1024 mm (40.3 in) above the geometric center of the foot platform. The weight may be rotated about the geometric center of the foot platform toward the up-slope side, up to a maximum of 15 degrees.

6.3.3.2 Pneumatic tires shall be inflated to the pressure recommended in the operator's manual for normal operation.

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6.3.3.3 Steerable or caster wheels, or both, shall be positioned in the most severe test conditions for lateral stability (see 6.3.4.3), and straight forward for longitudinal stability (see 6.3.4.2). All wheels may be locked to prevent rotation about the axle.

6.3.3.4 Stability requirements shall apply to the tire size and tread setting that give the most severe test condition. The tread setting shall be in the range specified by the machine manufacturer. If a tread setting of a machine can be obtained and is not specified by the manufacturer, this information should be stated in the operator's manual.

6.3.4 Test procedure

6.3.4.1 General

The machine shall be placed on a variable-slope single-plane tilt table. The table shall be tilted until lift-off of the upper wheel(s) of the machine occurs, or the minimum angles described in 6.3.5 are attained.

6.3.4.2 Longitudinal stability

The steerable wheels of the machine shall be straight forward. The machine shall be positioned on the tilt table with its longitudinal centerline perpendicular to the tilt axis of the table. The machine shall be tested with its front positioned downhill and again with its rear positioned downhill.

6.3.4.3 Lateral stability

The steerable wheels of the machine shall be placed on the most severe test 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 intersection line of the tilt axis of the table. The machine shall be tested with its left side downhill and again with its right side downhill.

6.3.5 Test acceptance

6.3.5.1 General

Lift-off shall have occurred when a strip of 20-gauge steel (approximately 1 mm (0.039 in) thick), 50 mm (2 in) wide with a length sufficient to extend beyond the tire footprint, can be pulled from or moved under any tire with a force of 9 N (2 lbf) or less.

6.3.5.2 Longitudinal test acceptance

The angle of the tilt table with the machine positioned as described in 6.3.4.2 shall reach a minimum of 30 degrees (58% slope), with either end positioned downhill, before the lift-off occurs and with no spillage or leakage in accordance with the requirements in 4.4.4.

6.3.5.2.1 If a propelling machine has more than one wheel that lifts off before 30 degrees, rigidly attached to the uphill side of the frame, the tester may shim under the footprint of that tire and repeat the stability test. The shim should be topped with a friction surface equivalent to a 16- or 32-grit abrasive material, and the steel strip (see 6.3.5.1) shall be placed between the tire and the shim surface.

6.3.5.2.2 If a propelling machine has an attachment or implement attached to the front or to the rear that, in the raised position, causes lift-off before 30 degrees, this condition shall be allowed if the attachment or implement provides a positive stop that will prevent the machine from tipping completely over, providing that the following requirements are met:

a) The machine does not experience lift-off at 30 degrees with the attachment or implement resting on the supporting surface at the start of the test; and

b) If the propelling machine is a turf tractor, it shall not experience lift-off at 30 degrees when the attachment or implement is removed.

6.3.5.3 Lateral test acceptance

The angle of the tilt table with the machine positioned as described in 6.3.4.3 shall reach a minimum of 20 degrees (36.4% slope), with either side positioned downhill, before the lift-off occurs and with no spillage or leakage in accordance with the requirements in 4.4.4.

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6.3.5.3.1 If a propelling machine has more than one wheel that lifts off before 20 degrees, rigidly attached to the uphill end of the frame, the tester may shim under the footprint of that tire and repeat the stability test. The shim should be topped with a friction surface equivalent to a 16- or 32-grit abrasive material, and the steel strip (see 6.3.5.1) shall be placed between the tire and the shim surface.

6.3.5.4 Machines with grass catcher

6.3.5.4.1 Test procedure

Fill the grass catcher container(s) to its volumetric struck level capacity or full enclosed capacity with material that has a minimum specific weight of 12 lb per cubic foot (192 kg per cubic meter). Settling of the material is acceptable. Follow the test conditions and procedures outlined in 6.3.3 and 6.3.4.

6.3.5.4.2 Test acceptance

Lift-off shall not occur before the tilt angles specified in a) and b) are reached:

a) *Longitudinal test angle*: 20 degrees (36.4% slope);

b) *Lateral test angle*: 20 degrees (36.4% slope).

6.3.5.5 Zero-turn machines with mid-mounted mowers and an operator-protective device

6.3.5.5.1 The operator protective device shall be installed with ballast, if required, and any other attachments to provide the worst-case conditions for stability.

6.3.5.5.2 Follow the test procedures outlined in 6.3.3 and 6.3.4.

6.3.5.5.3 Test acceptance

Lift-off shall not occur before the tilt angles specified in a), b), and c) are reached:

a) *Longitudinal*: 25 degrees (46.6% slope);

b) *Longitudinal w/ grass catcher*: 20 degrees (36.4% slope). Grass catcher shall comply with 6.3.5.4; and

c) *Lateral*: 20 degrees (36.4% slope).

6.4 Braking requirements and tests for ride-on units and ride-on turf tractors

6.4.1 General requirements

6.4.1.1 A separate means of braking is not required to meet the requirements of this standard. Those machines not requiring additional service brakes, parking brake systems, or means other than the braking provided in the drive systems shall comply with the requirements in 6.4.2 and 6.4.3. Burnishing brakes is permissible following the manufacturer's approved procedure.

6.4.1.2 Ride-on units and ride-on turf tractors

Braking system requirements shall apply to machines with attachments/implements in their most severe test condition, and with accessory equipment such as operator enclosures, dual wheels, ballast, lights, etc., installed so as to create the most severe test conditions. The machine shall be equipped with tires recommended by the manufacturer that provide the least contact area on the test surface.

6.4.2 Service brakes

A means shall be provided to stop the machine's motion in both the forward and reverse directions in accordance with the requirements in 6.4.2.1.

6.4.2.1 Service tests

6.4.2.1.1 Test equipment

Linear and force measurement means shall be provided.

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6.4.2.1.2 Test conditions

Test stops shall be conducted on a substantially level (not to exceed ±1% grade), dry, smooth, hard-surfaced roadway of concrete (or other surface with an equivalent coefficient of surface friction) that is free of loose material.

6.4.2.1.3 Test procedure

The machine shall be stopped from its maximum forward and reverse speeds. For a machine equipped with separate clutch and brake control means, the clutch shall be disengaged simultaneously with the brake engagement.

6.4.2.1.4 Test acceptance

The machine shall be equipped with a means capable of stopping its motion in both directions in a braking distance of 0.19 m (1 ft) for each, up to a maximum 1 km/h (0.62 mi/h) machine velocity of 13 km/h (8 mi/h) use. (For machine speeds in excess of 13 km/h (8 mi/h) use, $S= 0.0147\ V^2$ ($S= 0.125\ V^2$) where S is stopping distance in meters (feet) and V is test speed in kilometers per hour (miles per hour).) This shall be accomplished with a maximum force of 600 N (135 lbf) for foot-activated, or 222 N (50 lbf) for handgrip-activated, controls at the point of normal control actuation.

6.4.3 Parking brakes

6.4.3.1 Requirements

6.4.3.1.1 A means shall be provided to park a machine in any direction as described in 6.4.3.2.

6.4.3.1.2 An automatically operated parking brake, if provided, shall be activated when the operator-presence control is released.

6.4.3.1.3 A means shall be provided to prevent continuous application of power to the traction drive with the parking brake engaged and set. An audio or visual warning that the parking brake is engaged is acceptable. Sulky units are exempt from this requirement.

6.4.3.1.4 If the machine is equipped with either a hand- or foot-activated parking brake, the application force shall be as follows:

- *Foot-activated*: 600 N (135 lbf) maximum;
- *Hand-lever-activated*: 330 N (75 lbf) maximum; and
- *Handgrip-activated*: 222 N (50 lbf) maximum.

6.4.3.2 Parking brake test

6.4.3.2.1 Test equipment

A test slope of 16.7 degrees (30%), similar to the one described in 6.3.2, and a timer shall be provided.

6.4.3.2.2 Test conditions

The test surface shall be smooth and flat with tractive conditions equivalent to a 16- to 36-grit abrasive material.

6.4.3.2.3 Test procedure

The transmission speed selection shall be in neutral with the engine off. Tests shall be conducted with and without a test operator. A weight of 91 kg (200 lb), as described in 6.3.3.1, may be used in lieu of the test operator.

6.4.3.2.4 Test acceptance

The machine, when parked on the slope, shall not move more than 610 mm (24 in) in 1 hour.

6.4.4 Service brake system proof load test

This test is to be performed on units with separate brake systems. Machines not requiring additional service brakes, parking brake systems, turning assist brakes, or means other than the brake provided in the drive systems, as described in 6.4.1.1, are not subject to this test.

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6.4.4.1 Test equipment

The equipment shall include a force measurement means and a timer.

6.4.4.2 Test condition

The test shall be conducted under static conditions, with the engine off.

6.4.4.3 Test procedure

If more than one brake is provided, the test shall be applied to each control.

6.4.4.3.1 Foot-actuated controls

A constant load of 1670 N (375 lbf) shall be applied to the brake control for five (5) minutes in the direction of brake application.

6.4.4.3.2 Hand-operated controls

A constant load of 623 N (140 lbf) shall be applied to the brake control for five (5) minutes in the direction of brake actuation.

6.4.4.4 Test acceptance

After release of the load on the brake control, the service brake shall comply with the requirements in 6.4.2 and the parking brake shall comply with the requirements in 6.4.3.

6.5 Lighting and marking for ride-on units and ride-on turf tractors used on public roads

Lighting or marking devices, or both, that are provided for commercial turf equipment shall conform to ASAE S279.10. The operator's manual for the unit shall instruct the operator to turn on flashing warning lights, if provided, whenever traveling on a public road, except where such use is prohibited by law.

6.6 Lateral upset operator protection recommendations and tests for ride-on mowing equipment

NOTE – These tip angle tests shall be conducted on machines with a mass, including mowing attachment and a 91-kg (200-lb) operator, of 655 kg (1436 lb) or more.

6.6.1 General requirements

The tests shall be conducted under static conditions with the mower attachment in its most severe operating position (not the transport position) and without ballast other than that specified by the manufacturer as required equipment. For machines with a mass less than that specified in the note, see 6.6.5.

6.6.2 Test equipment

Test equipment shall include: a fixed platform with adequate height to allow lifting the machine to its tip angle without ground or other interference, a lifting device capable of tilting the machine to its tip angle, a means to measure the tip angle of the machine and a means to restrain the machine during the test.

6.6.3 Test conditions

The machine shall be prepared as required in 6.3.3.1 through 6.3.3.4 with the mowing attachment(s) specified by the manufacturer that gives the most severe condition.

6.6.4 Test procedure

6.6.4.1 The machine shall be placed on the platform with the left wheels parallel to the edge of the platform (figure 5(a)). For three-wheeled machines, this would be the left wheel of the wide axle and the single wheel (figure 5(b)). The steerable or caster wheels shall be placed in the position giving the least lateral stability. All wheels may be locked to prevent rotation about the axle.

6.6.4.2 The lifting device shall be attached to the heaviest axle on the right side and the machine lifted slowly until it starts to tip over center. (See figure 6.) Restraints should be used to keep the machine from tipping over.

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6.6.4.3 The tip angle is the angle of the frame of the machine with respect to horizontal, measured perpendicular to the tip axis. It shall be measured at the equilibrium point. The tip angle may be measured with an inclinometer set perpendicular to the tip axis, or by measuring the height that a point on the frame of the machine has been raised and the horizontal distance of that point from the tip axis and calculating the tip angle. The test shall be repeated, lifting the left side.

6.6.5 Test acceptance

If the machine's mass as described in 6.6.1 is less than 655 kg (1436 lb), an operator's protective device is not required. If the machine's mass is 655 kg (1436 lb) or more and the tip angle is less than 40 degrees as measured in 6.6.4.3, it is recommended that the machine be fitted with an operator's protective device to minimize crushing injury from a lateral upset.

7 Implements

7.1 General requirements

7.1.1 Tongue

Any trailed unit with a hitch connection characteristic causing the tongue (either loaded or empty) to move uncontrollably upward when disconnected shall have a conspicuous durable label in the vicinity of the hitch point to identify the hazard.

7.1.2 Attachment means

Mounted and semimounted rear implements shall be attached to the propelling means by one or a combination of the attachments described in ASAE S217.11, S278.6, S320.1, S348.2, and SAE J909.

7.1.3 Power supply means

Hydraulic, electric, or auxiliary power units shall conform to all applicable requirements of this standard.

7.2 Operating controls

The controls shall comply with the requirements in 4.4 and 4.5 except for controls mounted on towed equipment, which need not be located within the confines of the operator zone.

8 Functional components

8.1 General requirements (in addition to those in 4.5.8)

8.1.1 Stopping time

8.1.1.1 Functional components shall have a stopping time from the manufacturer's specified maximum operating speed that is equal to or less than seven (7) seconds after disengaging the driving mechanism. Longer stopping times shall require an audible or visible indication of motion from the position where exposed to the hazard. The machine shall have a 5-minute run-in period immediately prior to testing.

8.1.1.2 If audible or visible indication of motion is not provided, the machine manufacturer shall certify that the stopping time is equal to or less than seven (7) seconds after the component has been operated for 5000 on/off cycles. The controls used to cycle the functional component(s) are selected at the manufacturer's discretion. Each on/off cycle shall include:

a) Accelerating the component to the manufacturer's specified maximum speed;

b) Actuation of the stop means (primary blade engagement control of OPC);

c) Sufficient time for the component to decelerate to the static state; and

d) Sufficient time between on/off cycles is allowed to prevent damage to the stop means.

The component shall be maintained, adjusted, and serviced throughout the test in accordance with the instructions stated in the manufacturer's operator's manual.

8.1.1.3 The requirements of 8.1.1.2 do not apply to an operator-presence means that stops the engine and the functional component.

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8.1.2 Multisection mowers

Multisection mowers shall have a means of disconnecting power to any section that can be carried in a transport (folded up) position while mowing continues with the other sections. Multisection mowers shall meet the stopping time requirements in 8.1.1.

8.1.3 Guarding

Functional components that must be exposed for proper function shall be shielded to prevent direct discharge of material into the normal operator position.

8.1.4 Cutting elements

The components used in assembling the cutting elements should not become worn or fail in a hazardous manner before the elements themselves are worn beyond practical use.

8.1.5 Blade tip speed

The maximum tip speed of any blade shall be 5800 M/min (19 000 ft/min).

8.1.6 Transport

8.1.6.1 Cutting units that fold up to substantially decrease the width for transport shall be capable of being secured in the transport position by positive means.

8.1.6.2 If the cutter units have to be brought to the transport position by hand, they shall be provided with appropriate handles. The maximum force required shall be 350 N (79 lbf).

8.1.6.3 For ride-on units, the operation of the cutting means shall be independent of the traction drive.

8.2 Requirements for rotary mower components

8.2.1 Guards and grass catchers

Any guards required for the mower to meet the discharge-opening requirements in 8.3.3 shall pass the test given in 8.3.5. If either guard or grass catcher is so required, the mower shall comply with the following requirements:

a) Warning instructions shall be affixed to the mower near the discharge opening conveying the message that the mower shall not be operated without either the entire grass catcher or the guard in place. Such instructions shall be easily legible to a person of normal vision (20/20 corrected) and height standing upright two (2) feet away from the machine and adjacent to the sign. If an adapter for a grass collector obscures the on-machine warning instructions, a warning shall be provided on the adapter conveying the message: “Do not operate mower unless grass catcher is attached or guard is in place.” Pictorials may be used to convey the above message. Additional statements and/or pictorials of safety practices are allowed.

b) The grass catcher or the guard shall be shipped and sold as part of the mower;

c) The instruction manual shall state that the mower shall not be operated without either the entire grass catcher or the guard in place; and

d) If a grass-catcher bag constructed of woven fabric or material subject to both wear and deterioration is used, a notice shall be provided in the operator’s manual stating that, under normal usage, the bag material is subject to deterioration and wear and should therefore be frequently checked for necessary replacement. It shall also state that any replacement bag should be checked to ensure compliance with the original manufacturer’s recommendations or specifications.

8.2.2 Blade enclosure

8.2.2.1 General

The mower blade shall be enclosed except on the bottom, and the enclosure shall extend 3 mm (1/8 in), minimum, below the lowest cutting point of the blade in the lowest blade position, including tolerance, except for the discharge openings and such other openings as described in 8.2.2.2. Any extension of the walls of the blade enclosure not meeting this requirement shall be considered part of the discharge opening. All parts of the enclosure shall comply with the tests given in 8.3.2, 8.3.3, and 8.3.5.

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8.2.2.2 Front blade enclosure (see figure 7)

The highest points of all openings in the front blade enclosure shall be limited by a vertical angle of opening of 15 degrees and a maximum distance of 38 mm (1.5 in) above the lowest cutting plane of the blade in the lowest blade position. The highest point in the openings of a front comb or rake arrangement shall be considered a point on the bottom of the blade enclosure front. Any guards that can be moved or adjusted shall be placed in their highest operating position as specified by the manufacturer. Flexible flaps or hinged shields shall be considered part of the blade enclosure and shall be in their operating position.

8.2.3 Safety Sign

A safety sign with a pictorial, such as that shown in Annex C, warning of the blade contact hazard shall be placed at or near the hazard location(s). If a signal word is used, it shall be “Danger”. The safety sign shall conform to the legibility requirements of 8.2.1(a).

8.3 Test for rotary mower components

8.3.1 Test conditions – General

8.3.1.1 Assembly

The mower shall be completely assembled and mounted on its riding unit, except for tests in which mounting on a suitable test fixture is designated. When desired, the mower unit may be tested while separated from the riding or power unit with power provided by some other means; however, the speeds shall be the same as when the mower is on the riding or power unit, and parts that extend into the trajectory area should be duplicated as nearly as practicable. Adjustable guards, except for the guards on the mower discharge opening, shall be in the most open position for the test.

8.3.1.2 Mower position

The mower shall rest on a horizontal surface and in a horizontal position that is flat within two (2) degrees.

8.3.1.3 Test speed

The mower shall be operated at the mower manufacturer’s specified maximum engine (motor) speed, which is the fastest speed that the mower manufacturer intends the engine (motor) to run with the blades engaged, taking into account all tolerances.

8.3.1.4 Sequence and number of tests

Unless otherwise noted, tests may be run in any sequence. All tests shall be run once for each mower blade assembly, except where otherwise designated. A new mower or grass catcher may be used for each test, except for the tests described in 8.3.5 and 8.3.7. However, a new cloth or a fiber catcher may be used for these tests described in 8.3.6. Mowers with grass catchers shall be tested both with and without catchers.

8.3.1.5 Restraints

Resilient restraints may be used to keep the mower in position during the test.

8.3.1.6 Equipment for tests described in 8.3.2, 8.3.4, 8.3.8, and 8.3.9

The mower shall be completely encircled at the time of test by a wall of target material (see 3.33) resting on the floor. The wall shall be approximately 610 mm (2 ft) from the blade tip circle with a minimum height of 610 mm (2 ft) above the horizontal plane of the blade tip circle. When testing a unit that includes a tractor that would extend beyond the target, the target should be extended to the tractor stopping at the point of intersection with the machine.

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All mowers except those with a blade tip circle diameter of 775 mm (30.5 in) or greater, and blade thickness of 8 mm (0.312 in), or greater, for one or more blades. Subclauses 8.3.2 through 8.3.7 apply to these mowers.

8.3.2 Impact test

8.3.2.1 Test equipment

The equipment shall consist of the test fixture illustrated in figure 8 and the target described in 8.3.1.6.

8.3.2.2 Test conditions

The mower shall be positioned so that when the rod is injected into the rotating blade, the blade will strike the rod within 50 mm (2 in) of the tip of the blade. The blade shall be adjusted to the cutting height closest to 50 mm (2 in). The mower operating speed shall be in accordance with the requirement in 8.3.1.3.

8.3.2.3 Test procedure

The rod shall be injected once into the path of the blade. The test shall be conducted once for each blade assembly. A new mower may be used for each test.

8.3.2.4 Test acceptance

The test shall be completed without loss of any part of the unit or failure of any component in a manner that could be hazardous to the operator or bystander. Any target penetration by any part of the mower shall constitute a test failure.

8.3.3 Foot probe test

8.3.3.1 Test equipment

The equipment for the foot probe test shall be as illustrated in figure 9(a).

8.3.3.2 Test conditions

The test shall be conducted under static conditions on a flat surface.

8.3.3.3 Test procedure

The test shall be conducted with the blades in the highest and lowest cutting positions. If the blade path height is different for different blade speeds or blade options, the test shall be conducted so as to include the two extremes of blade height. The probe shall be held in a vertical plane perpendicular to the flat surface and rotated in that plane a maximum of 15 degrees, as shown in figures 9(c) and 9(e), and shall be tested in all positions within those rotation limits. The probe shall be inserted as far as possible at any point of the discharge opening with a horizontal force of 20 N (4.5 lbf) or until the blade enclosure lifts from the original position, whichever occurs first. The probe need not remain on the floor.

The sides of any discharge chute and the front blade enclosure shall be probed if they are less than 3 mm (1/8 in) below the plane of the blade tip circle. The probe test of the front blade enclosure may be excluded if a safety sign warning of the hazard of blade contact is affixed at the front blade enclosure.

The probe shall be applied to the rear of all pedestrian-controlled units, as shown in figure 9(b).

The highest cutting position for this test shall not exceed 203 mm (8 in). Components of the mower or machine (such as frames or wheels) may be considered part of the blade enclosure for the purpose of this test.

8.3.3.4 Test acceptance

The probe shall not enter the cutting path of the blade or blade assemblies.

8.3.4 Unbalance test

8.3.4.1 Test equipment

The target shall be as described in 8.3.1.6.

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8.3.4.2 Test conditions

Blades shall be unbalanced by the addition or removal of material determined by the following formula:

$23.73\ L^3$ g-m (or $5.391 \times 10^{-4}\ L^3$ oz-in) where L is the blade tip circle diameter in meters (inches).

8.3.4.3 Test procedure

The mower shall be run with the unbalanced blades as described in 8.3.4.2 for an uninterrupted period of one (1) hour or until structural failure occurs. The test shall be conducted once for each blade assembly. All blade assemblies of a multispindle mower may be tested simultaneously. A new mower may be used for each test.

8.3.4.4 Test acceptance

See 8.3.2.4.

8.3.5 Structural integrity test – Blade enclosures and guards

8.3.5.1 Test equipment

The test fixture to be used is illustrated in figure 10. The test projectiles shall consist of 100 hardened, minimum Rockwell C scale 45, 13-mm (0.50-in) diameter steel balls for each spindle. The mower or mower attachment shall be equipped with a 20-mm (0.75-in) thick plywood panel that shall be faced with at least a 16-gauge steel sheet for wear, or a single steel sheet with a minimum of 4-mm (0.150-in) thickness, parallel to and 16 mm (0.62 in) below the horizontal plane of the blade. The panel shall extend a minimum of 25 mm (1 in) beyond the blade tip circle at the discharge opening(s). An air inlet hole with a diameter approximately 30% of the blade length shall be provided in the panel concentric with each blade tip circle.

On mulching mowers only, the concentric air inlet opening of the mower support fixture may be increased to a diameter up to 80% of the blade length, provided that a minimum overlap of 25 mm (1 in) is maintained between the edge of the injection-opening periphery and the edge of the concentric air inlet opening. The opening between the lower edge of the blade enclosure and the panel shall be closed except at the discharge opening(s). The holes in the test panel for the introduction of the test projectiles shall be 25 mm (1 in) in diameter and generally spaced equally from the primary hole, which shall be located 45 degrees back of a radial line drawn through A, the center-point of the discharge opening (end of discharge chute), as shown in figure 10. The angular location of the other holes may be varied slightly to avoid interference with the structural components or the test equipment. A projectile injection means (spring, air, or other assists) may be used to ensure proper introduction of the test material. When a tube is used to introduce the test projectiles through the holes, the end of the tube should be 51 mm (2 in) below the horizontal plane of the blade in order to permit the test projectiles to emerge freely from the tube.

8.3.5.2 Test conditions

The mower shall be operating in accordance with the requirement in 8.3.1.3. The test projectiles shall be injected with sufficient energy so that they will rise a minimum of 13 mm (0.5 in) and a maximum of 305 mm (12 in), if unobstructed, above the horizontal plane of the blade. If the blade height is adjustable relative to the blade housing, the blade shall be placed in the lowest operating position.

8.3.5.3 Test procedure

The test shall be conducted with the equipment shown in figure 10 and shall consist of the vertical introduction of a total of 100 balls, one at a time, through two or more equally spaced holes for each blade. The balls shall be divided in approximately equal numbers among the holes. The test shall be conducted once for each blade assembly. A new blade enclosure or mower attachment may be used for each blade of multiblade mowers.

8.3.5.4 Test acceptance

There shall be no penetration of more than one-half of the ball through any outer surface of the mower, and the mower shall remain in compliance with all applicable requirements of this standard.

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8.3.6 Structural integrity tests – Grass collection system

8.3.6.1 Ball test

8.3.6.1.1 Test equipment

The test equipment shall be as described in 8.3.5.1. A target material shall be provided as shown in figure 10. For pedestrian-controlled units/tractors, an additional target shall be placed to delineate the mower side of the operator zone as shown in figure 10(g). If the target is less than 457 mm (18 in) from any part of the grass catcher, the target may be moved to maintain a maximum separation of 457 mm (18 in).

8.3.6.1.2 Test conditions

The test conditions shall be as described in 8.3.5.2, except that the grass collection system shall be in place on the mower, and any opening between the bottom panel and the lower edge of the grass collection system shall be closed.

8.3.6.1.3 Test procedure

The test procedure shall be as described in 8.3.5.3, except that, for multiblade mowers, this test needs to be conducted only for the blade(s) nearest the discharge opening(s).

8.3.6.1.4 Test acceptance

There shall be

- no target penetration by any particle of the test projectile;
- no strike or penetration of the operator zone target;
- no opening of a zipper or bag seam, or other components; and
- no dislodging of any of the grass collection system component(s) from their normal operating position.

8.3.6.2 Nail test

8.3.6.2.1 General

This test shall be performed identically to the ball test described in 8.3.6.1, except that it shall consist of the upward vertical introduction of a total of 200 steel sixpenny common nails, in accordance with ASTM F1667, one at a time, headfirst. The test shall be performed with the same catcher and mower as was tested in accordance with the procedures described in 8.3.6.1.

8.3.6.2.2 Test acceptance

See 8.3.6.1.4.

8.3.7 Thrown objects test

8.3.7.1 General

This shall be conducted after the structural integrity test of both blade enclosures and guards, and grass collection system. The same blade enclosure as used in the structural integrity test shall be used.

8.3.7.2 Test equipment

8.3.7.2.1 Enclosure

The test enclosure shall be constructed generally as shown in figure 11(a). Variations to accommodate different mower types and configurations are shown in figures 11(b) through 11(f).

The target panels shall consist of eight areas of target material, each 900 mm (35.4 in) high, perpendicular to the base so as to form an octagon. In order to facilitate the counting of hits, the panel supports should be designed to allow sliding in and out of at least one target panel.

(For pedestrian-controlled mowers only) The target in the operator's area of a pedestrian-controlled mower above 900 mm (35.4 in) shall consist of a single sheet of kraft paper rising to a height of 2000 mm (78.7 in).

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The cardboard shall be tested immediately before and after the thrown object test by utilizing the fixture shown in figure 11(g). The cardboard shall be cut into test samples of 150 mm (6 in) square. Position the cardboard squares centered on the bottom plate of the test fixture. Squares may be secured at the edges by tape or adhesive. Cover with the top plate. Make sure the center holes in the steel plates are aligned and that the cardboard is flattened by the steel top plate. Raise the penetrator to the recommended height and allow the penetrator to fall on the cardboard samples. Repeat five times. When dropped from 300 mm (11.8 in), the spherical end of the penetrator shall not penetrate completely through the test samples more than two out of five drops. When dropped from 400 mm (15.7 in), the spherical end of the penetrator shall penetrate completely through the test sample in at least four out of five drops. If the penetrator penetrates the cardboard more than the allotted number of times permitted by the acceptance criteria when dropped 300 mm (11.8 in), add sufficient sheets of kraft paper to the target face of the cardboard in order to meet penetration requirements. Kraft paper should be the same type utilized for the pedestrian-controlled mower operator target.The target panels shall generally be located perpendicular to a radial line extending 750 mm ± 50 mm (29.5 in ± 2.0 in) from the blade tip circle of single spindle mowers, or to the nearest blade tip circle of multispindle mowers, as shown in figure 11(b) through 11(f). If the target panel interferes with a part of the mower, such as a grass catcher, handle or wheel, the target shall be moved back to avoid such interference. The target shall be divided into elevation zones by horizontal lines as indicated in figure 11(a). The lower elevation zone is defined by the area between the base and the 300 mm (11.8 in) line. The middle elevation zone is defined by the area between the 300 mm (11.8 in) and the 450 mm (17.7 in) lines. The top elevation zone is defined by the area about the 450 mm (17.7 in) line to the top of the 900 mm (35.3 in) target.

(For pedestrian-controlled mowers only.) The rear or operator's target area is determined by the intersection of lines extending from the center A (see figure 11(b)) of the blade tip circle for single blade mowers or from the center B (see figure 11(c)) of a line through the centers of the outer blade tip circles for multibladed mowers and tangent to 1000 mm (39.4 in) diameter operator target area. The center of the operator target area is located 330 mm (13 in) to the rear of the handles on a line passing from centers A or B through the center of the handgrip part of the handle. The target surface between the intersection of the two tangents and the target is the rear of the operator’s target area. For mowers with movable offset handles, the handle shall be positioned to the left to locate the left limit, then to the right to locate the right limit.

8.3.7.2.2 Base

The test enclosure shall consist of a test fixture base of 19 mm (0.75 in) plywood covered with 500 mm (19.7 in) squares of coconut matting nailed to the plywood with nails spaced as shown in figure 11(h) and figure 11(i). The coconut matting shall have approximately 20 mm (0.79 in) high fibers embedded in a PVC base weighing approximately 7000 g/m² (1.43 lb/ft²). The minimum base size shall be 1550 mm (61 in) larger than the cutting width and 1550 mm (59 in) larger than the distance between the forward edge of the leading blade tip circle and the rear edge of the trailing blade tip circle shown in figures 11(c), 11(e) and 11(f).

8.3.7.2.3 Target composition

A single target panel may be any of the following (see figure 11(j)) that meets the penetration tests:

a) A single sheet of corrugated cardboard;

b) A single sheet of corrugated cardboard with extra sheets of kraft paper added in front of the target face; or

c) Two sheets of corrugated cardboard stacked together.

The cardboard construction may have two or three liners and have one or two flutes. Kraft paper shall be of nominal 225 g/m² (50 lb/1000 ft²) construction.

8.3.7.3 Projectiles

Five hundred projectiles consisting of 6.35 mm (0.25 inch) diameter balls of hardened steel (45 HRC) minimum shall be used.

8.3.7.4 Injection points

Injection points shall be provided at the 12 o'clock position as shown in figures 11(b) through 11(f) and located at 25 mm ± 5 mm (1.0 in ± 0.20 in) inside the blade tip circle for the injection of projectiles. An injection point shall be provided for each blade of a multispindle mower.

The injection tube outlets shall be fixed and flush with the upper surface of the coconut mat (see figure 11(i)) and the system shall be so arranged that the ball may be injected with variable velocity. The ball injection mechanism

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shall ensure consistent free rise heights within a range of 100 mm (3.9 in). Adjust the velocity with which the ball is ejected so that the ball rises not less than 30 mm (1.2 in) above the surface of the coconut matting and within an angle of 10 degrees of the vertical axis.

8.3.7.5 Test method

The test shall be conducted for each blade assembly. The mower blades shall be adjusted to a 30-mm (1.2-in) cut height or the next higher cutting position when set on a hard level surface. Machines with a maximum height setting of 30 mm (1.2 in) or less shall be set at their maximum height setting.

With the mower in place and the blade cutting height adjusted and the engine operating at the manufacturer's specified maximum engine speed, allow balls, one at a time, into the mower. Increase the velocity of the ball in small increments until each ball is hit by the mower blade. This procedure is intended to ensure that the ball rise height is as low as possible and yet ensure regular blade impact with the ball. Start the test when this minimum velocity is established. Chipped or damaged balls shall be replaced.

Inject 500 projectiles into each injection point for each test. On multispindle mowers, the test shall be run for each spindle with the results evaluated for each test.

During any of the tests, in the event of excessive hits at a localized area, it may be necessary to repair or replace the target before continuing with the tests. Balls remaining within the test fixture (or on the test surface) may be removed at the option of the tester to minimize ricochet hits.

If a re-test is required, a new blade shall be used for each test of 500 projectiles, unless the blade is not damaged by impact with the projectiles.

Count and record hits on the data sheet provided (see figure 11(k)). Projectiles that hit and damage the centerline of the target zone height line shall be scored with the target zone below that line.

8.3.7.6 Test acceptance

8.3.7.6.1 On multispindle mowers, a test (500 projectiles) shall be run for each spindle. The total hits for each spindle shall be added together and divided by the number of spindles to obtain an average number of hits that is used for test acceptance.

For side discharge mowers, there shall be an average of no more than 45 hits between the base and the 450 mm (17.7 in) line (lower and middle elevation zones) of which not more than six (6) may be above the 300 mm (11.8 in) line (middle elevation zone). There shall be no hits above the 450 mm (17.7 in) line (top elevation zone).

(For pedestrian-controlled mowers only.) There shall be not more than two hits in the operator target zone between the base and the 450 mm (17.7 in) line.

For all other mowers, there shall be an average of no more than 30 hits between the base and the 450 mm (17.7 in) line (lower and middle elevation zones) of which not more than six (6) may hit the target above the 300 mm (11.8 in) line (middle elevation zone). There shall be no hits above the 450 mm (17.7 in) line (top elevation zone).

The average hits in any zone shall not exceed the number in the table below.

Target Zone	Side Discharge Mowers	All other Mowers
Total 0 - 450 mm	45	30
300 > 450 mm	6	6
450 > 900	0	0
Operator Target Area for Pedestrian-Controlled Mowers below 450 mm	2	2
Operator Target Area for Pedestrian-Controlled Mowers above 450 mm	0	0

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8.3.7.6.2 Additional testing
In the event of a test failure, two additional machines shall be tested. If either of the additional machines fails a test, the model is considered to be not in compliance with the thrown objects requirement of this standard.

Mower components with the blade tip circle diameter of 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades

8.3.8 Impact test

8.3.8.1 Test equipment

The target described in 8.3.1.6 and the fixture shown in figure 12 shall be used.

8.3.8.2 Test conditions

The mower shall be adjusted for a cutting height of approximately 76 mm (3 in), or the cutting height shall be adjusted as closely as possible to 76 mm (3 in).

8.3.8.3 Procedure

The mower shall be positioned over the fixture and dropped onto the test rod so that the blade or blade holder makes positive contact with the rod. The mower shall be dropped fast enough so that mower speed is not materially reduced by glancing contact before solid contact is made. The mower shall be dropped onto the rod and allowed to continue for a minimum of two (2) seconds before disengaging the power or lifting the mower. The test shall be conducted once in each of the following modes:

a) The mower shall be positioned so that the contact between the blade and the rod is at a point as close to the blade holder connection as possible and

b) The mower shall be positioned so that the contact between the blade and centerline of the rod is 25 mm ± 10 mm (1 in ± 0.4 in) from the outer tip of the blade.

8.3.8.4 Test acceptance

See 8.3.2.4.

8.3.9 Unbalance test

8.3.9.1 Test equipment

See 8.3.1.6.

8.3.9.2 Test conditions

For multipiece blade construction, one set of cutting elements and fasteners shall be removed from the end of the blade attaching point. For one-piece blade construction, the beveled or sharpened length of the blade on one end only shall be removed.

8.3.9.3 Test procedure

The mower shall be run for two (2) minutes before shutoff. For multispindle mowers, the test may be conducted on all spindles concurrently.

8.3.9.4 Test acceptance

See 8.3.2.4.

8.3.10 Structural integrity tests

8.3.10.1 Test equipment

The test fixtures shown in figure 13 shall be used. The test rods shall be low-carbon hot-finish steel with sawed or sheared ends. For mowers with the blade-tip-circle diameter of up to 1220 mm (48 in) for all blades, the rods shall be 10 mm (0.4 in) in diameter x 51 mm (2 in) in length. For mowers with the blade-tip-circle diameter of greater than 1220 mm (48 in) for one or more blades, the rods shall be 13 mm (0.5 in) in diameter x 51 mm (2 in) in length. The rod length tolerance shall be ± 3 mm (± 0.125 in).

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8.3.10.2 Test conditions

The mower should be positioned so that the cutting edge of a stationary blade is 305 mm ± 13 mm (12 in ± 0.5 in) above the sand base. When supports are necessary to position the mower such that the cutting edge of the blade is 305 mm (12 in) above the sand base, the supports shall be of round steel bars or tubing no larger than 38 mm (1.5 in) in diameter, and no more than six shall be used per frame unit. The supports shall be placed as necessary under wheels, side skids, or other structural components that normally rest on the ground if the mower is at the minimum cutting height. If additional supports are needed, they should be located at least 153 mm (6 in) outside the blade enclosure. The mower may also be supported from above.

8.3.10.3 Test procedure

The test shall consist of test rods inserted vertically downward into each of eight (8) equally spaced holes for each blade, in accordance with figure 13(a). The test rods shall be inserted through the tube and funnel arrangement as specified in figure 13(b), or through a similar arrangement with air or mechanical assist. A sufficient number of test rods shall be dropped into each of the eight (8) positions so that the blade contacts at least 12 test rods per position.

8.3.10.4 Test acceptance

The mower shall remain in compliance with all applicable requirements of this standard. The test rods shall not break through the blade housing or enclosure with an opening greater than half the diameter of the test rod.

8.3.11 Structural integrity test – Grass collection system

8.3.11.1 Test procedure

The test shall be conducted in accordance with 8.3.10, except the multispindle mower may be tested only for the blade(s) nearest the discharge opening. When a fiber or cloth grass catcher is used for this test, it may be replaced for test completion in 8.3.12.

8.3.11.2 Test acceptance

There shall be

- no penetration of the target (see figure 13(d)) by any test projectile;
- no strikes or penetration of the operator zone of the target shown in figure 13(e);
- no opening of a zipper or bag seam; and
- no dislodging of the grass catcher from its adapter or falling of the grass catcher from its normal operating position.

8.3.12 Thrown objects test

This test shall be conducted after the structural integrity test of both blade enclosures and guards, and the grass collection system.

8.3.12.1 Test equipment

The test fixtures shown in figures 13(f) and 13(g) and test projectiles, as described in 8.3.6.2.1 shall be used. For ride-on units, a vertical cylinder of target material with a diameter of 914 mm (35 in) shall be placed in the operator zone, such that the back of the cylinder will be 76.2 mm (3 in) behind the rear position of an actual operator in the event there is no back support on the seat. The target cylinder shall extend from the operator's normal foot position to a height of 1000 mm (39 in) above the operator's seat.

8.3.12.2 Test conditions

See 8.3.10.2.

8.3.12.3 Test procedure

The test shall consist of 150 test projectiles (75 headfirst and 75 point first) inserted vertically downward into each of eight (8) equally spaced holes for each blade in accordance with figure 13(a). The test projectiles shall be inserted through the tube and funnel arrangement as specified by figure 13(b), or through a similar arrangement with air or mechanical assist. The introduction shall be repeated three (3) times for each hole (450 per hole) for a total of 3600 per blade. The drop velocity should remain relatively constant and be adjusted to ensure that

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between 5% and 15% of the test objects drop through the blade without making blade contact (in order to ensure that the entire length of the test object is exposed to the blade). After all 150 test projectiles are inserted, the projectiles in a 610-mm (24-in) diameter circle under the introduction hole shall be counted to verify that between 5% and 15% of the test projectiles pass through the blade without making blade contact.

On some mowers, it may not be possible to prevent more than 15% of the test projectiles from passing through the blade path without contact. In this case, the 150 quantity shall be increased to assure that at least 127 projectiles do make blade contact each test. This can be determined either by sound or counting the pass-throughs.

8.3.12.4 Scoring

After all 150 nails have been inserted, the number of nails contacted by the blade shall be recorded and the marks on the wall above the blade line shall be recorded in the following groups:

- Strikes in the operator zone;
- Penetration in the operator zone;
- Strikes outside the operator zone; and
- Penetration outside the operator zone.

The number of marks in each of these four categories shall be added to obtain their totals for that particular blade spindle (strikes include penetrations, inasmuch as they are also marks in the first layer of the target material). Each sum shall be divided by the total number of blade-to-nail contacts for that spindle.

8.3.12.5 Test acceptance

For each blade spindle, none of the composite individual spindle scores shall exceed the following acceptance criteria:

- 2%: Strikes in the operator zone;
- 0.5%: Penetrations in the operator zone;
- 15%: Strikes outside the operator zone;and
- 5%: Penetrations outside the operator zone.

Failure of any of the four acceptance criteria shall constitute failure of the machine. In the event that the machine fails the test, it may be re-tested. The scores shall then be computed on the sum of the two tests. If the score still exceeds the acceptance criteria, the machine has failed the test.

8.3.13 Foot probe test

See 8.3.3.

8.4 Requirements for flail mowers and flail power rakes

8.4.1 Requirements for openings

Openings in the housing for the entrance and discharge of material to be cut and for other purposes shall be limited in accordance with the requirements in 8.4.1.1 and 8.4.1.2.

8.4.1.1 Units that eject material forward in the direction of ground travel when cutting shall limit the angle of trajectory to a 10-degree-maximum upward angle, tangent to the tip of the blades relative to the supporting surface. Units mounted on tractors shall also limit the path of ejected material to the space below a plane parallel to the supporting surface intersecting the centerline of the tractor rear axle, rearward of the tractor rear axle. See figure 14.

8.4.1.2 Units that eject material rearward to the direction of travel shall limit the path of the ejected material to a downward direction relative to the supporting surface. Any ejected material shall be directed to contact the ground within a distance of 508 mm (20 in) from the blade enclosure. For pedestrian-controlled units, any material shall be of very low energy within a distance of 508 mm (20 in) from the mower/rake housing.

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8.4.2 Test conditions

8.4.2.1 Assembly

See 8.3.1.1.

8.4.2.2 Unit position

See 8.3.1.2.

8.4.2.3 Test speed

See 8.3.1.3.

8.4.2.4 Restraints

See 8.3.1.5.

8.4.3 Tests for flail mowers and flail power rakes

Tests on rotating parts shall be cumulative. Each section of multisection units shall be tested.

8.4.3.1 Foot probe test

8.4.3.1.1 Test equipment

See figures 9(a) and 9(b).

8.4.3.1.2 Test procedure

The probe shall be held in a vertical plane and rotated horizontally and vertically at a maximum of 15 degrees each side of centerline, as shown in figure 9, and shall be tested in all positions within those rotational limits. The probe shall be inserted as far as possible at any point around the blade enclosure with a horizontal force of 111 N (25 lbf) with the cutter deck in its highest (cutting) position and adjustable blades (if used) in the lowest position. The probe need not remain on the floor. The highest cutting position for this test shall not exceed 203 mm (8 in). If the blade path height is different for different blade speeds or blade options, the test shall include the two blade height extremes. Components of the mower or machine, or both (such as frames), may be considered part of the blade enclosure for the purpose of this test. The test is conducted with all the power off, and by slow manual rotation and swinging of the blades.

8.4.3.1.3 Test acceptance

The probe shall not enter the path of the blade or blade assemblies.

8.4.3.2 Sudden impact test

8.4.3.2.1 Test equipment

A test obstruction as shown in figure 15 shall be used.

8.4.3.2.2 Test conditions

The cutting height shall be set to 50 mm (2 in). The unit shall be operated at 10% over the manufacturer's maximum specified speed.

8.4.3.2.3 Test procedure

The unit shall be dropped three (3) times onto the test obstruction of figure 15, so that the entire cutting width of the cutting unit interferes 13 mm to 25 mm (0.50 in to 1 in) with the test obstruction for 30 seconds.

8.4.3.2.4 Test acceptance

None of the parts should fracture, break, loosen, or deform in a manner hazardous to the operator or bystander, except that failure of the blades, after the first run or pass, shall not constitute failure of the test.

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8.4.3.3 Repeated impact test

8.4.3.3.1 Test equipment

See 8.4.3.2.1.

8.4.3.3.2 Test conditions

See 8.4.3.2.2.

8.4.3.3.3 Test procedure

The unit shall be moved forward from a point rearward of the test obstructions at the rate of 1.6 km/h (1 mi/h), passing over the test obstruction 25 times.

8.4.3.3.4 Test acceptance

See 8.4.3.2.4.

8.4.3.4 Blade unbalance test

8.4.3.4.1 Test equipment

A timer shall be used.

8.4.3.4.2 Test conditions

Twenty percent of the cutting or raking elements and attaching hardware shall be removed in such a manner as to create the most severe imbalance condition.

8.4.3.4.3 Test procedure

The unit shall be operated at the manufacturer's maximum specified speed for two (2) minutes.

8.4.3.4.4 Test acceptance

See 8.4.3.2.4.

8.5 Requirements for reel mower components

8.5.1 Subclauses 8.1.1 through 8.1.3 shall apply to reel mowers.

8.5.2 Safety sign

A safety sign with a pictorial, such as shown in annex C, warning of the blade contact hazard shall be placed at or near the hazard location(s). If a signal word is used, it shall be "Danger". The safety sign shall conform to the legibility requirements of 8.2.1(a).

8.5.3 Grass collection systems

Any removable grass collection system(s) shall conform to the requirements of 8.6.3 and 8.6.4 with the grass collection system either in place or removed.

8.6 Tests for reel mower components

8.6.1 Test conditions – General

8.6.1.1 Assembly

The cutting unit(s) shall be completely assembled and mounted on its traction unit. Adjustable guards shall be in the most unfavorable position for the tests. The cutting unit(s) shall be assembled into the highest and lowest configuration as recommended by the manufacturer.

8.6.1.2 Test Surface

The mower(s) shall rest on a flat horizontal surface.

8.6.2 Side coverage of reels

Reels shall be covered at the sides by guards or by location, as shown in figure 16. Openings required for adjustment are acceptable.

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8.6.3 Guarding

8.6.3.1 Rear-throw mowers

Reels shall be covered from above with a guard or structure rigidly attached to the mower frame that extends so that its projection on the horizontal plane covers at least the projection of the reel on the same horizontal plane. See figure 17.

8.6.3.2 Front-throw mowers

Reels shall be covered from the rear with a guard or structure that extends so that its' projection on the vertical plane covers from the top of the reel to not more than 25 mm (4 inches) from the bottom. See figure 18.

8.6.3.3 Free-throw mowers

The throw line shall not intersect the vertical plane at the front edge of the driver's seat at a point higher than the seat upper surface. The seat shall be in its most unfavorable adjustment position and loaded with 91 kg ± 5 kg (200 lb ± 11 lb). It shall be ensured that this is satisfied for a width of 400 mm (16 in) on both sides of the seat centerline.

8.6.3.4 Pedestrian-controlled reel mowers

Front discharge machines are not required to be tested. Rear discharge and free discharge machines shall be fitted with a nondetachable guard that limits the throw line to a maximum height of 1000 mm (39.4 in) in the vertical plane of the handle grips (see figure 19). The throw line shall be the steepest line in a vertical plane, tangential to the periphery of the cutting reel in the direction of rotation of the reel that does not intersect a guard or other part of the mower. Measurements shall be taken at the most unfavorable height-of-cut setting.

8.6.4 Pedestrian-controlled reel mowers

8.6.4.1 Handle Structure

8.6.4.1.1 The end of the handle adjacent to the operator shall be at least 450 mm (18 in) horizontally behind the rear vertical tangent of the reel, or 8.6.4.1.2 applies

8.6.4.1.2 If the end of the handle adjacent to the operator is less than 450 mm (18 in) horizontally behind the rear vertical tangent of the reel, the requirements of a foot probe test (8.3.3) shall be fulfilled. The foot probe (see figure 9(a)) shall be applied from the operating position side only, with the sole of probe held horizontally at any height and then tilted forward or backward up to 15° from the horizontal. The foot probe shall not contact the cutting reel.

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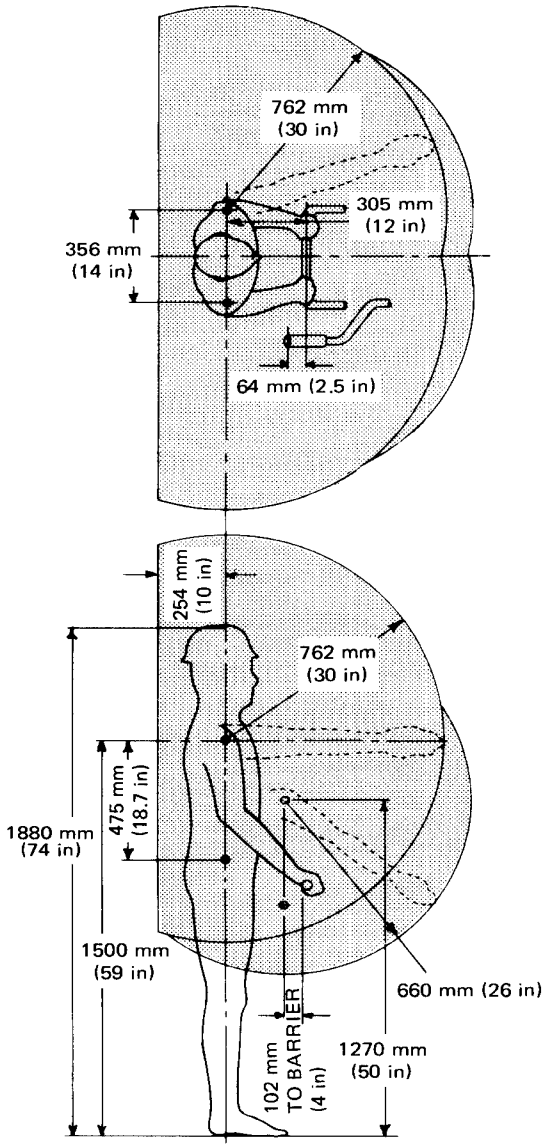


Figure 1 – Operator zone – Pedestrian-controlled units

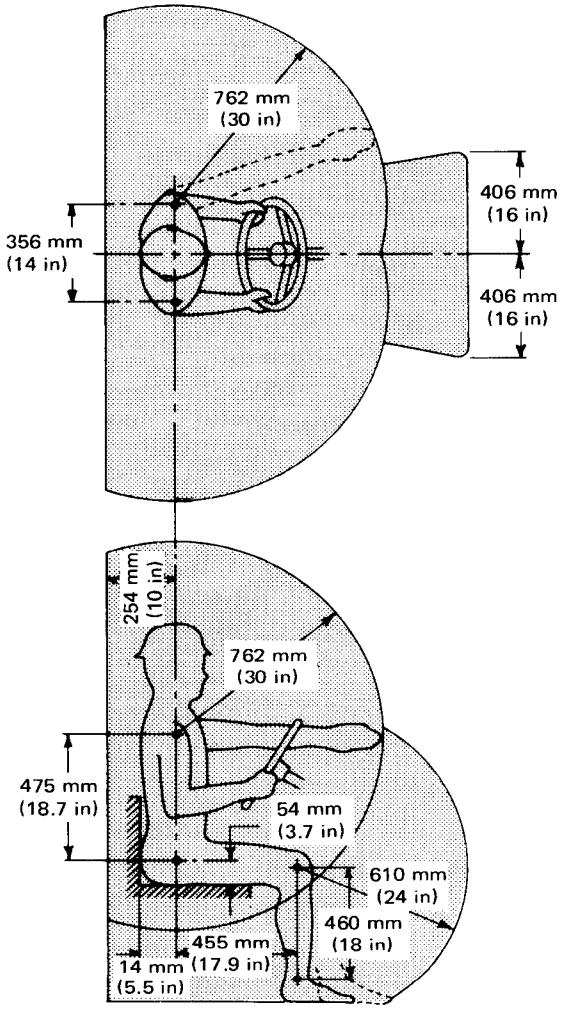


Figure 2 – Operator zone – Ride-on units

NOTES (For figures 1 and 2)

1 The operator zone, illustrated in figures 1 and 2, is the area into which the extremities of a 95th percentile male can reach from the normal operator position.

2 On riding units, the zone is established with the seat in the rearward adjustment position. A 102-mm (4-in) forward adjustment will approximate the position of a 5th percentile male or a 50th percentile female.

3 On pedestrian-controlled units, the lowest forward zone is the area into which a 5th percentile male or a 50th percentile female can reach when against the handle barrier. This zone can also be reached by a 95th percentile male leaning forward against the handle barrier.

4 All barriers within the operator zone will reduce the zone by the space occupied and protected by the barrier.

5 The operator zone includes the maximum range of all frequently used operator control movement but is not intended to represent preferred operator control positions. SAE J898 is recommended for determining desirable hand and foot control locations and space allocations. SAE J833 is a source of male and female physical dimension. For less frequently used controls, see 4.5.1.

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1.0 Training

1.1 Read the Operator's Manual and other training material. If the operator(s) or mechanic(s) cannot read English it is the owner's responsibility to explain this material to them.

1.2 Become familiar with the safe operation of the equipment, operator controls, and safety signs.

1.3 All operators and mechanics should be trained. The owner is responsible for training the users.

1.4 Never let children or untrained people operate or service the equipment. Local regulations may restrict the age of the operator.

1.5 The owner/user can prevent and is responsible for accidents or injuries occurring to themselves, other people or property.

2.0 Preparation

2.1 Evaluate the terrain to determine what accessories and attachments are needed to properly and safely perform the job. Only use accessories and attachments approved by the manufacturer.

2.2 Wear appropriate clothing including hard hat, safety glasses and hearing protection. Long hair, loose clothing or jewelry may get tangled in moving parts.

2.3 Inspect the area where the equipment is to be used and remove all objects such as rocks, toys and wire which can be thrown by the machine

2.4 Use extra care when handling gasoline and other fuels. They are flammable and vapors are explosive.
- a. Use only an approved container
- b. Never remove gas cap or add fuel when engine is running. Do not smoke.
- c. Never refuel or drain the machine indoors.

2.5 Check that operator's presence controls, safety switches and shields are attached and functioning properly. Do not operate unless they are functioning properly.

3.0 Operation

3.1 Never run an engine in an enclosed area.

3.2 Only operate in good light, keeping away from holes and hidden hazards.

3.3 Be sure all drives are in neutral and parking brake is engaged before starting engine. Only start engine from the operator's position. Use seat belts if provided.

3.4 Be sure of your footing while using pedestrian controlled equipment, especially when backing up. Walk, don't run. Never operate on wet grass. Reduced footing could cause slipping.

3.5 Slow down and use extra care on hillsides. Be sure to travel in the recommended direction on hillsides. Turf conditions can affect the machine's stability. Use caution while operating near drop-offs

3.6 Slow down and use caution when making turns and when changing directions on slopes.

3.7 Never raise deck with the blades running.

3.8 Never operate with the PTO shield, or other guards not securely in place. Be sure all interlocks are attached, adjusted properly, and functioning property.

3.9 Never operate with the discharge deflector raised, removed or altered, unless using a grass catcher.

3.10 Do not change the engine governor setting or overspeed the engine.

3.11 Stop on level ground, lower implements, disengage drives, engage parking brake (if provided), shut off engine before leaving the operator's position for any reason including emptying the catchers or unclogging the chute.

3.12 Stop equipment and inspect blades after striking objects or if an abnormal vibration occurs. Make necessary repairs before resuming operations.

3.13 Keep hands and feet away from the cutting units.

3.14 Look behind and down before backing up to be sure of a clear path.

3.15 Never carry passengers and keep pets and bystanders away.

3.16 Slow down and use caution when making turns and crossing roads and sidewalks. Stop blades if not mowing.

3.17 Be aware of the mower discharge direction and do not point it at anyone.

3.18 Do not operate the mower under the influence of alcohol or drugs.

3.19 Use care when loading or unloading the machine into a trailer or truck.

3.20 Use care when approaching blind corners, shrubs, trees, or other objects that may obscure vision.

Figure 3 - Safety practices for commercial turf care equipment

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4.0	**Maintenance and storage**
4.1	Disengage drives, lower implement, set parking brake, stop engine and remove key or disconnect spark plug wire. Wait for all movement to stop before adjusting, cleaning or repairing .
4.2	Clean grass and debris from cutting units, drives, mufflers, and engine to help prevent fires. Clean up oil or fuel spillage.
4.3	Let engine cool before storing and do not store near flame.
4.4	Shut off fuel while storing or transporting. Do not store fuel near flames or drain indoors.
4.5	Park machine on level ground. Never allow untrained personnel to service machine.
4.6	Use jack stands to support components when required.
4.7	Carefully release pressure from components with stored energy.
4.8	Disconnect battery or remove spark plug wire before making any repairs. Disconnect the negative terminal first and the positive last. Reconnect positive first and negative last.
4.9	Use care when checking blades. Wrap the blade(s) or wear gloves, and use caution when servicing them. Only replace blades. Never straighten or weld them.
4.10	Keep hands and feet away from moving parts. If possible, do not make adjustments with the engine running.
4.11	Charge batteries in an open well ventilated area, away from spark and flames. Unplug charger before connecting or disconnecting from battery. Wear protective clothing and use insulated tools.
4.12	Keep all parts in good working condition and all hardware tightened. Replace all worn or damaged decals.

Figure 3 *(concluded)*

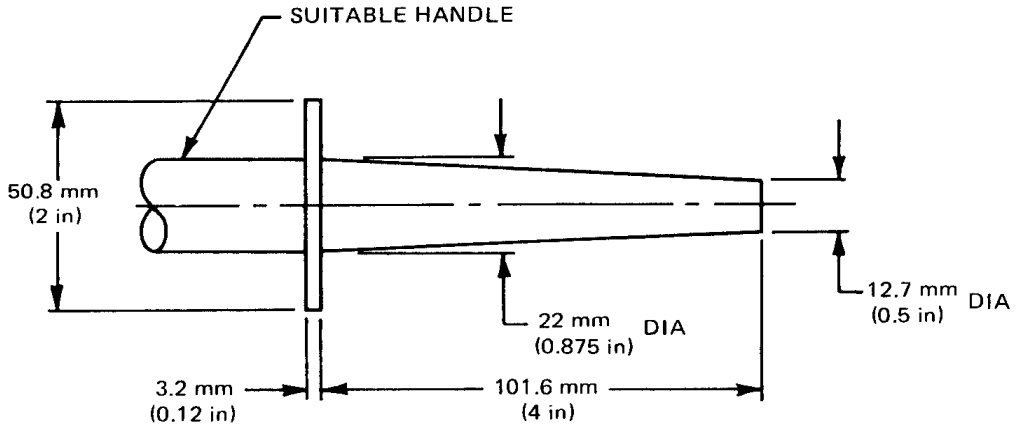
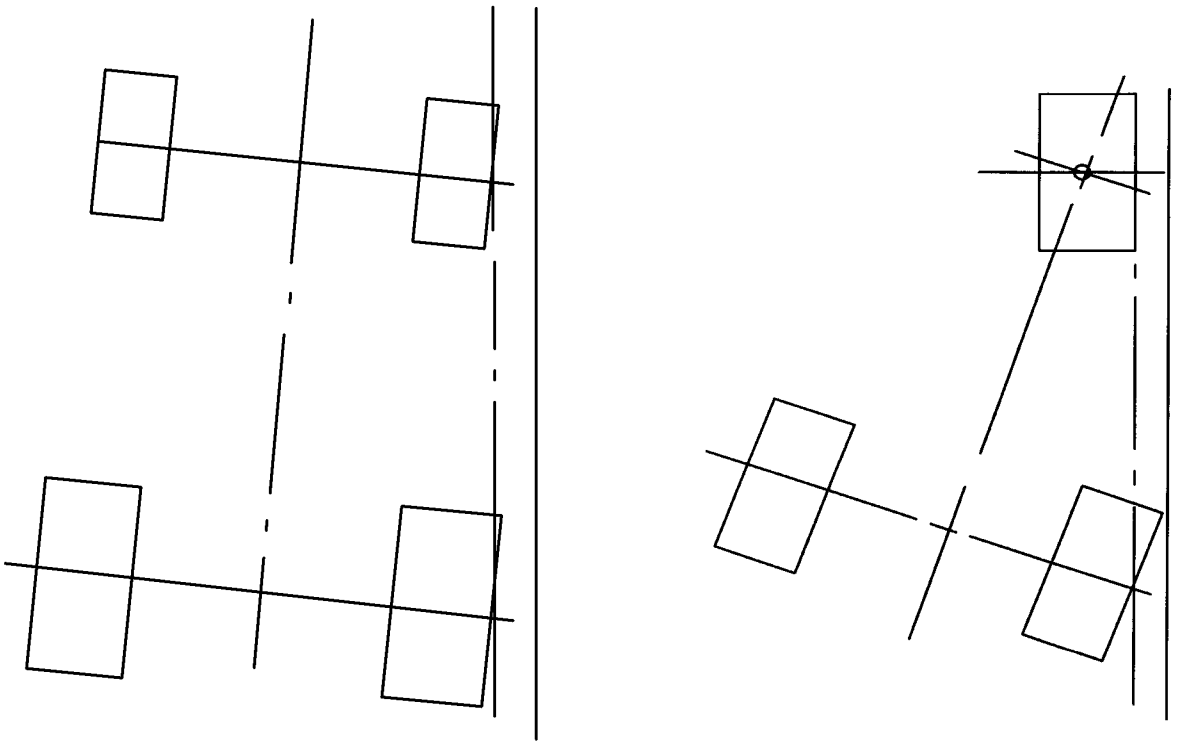


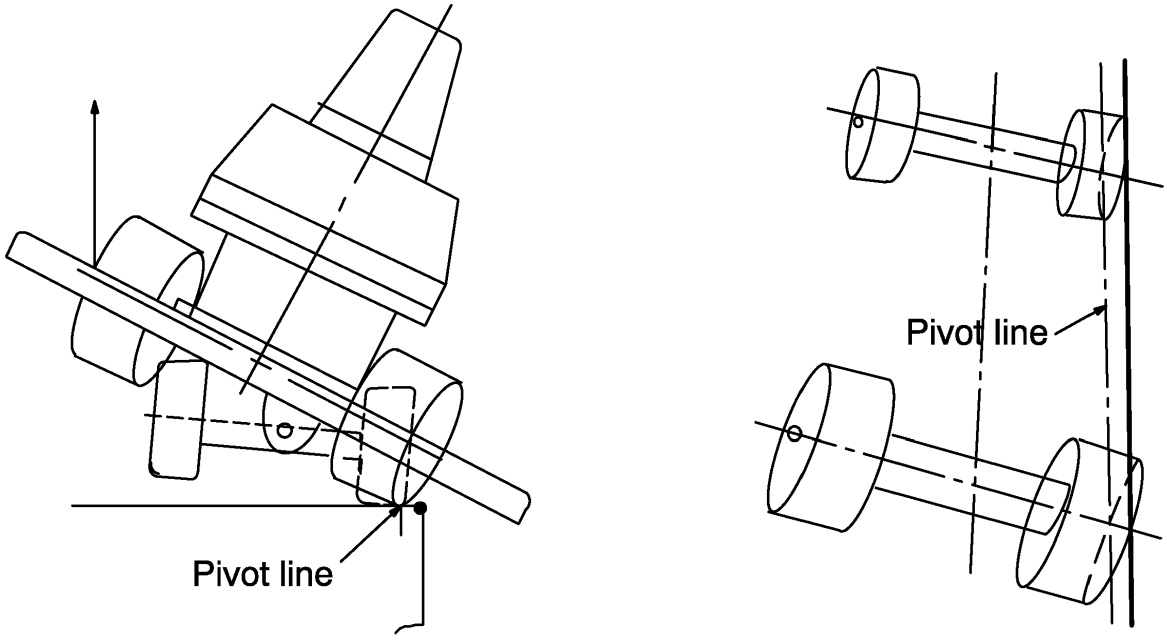
Figure 4 – Finger probe

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(a) 4-wheeled machine **(b) 3-wheeled machine**

Figure 5 - Machine position on the platform



(a) End view **(b) Top view**

Figure 6 - Machine at equilibrium

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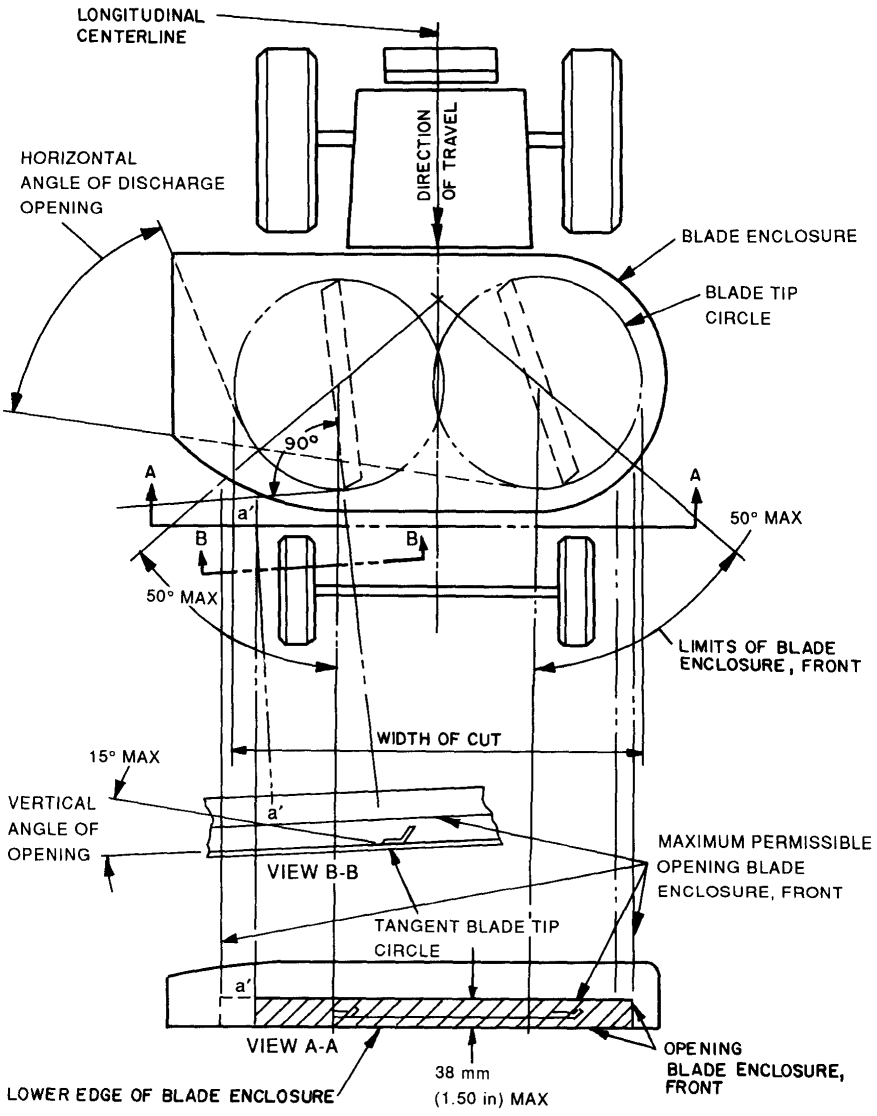
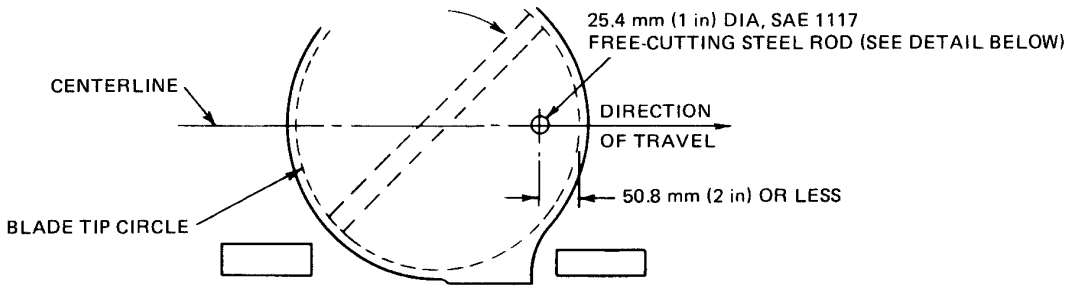
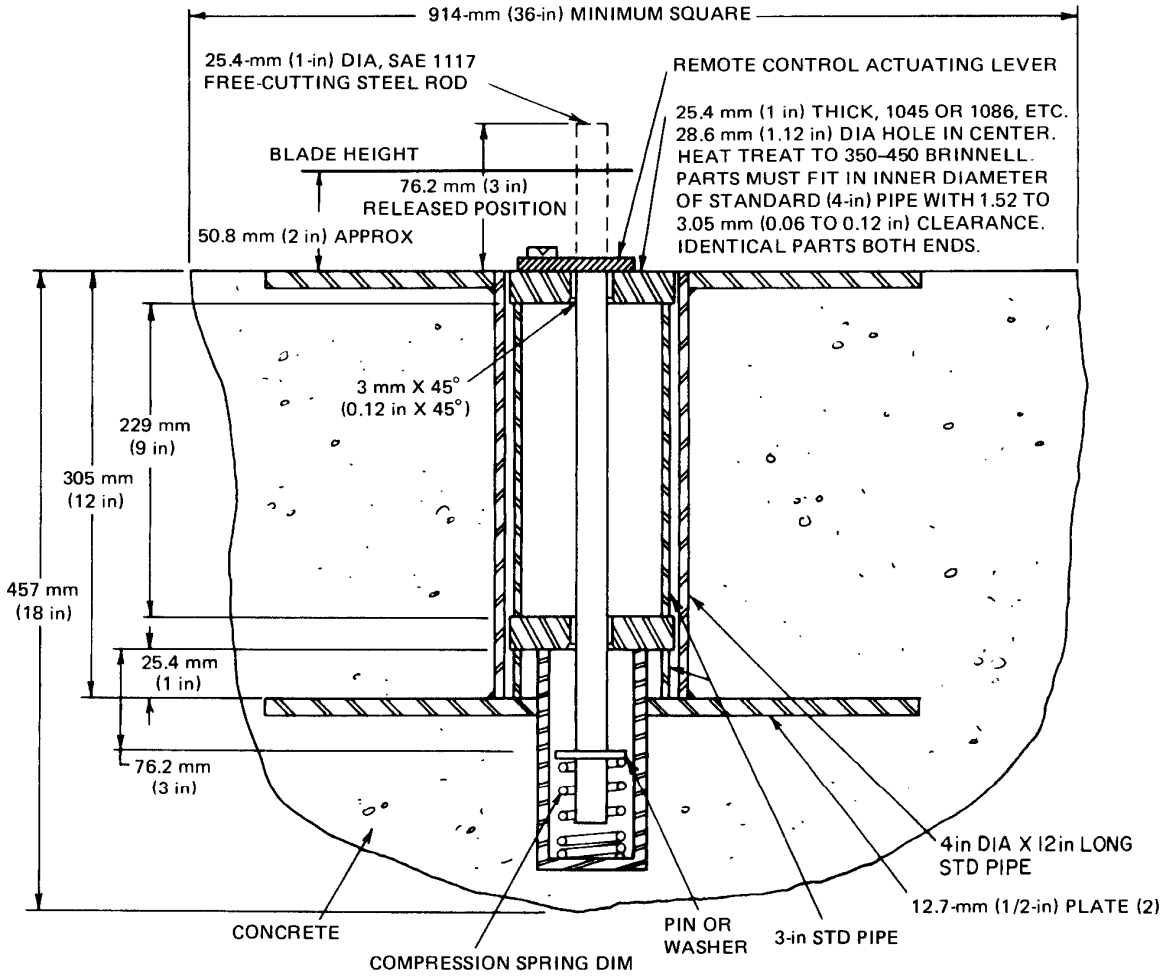


Figure 7 – Characteristic dimensions of a ride-on vehicle

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(a) Schematic plan view



FREE LENGTH	165.1 mm (6.5 in)
WIRE DIAMETER	2.794 mm (0.110 in)
COILS	0.078 COIL/mm (2 COILS/in)
MEAN DIAMETER	31.75 mm (1.25 in)
SPRING RATE	2.28 N/mm (13 lbf/in)

(b) Test arrangement

NOTE - Spring physical dimensions for reference *only*

Figure 8 – Impact test fixture for mowers with the blade tip circle diameter less than 775 mm (30.5 in) for all blades

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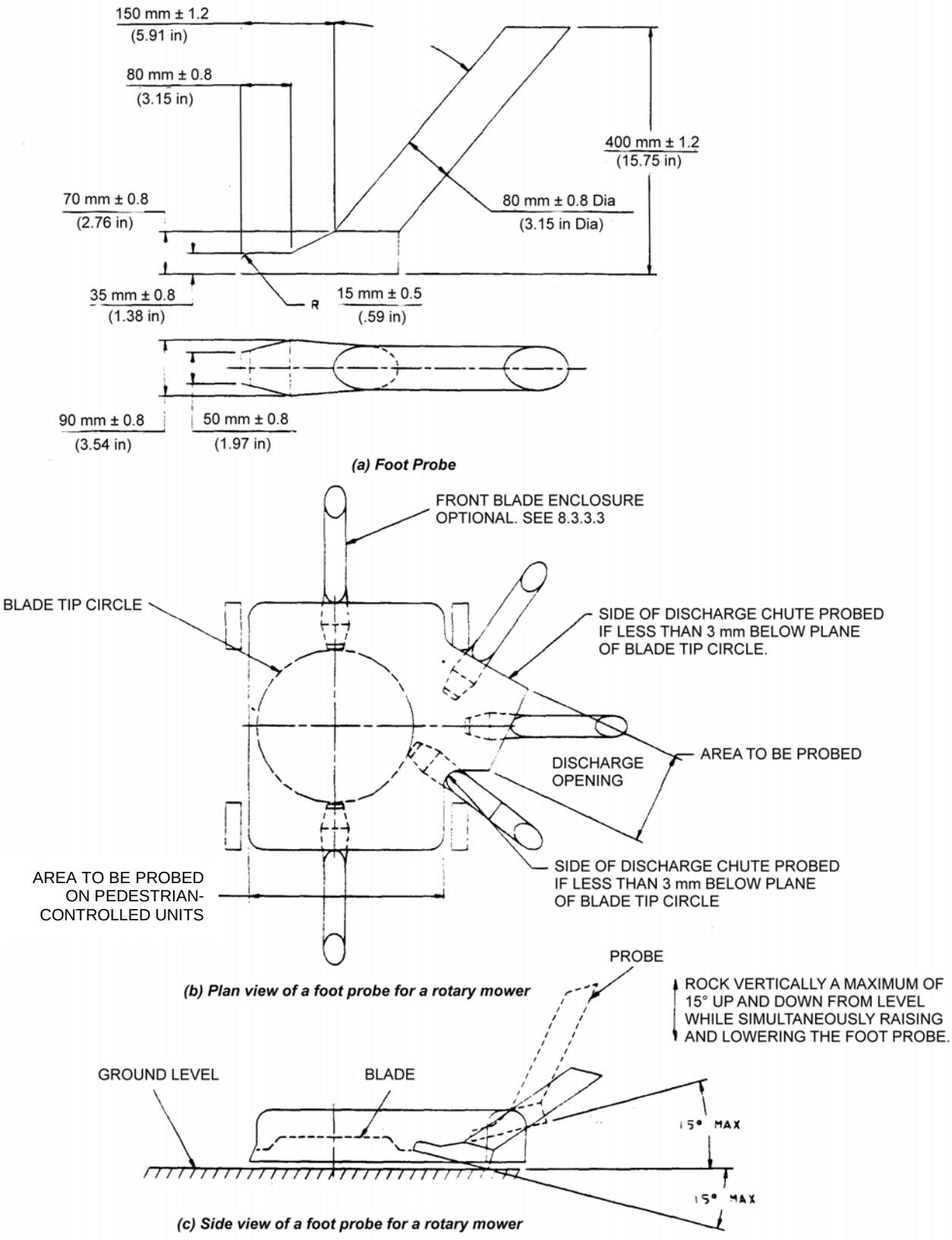
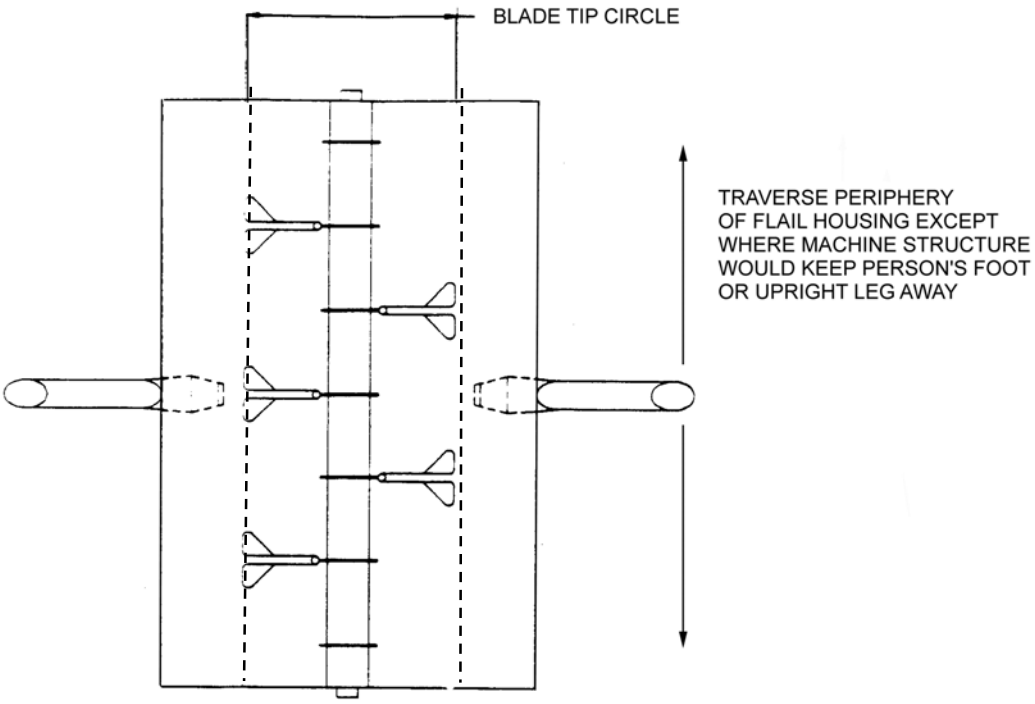
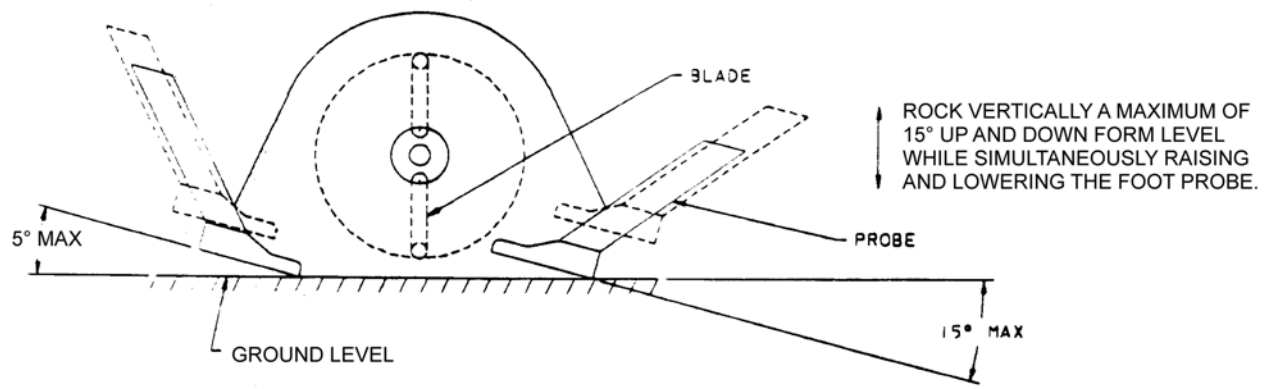


Figure 9 – Foot probe

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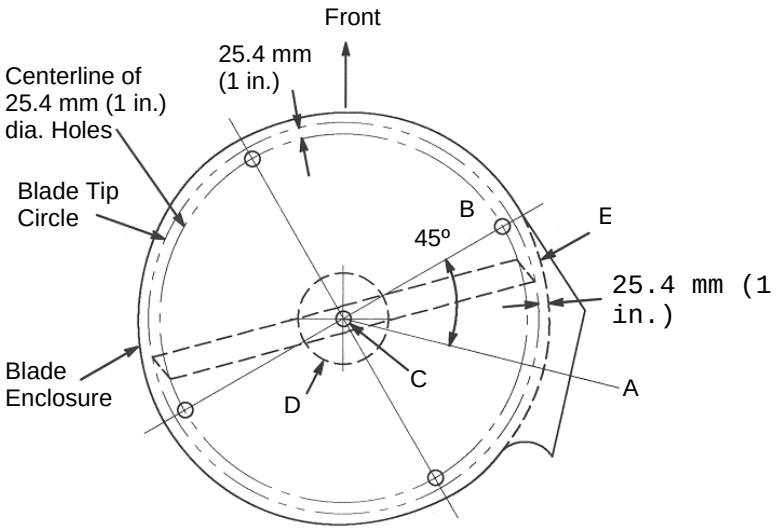
(d) Plain view of a foot probe for a flail mower



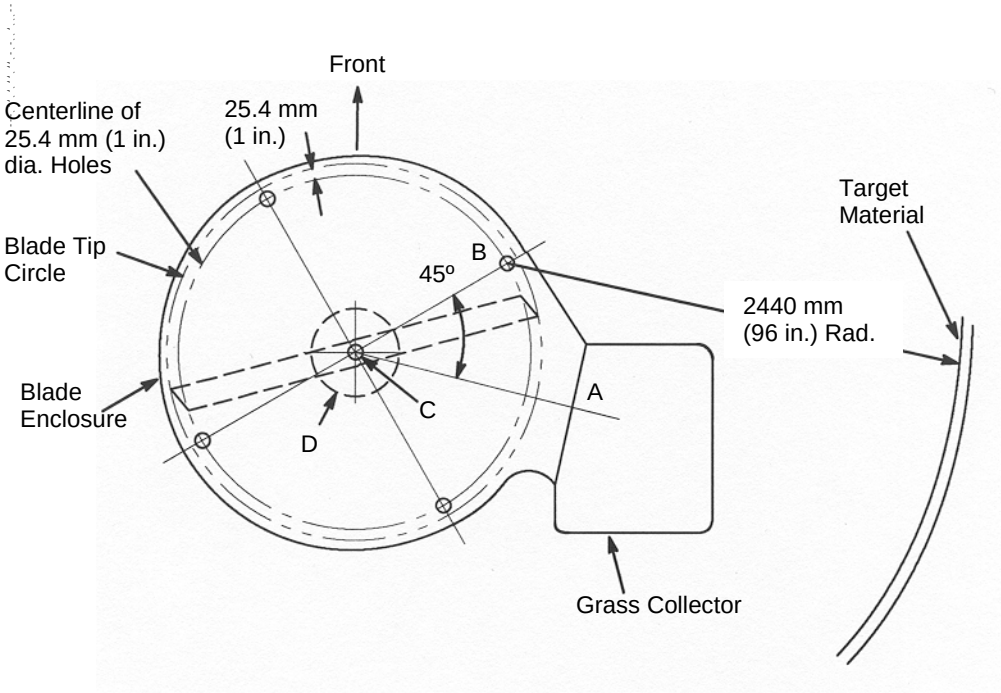
(e) Side view of a foot probe for a flail mower

Figure 9 *(concluded)*

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(a) Plan view of single blade side discharge mower injection hole locations

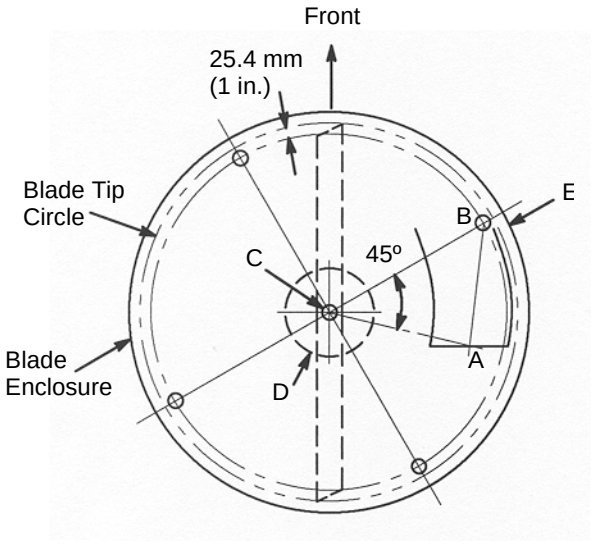


(b) Plan view of test arrangement with grass collection system

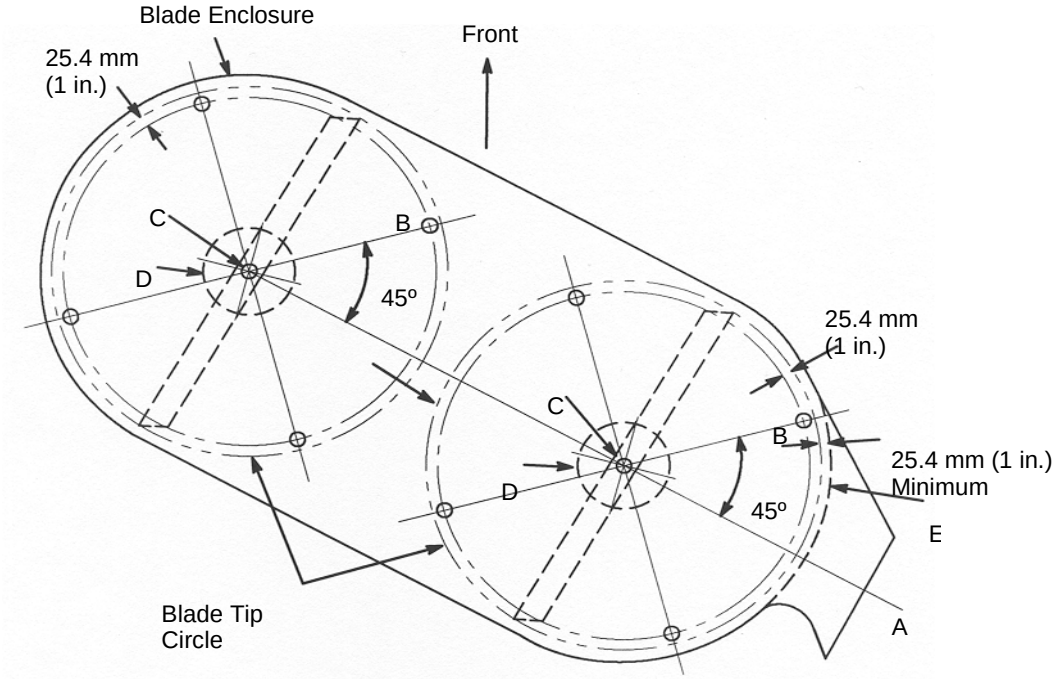
NOTES
A – Center of discharge opening
B – Primary injection hole
C – Blade Axis
D – Center air hole
E – Edge of panel (see 8.3.5)

Figure 10 – Structural Integrity test fixture for mowers with blade tip circle diameter less than 775 mm (30.5 in) for all blades

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(c) Plan view of single blade top discharge mower injection hole locations

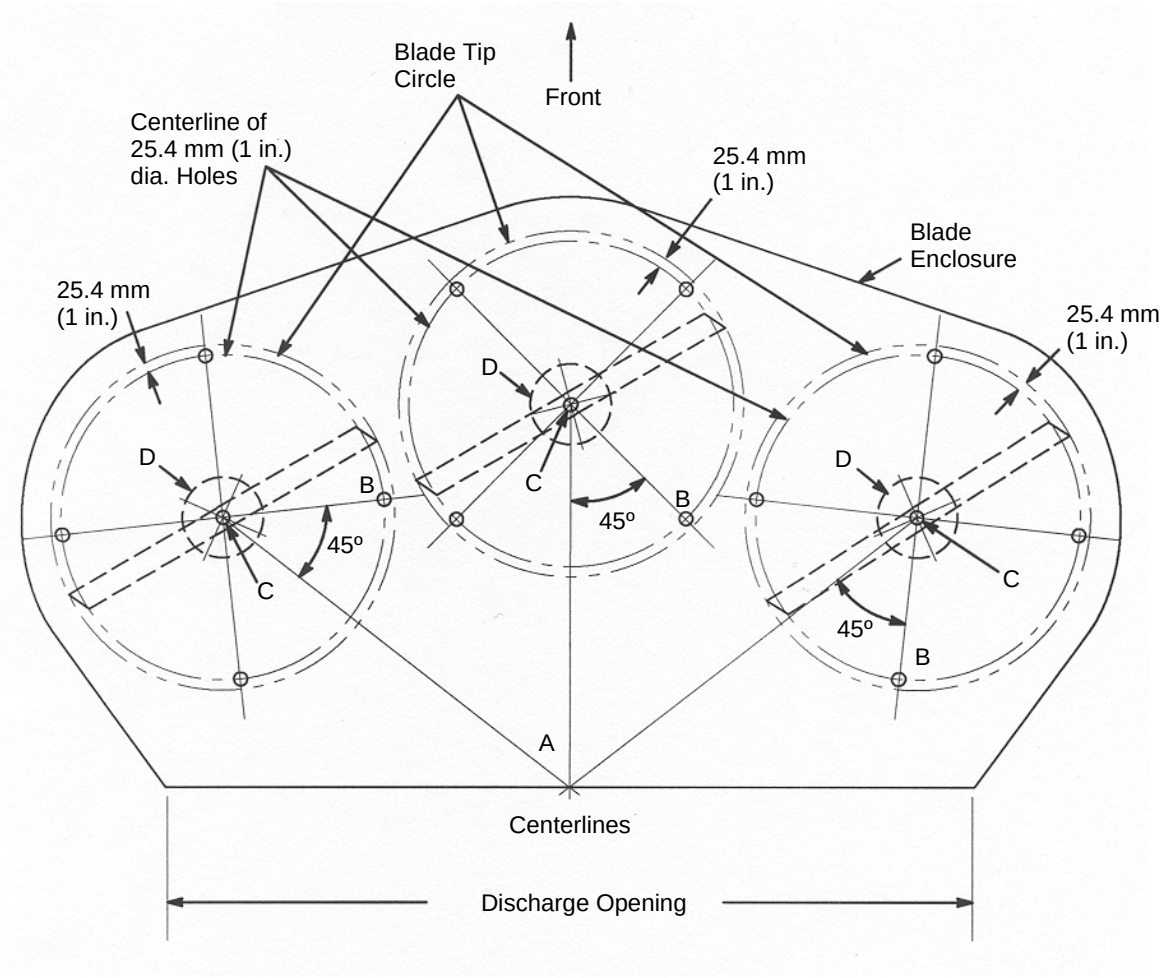


(d) Plan view of multi-blade side discharge mower injection hole locations

NOTES
A – Center of discharge opening
B – Primary injection hole
C – Blade Axis
D – Center air hole
E – Edge of panel (see 8.3.5)

Figure 10 *(continued)*

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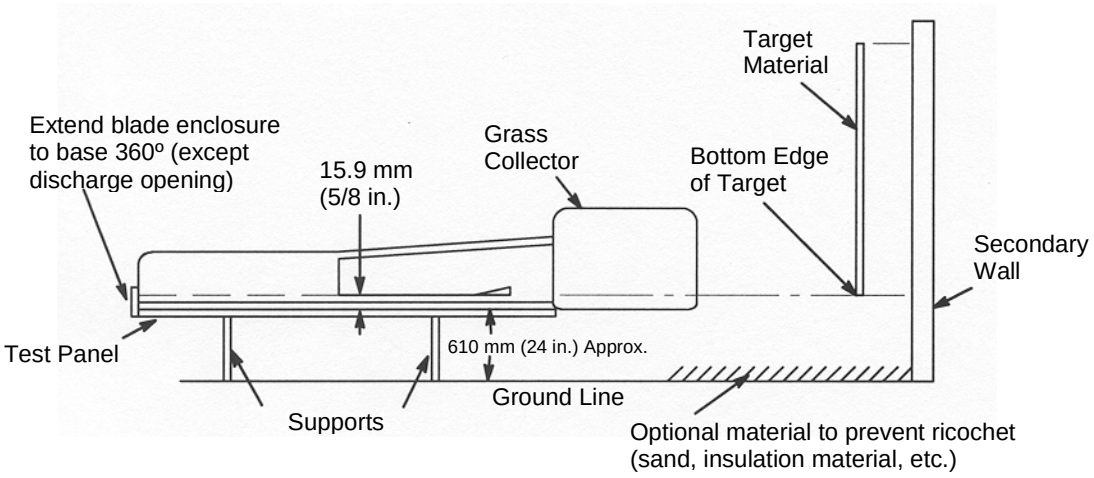
(e) Plan view of multi-blade rear discharge mower injection hole locations

NOTES
A – Center of discharge opening
B – Primary injection hole
C – Blade Axis
D – Center air hole

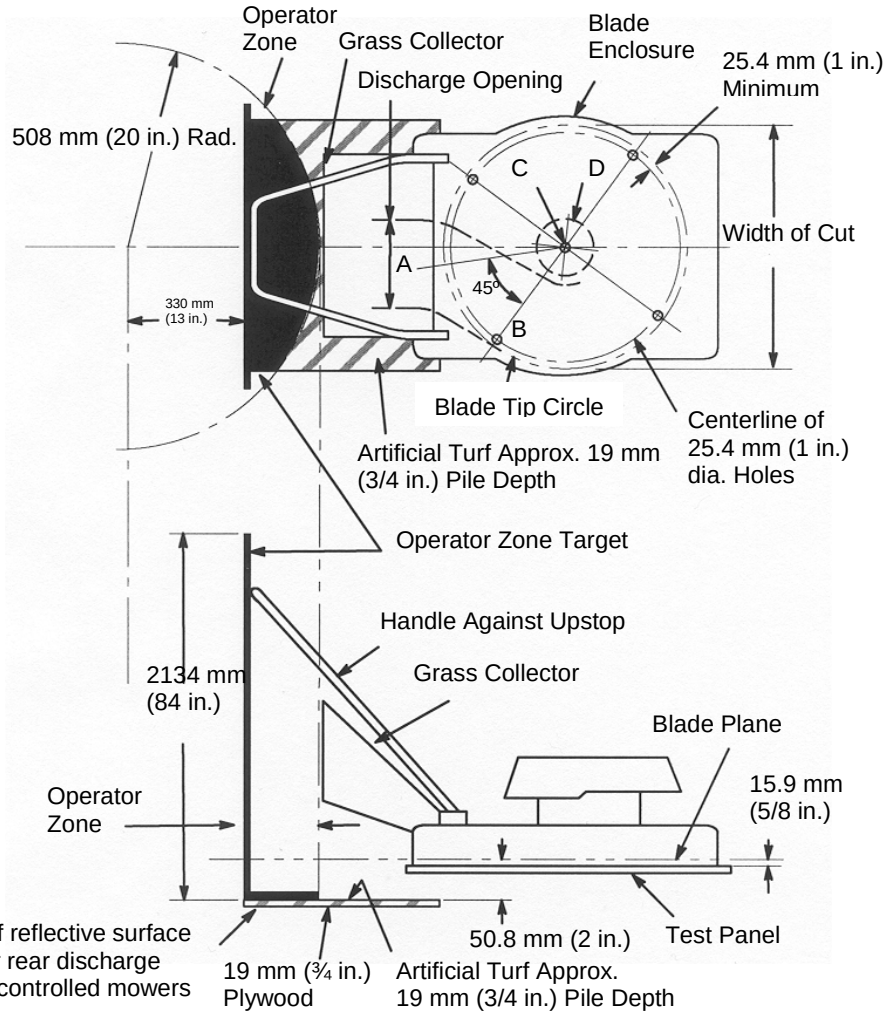
Figure 10*(continued)*

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(f) Test arrangement with grass collection system



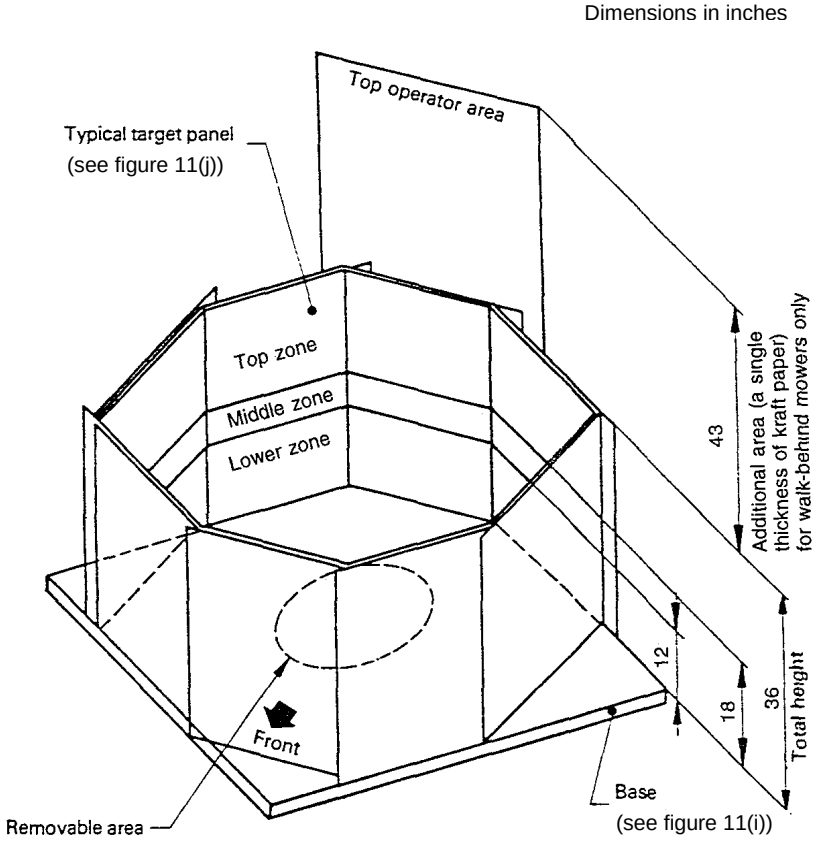
NOTES

A - Center of discharge opening
B - Primary injection hole
C - Blade axis
D - Center air hole

(g) Views of rear discharge pedestrian controlled mower with grass collection system

Figure 10 *(concluded)*

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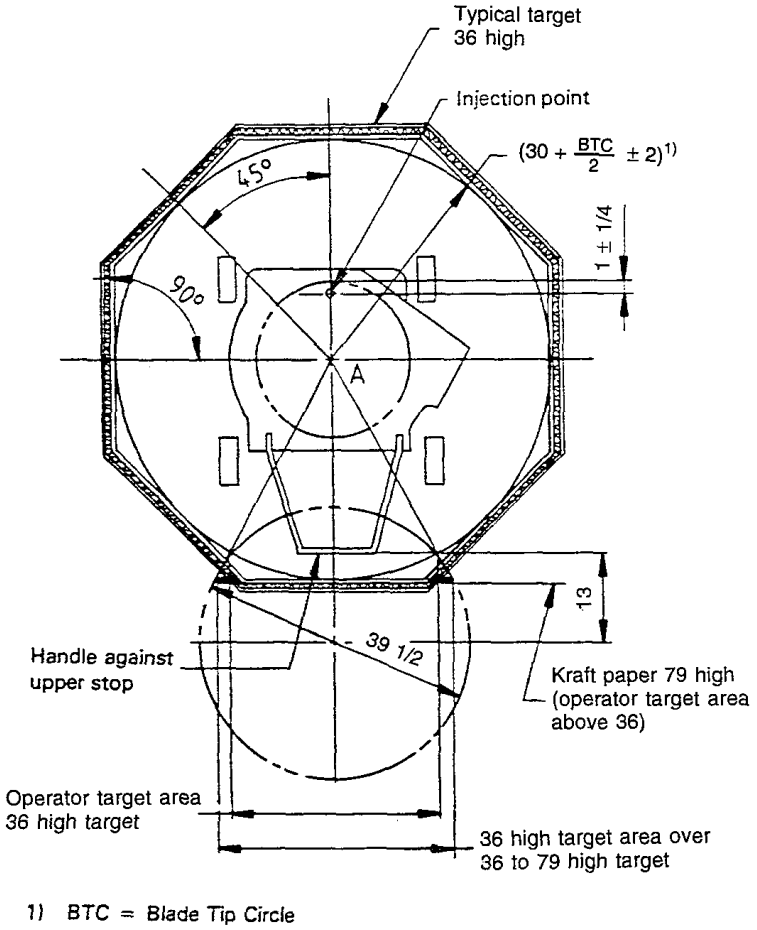
(a) General layout

Figure 11 – Thrown object test fixture

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Dimensions in inches



1) BTC = Blade Tip Circle

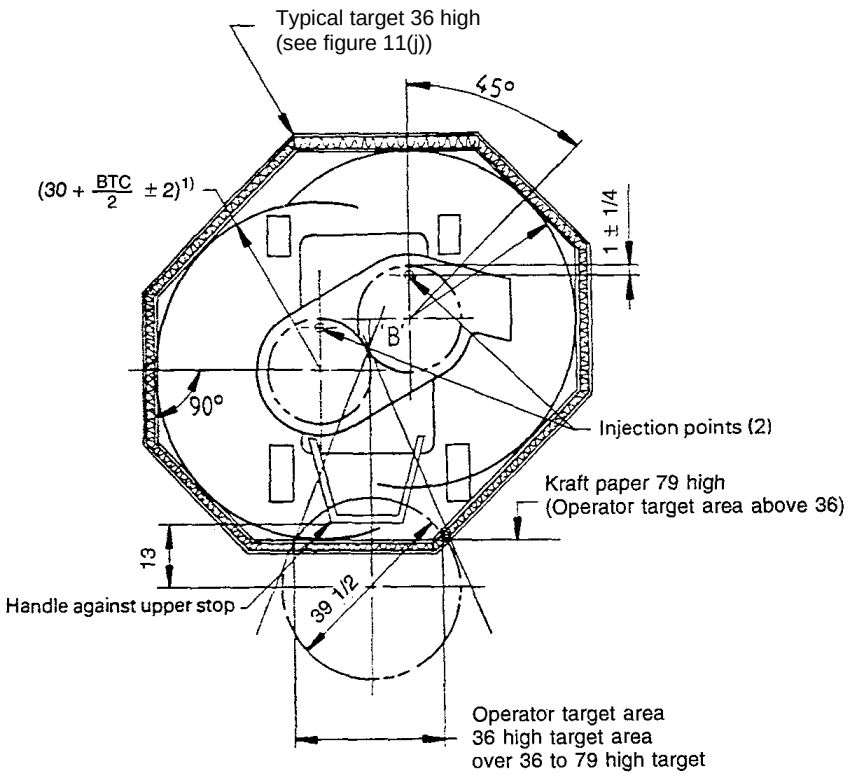
(b) Single-spindle pedestrian-controlled mower – Test enclosure

Figure 11 *(continued)*

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Dimensions in inches



1) BTC = Blade Tip Circle

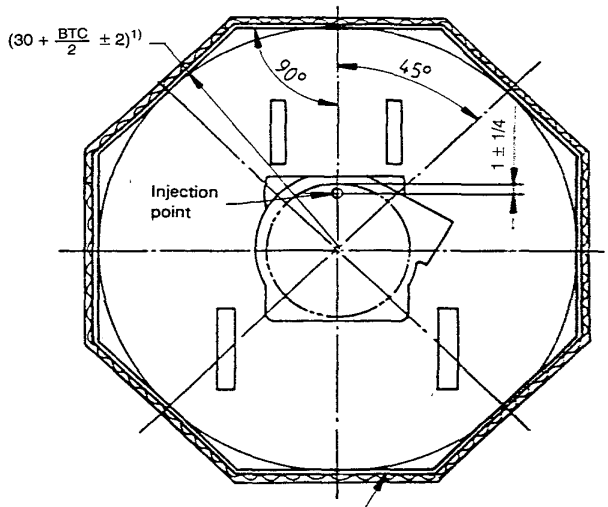
(c) Two-spindle pedestrian-controlled mower – Test enclosure

Figure 11 *(continued)*

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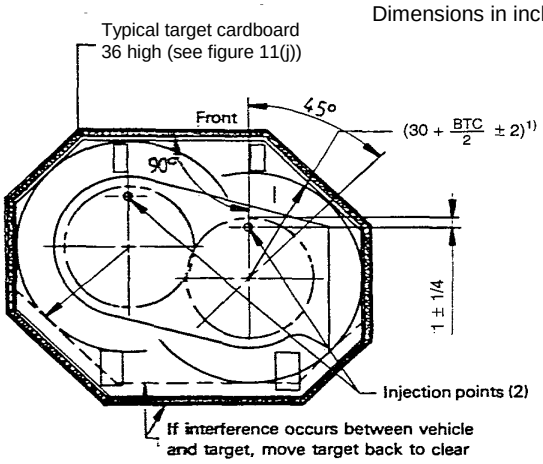
Dimensions in inches



1) BTC = Blade Tip Circle

(d) Single spindle ride-on mower – Test enclosure

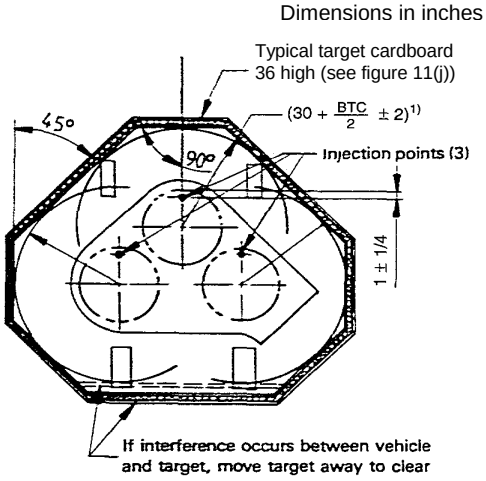
Dimensions in inches



1) BTC = Blade Tip Circle

(e) Two spindle ride-on mower – Test enclosure

Dimensions in inches



1) BTC = Blade Tip Circle

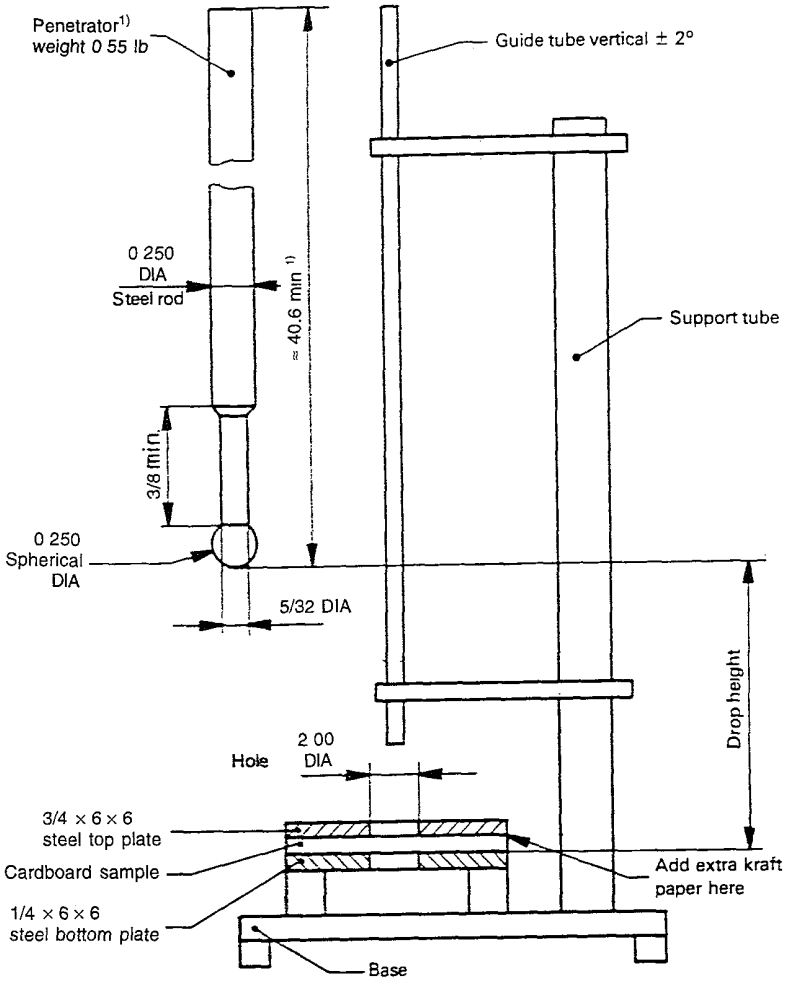
(f) Three spindle ride-on mower – Test enclosure

Figure 11 *(continued)*

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Dimensions in inches



[1)] The penetrator shall be made longer and then shortened to give a weight of 0 55 lb

NOTE — The figure varies in scale.

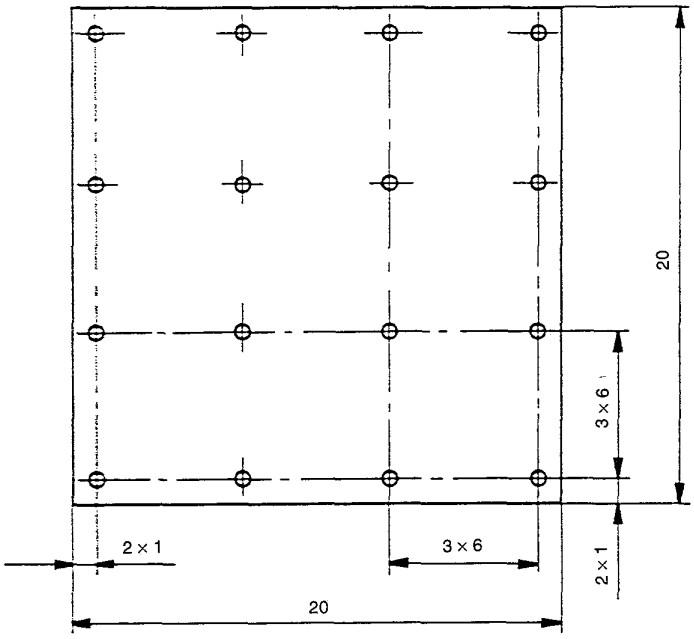
(g) Test fixture for corrugated cardboard penetration tests

Figure 11 *(continued)*

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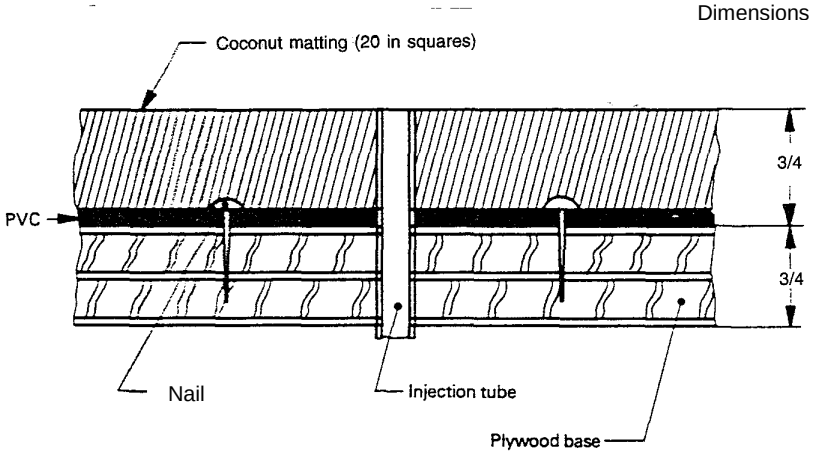
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Dimensions in inches



(h) Nail plan of test fixture base

Dimensions in inches

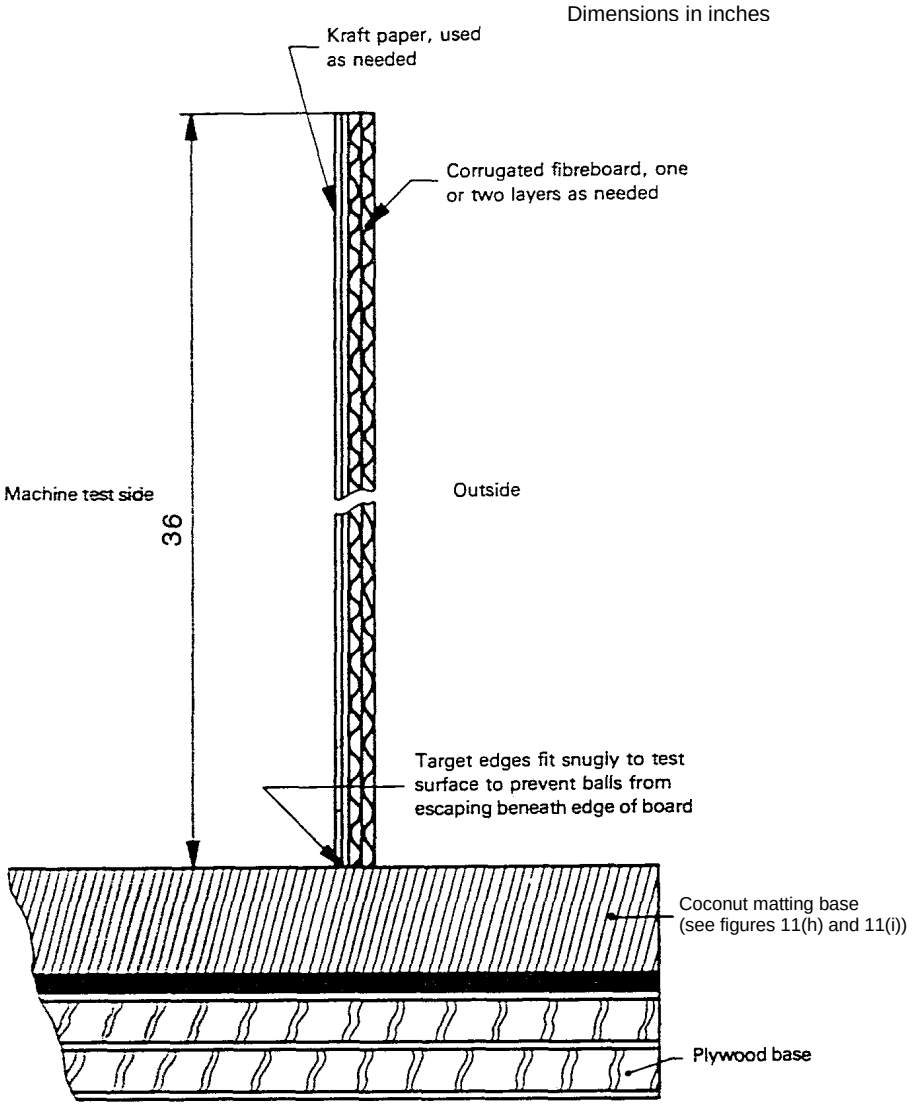


(i) Thrown object test fixture: base detail

Figure 11 *(continued)*

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(j) Test enclosure walls and base

Figure 11 *(continued)*

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Manufacturer ..... Model ..... Size .....
Type: Rider / Pedestrian-controlled Discharge location.....
Power: Gas / Battery / Electrical
Blades – number: ..... r/min:.....

Lot	Elevation area	Sector		Total hits
		Operator (Rear)	*Other (Front/Sides)*	
1	Top[1)]			
	Middle			
	Lower			
2	Top[1)]			
	Middle			
	Lower			
3	Top[1)]			
	Middle			
	Lower			
4	Top[1)]			
	Middle			
	Lower			
5	Top[1)]			
	Middle			
	Lower			
Test summary	Top[1)]			
	Middle			
	Lower			
	All areas			

1) Top includes the 36 in to 79 in high kraft paper panel of the operator target area for pedestrian machines only.

(k) Data sheet for thrown object test

Figure 11 *(concluded)*

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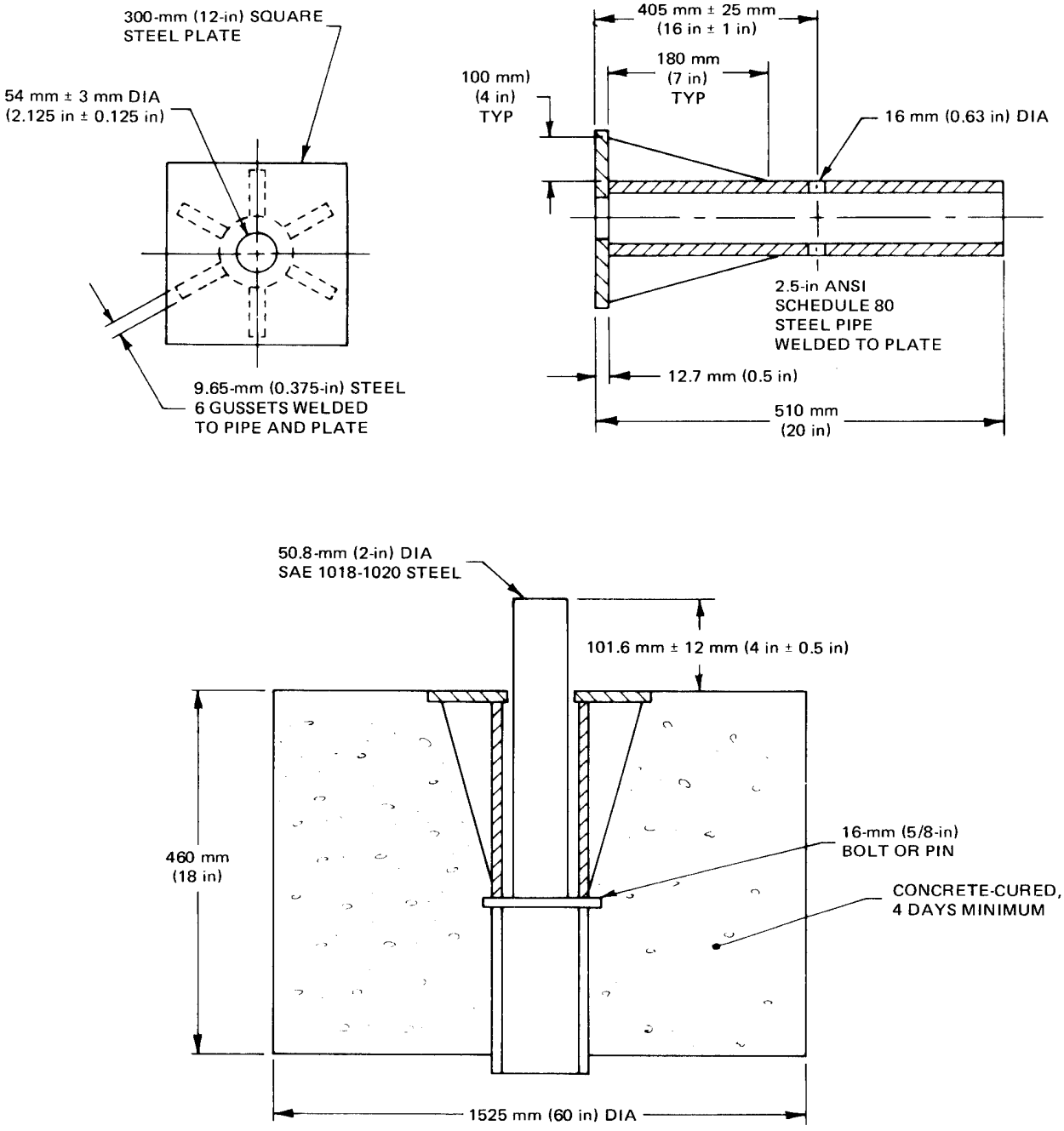
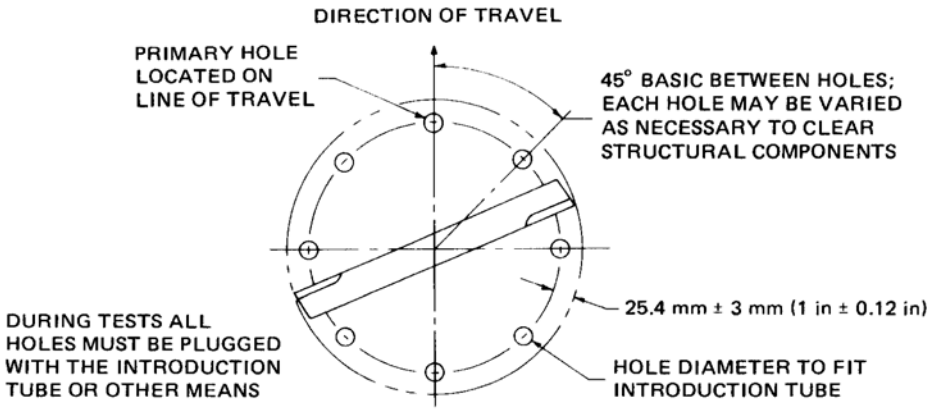
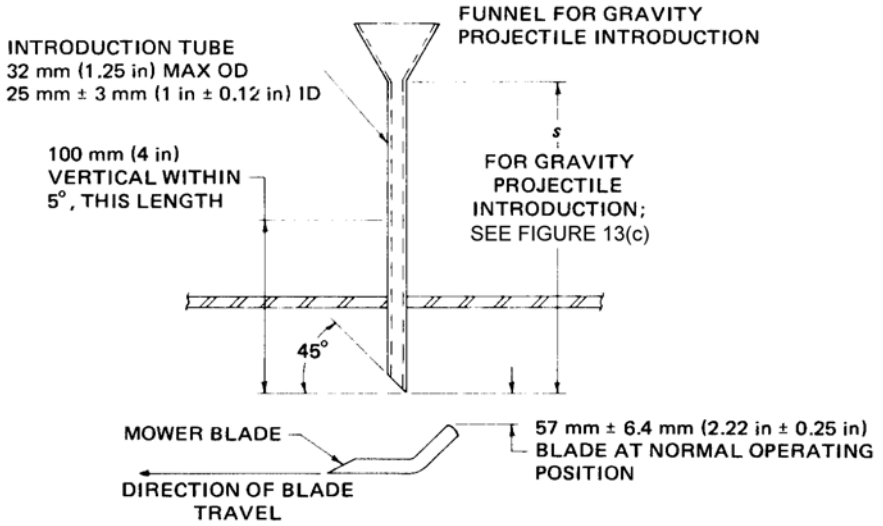


Figure 12 - Impact test fixture for mowers with the blade tip circle diameter of 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades

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(a) Typical introduction tube location, plan view



(b) Introduction tube configuration

NOTE -

s in millimeters = $5.66 \times 10^{-8}\ n^2\ L^2$

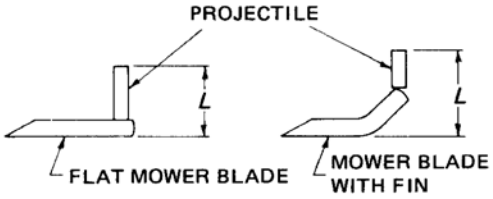
s in inches = $1.438 \times 10^{-6}\ n^2\ L^2$

where

n = blade revolutions per minute

L = length of projectile and blade height, millimeters

s = drop height, millimeters or inches; see Figure 13(b)

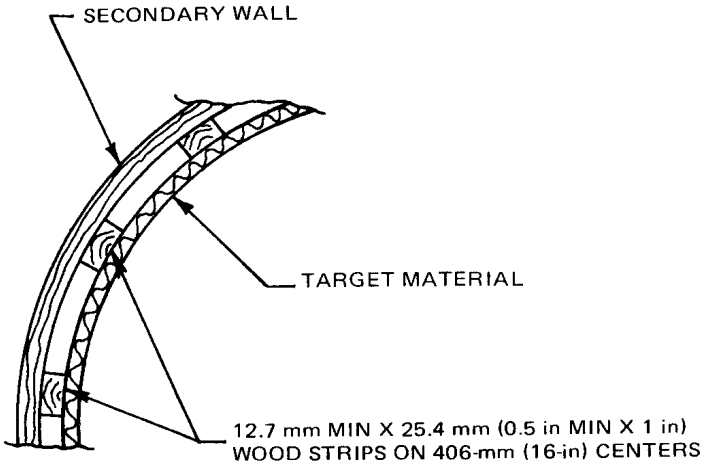


(c) Calculation of drop heights from figure 13(b)

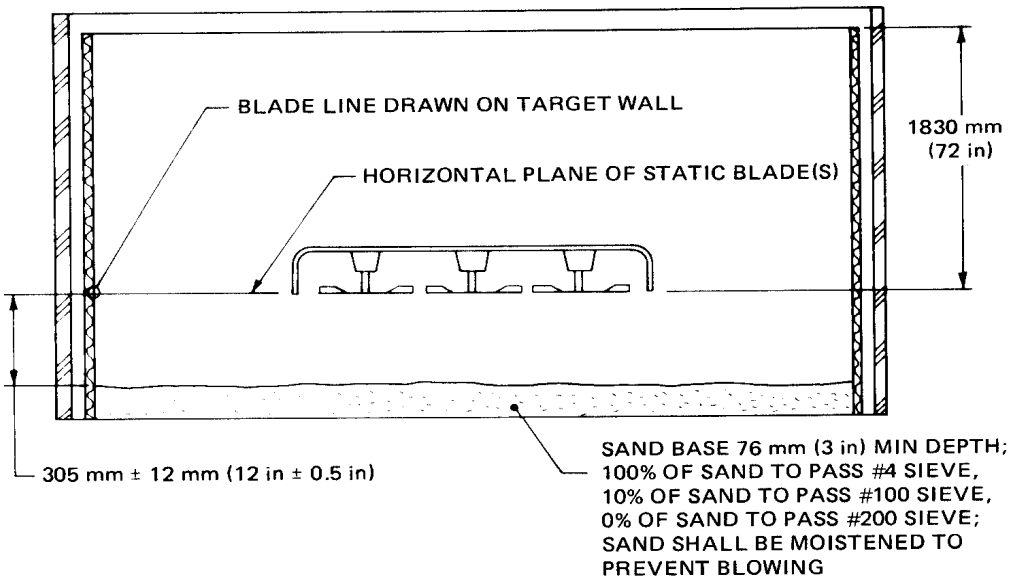
The drop height calculated from the above formula may have to be adjusted to obtain the pass-through criteria due to adverse air flow up the introduction tube generated by the mower blade and drag of the projectile against the inside of the introduction tube. Air or mechanical assist may be required for mower blade lengths near 775 mm (30.5 in).

Figure 13 - Structural integrity and thrown objects test fixture for mowers with the blade tip circle diameter 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades

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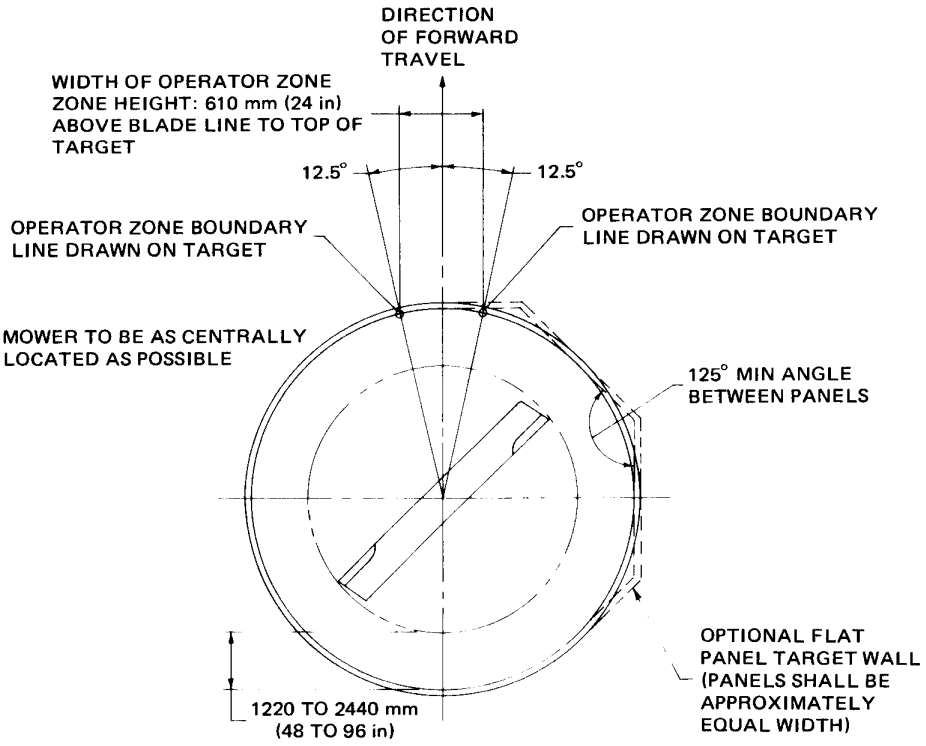
(d) Typical target wall construction



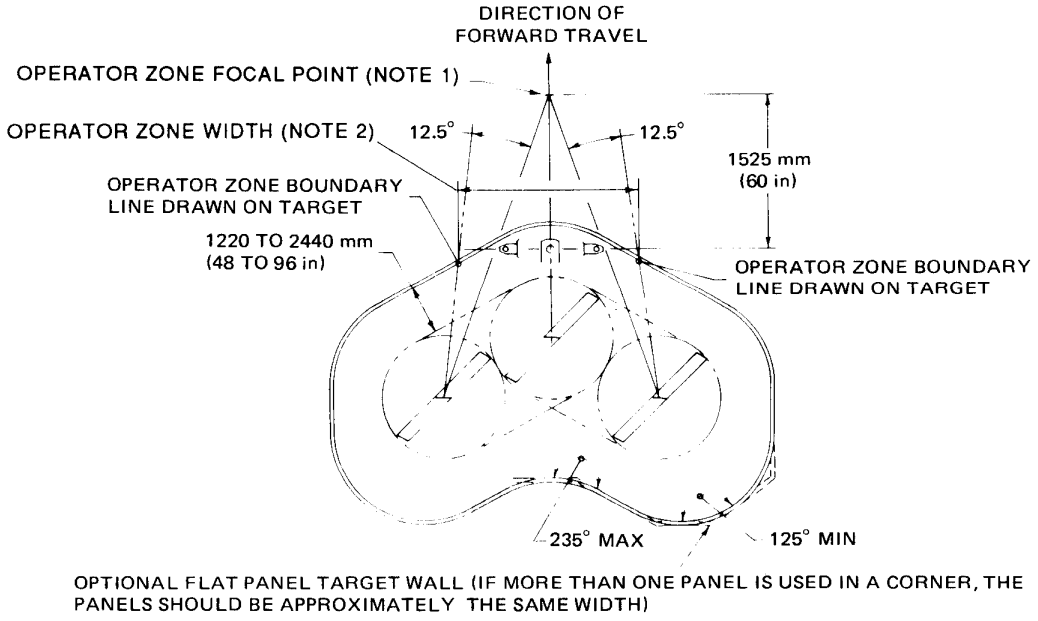
(e) Typical target and mower vertical position

Figure 13 *(continued)*

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(f) Target configuration and operator zone for single-blade mowers



NOTE–
(1) The operator zone focal point shall be on a line in the forward direction of travel midway between the hitch pins or on the centerline of the tongue hole.
(2) Operator zone height is 610 mm (24 in) above the blade line to the top of the target wall.
(3) The mower position shall be as symmetrical as possible within the target enclosure.

(g) Target configuration for multiblade mowers

Figure 13 *(concluded)*

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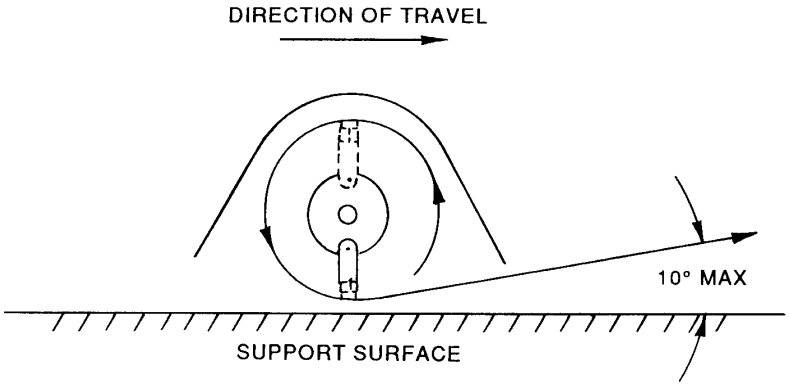


Figure 14 – Flail forward trajectory

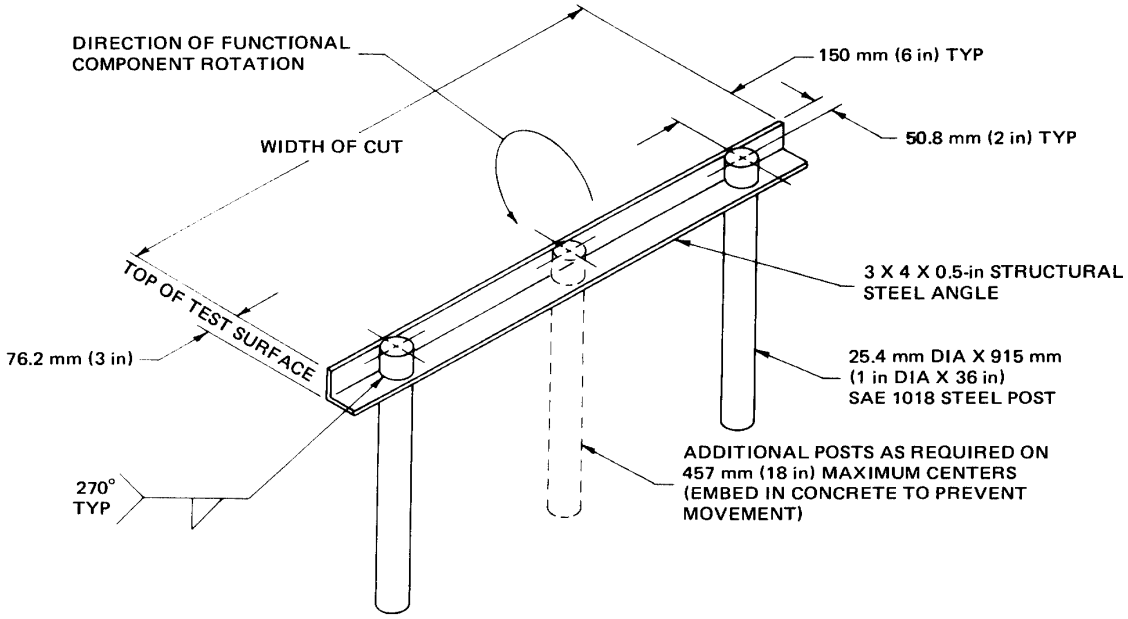


Figure 15 – Flail mower test obstruction

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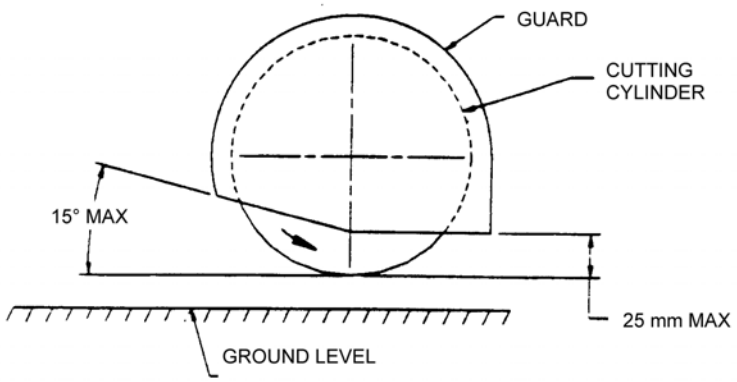


Figure 16 – Side coverage of reels

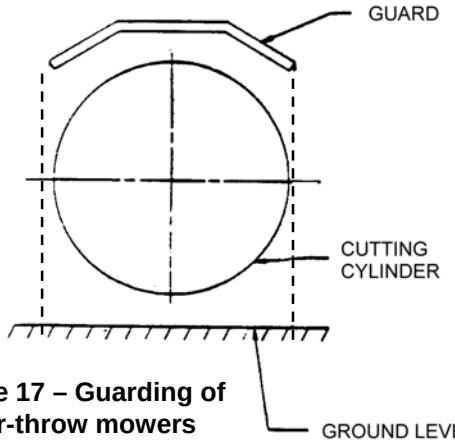


Figure 17 – Guarding of rear-throw mowers

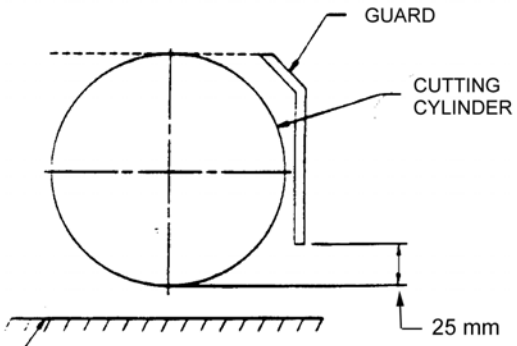


Figure 18 – Guarding of front-throw mowers

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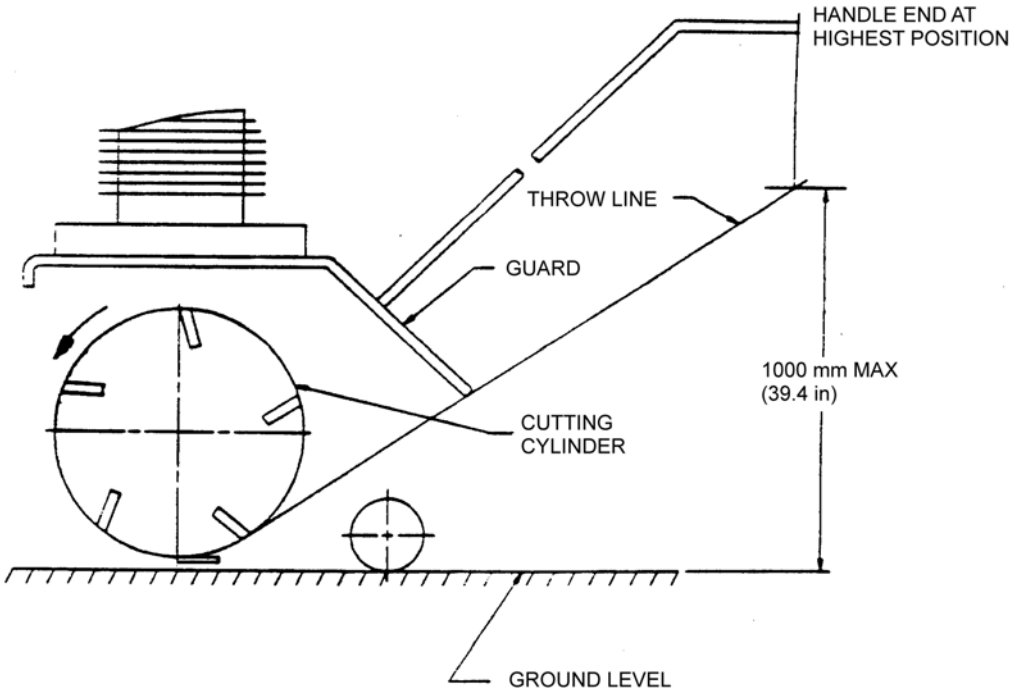


Figure 19 – Guarding of pedestrian-controlled reel mowers

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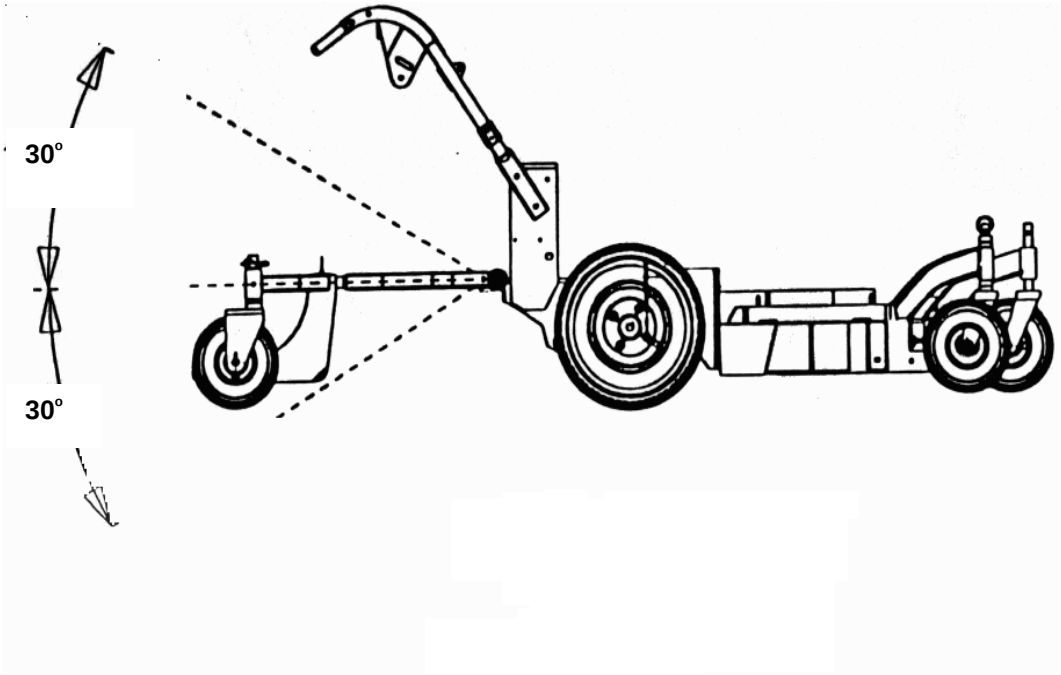


Figure 20 – Pitch

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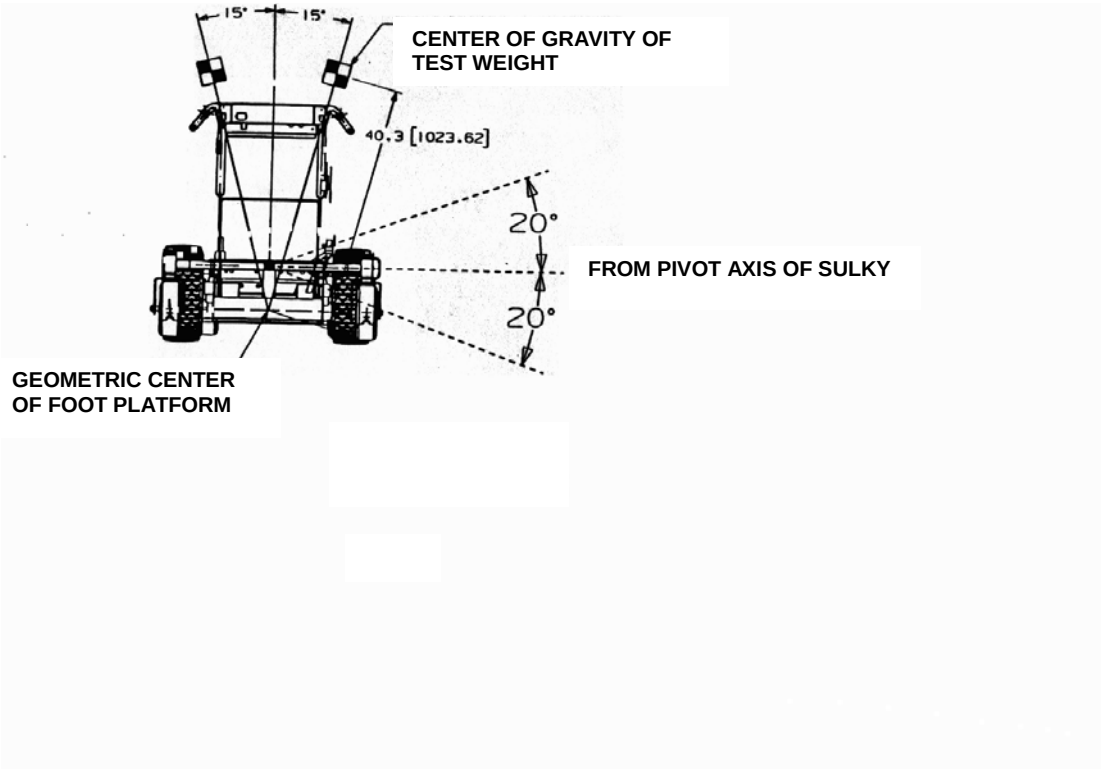


Figure 21 – Roll

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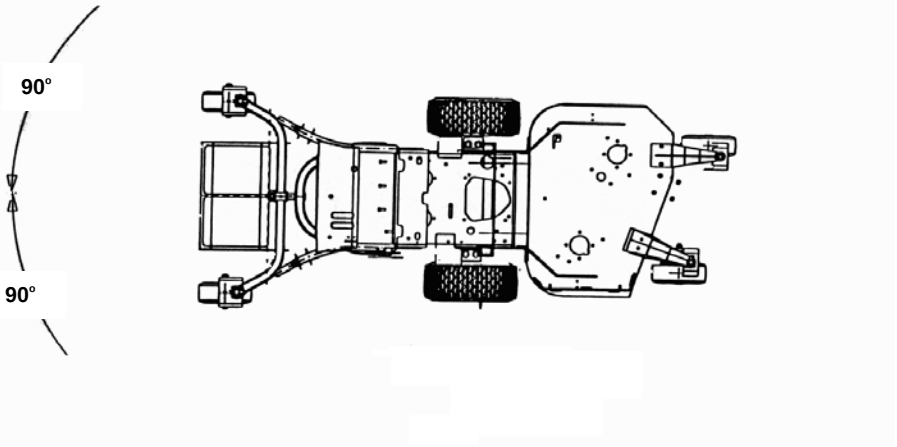


Figure 22 - Yaw

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Annex A
(informative)

Rationale

A.1 Overview of the format of the standard

This standard is arranged so that the common requirements applicable to all types of equipment are grouped together in clause 4. Other clauses address specific areas such as pedestrian-controlled units, ride-on units, implements, and functional components. Clause 8, on functional components, includes a general requirements subclause that is applicable to all types of functional components. It is then expanded to include specific requirements and tests for components such as rotary mowers, flail mowers, and flail power rakes. This requirement provides for future expansion, which can address other functional components not included in the present edition of this standard.

A.2 Standard references

This standard includes many requirements taken from existing standards. These references are listed in annex D. The committee often considered modifying the language for clarity. However, the original language was retained wherever possible for maximum coordination between the standards. The subcommittee will work with other standards writing groups to upgrade these common requirements on a regular basis. Changes to the referenced standards must be reviewed by the subcommittee before adoption to be sure that the revisions are consistent with other parts of the standard. Where existing standards have been modified, or adopted in part, these variations are noted in the rationale for these paragraphs.

A.3 Rationale for requirements of the standard

The following clause numbers correspond to those in the standard.

1 Scope

The basic objective of the scope is to identify the equipment to be covered by the intended end use rather than by product design specifications. The principal aim is to differentiate commercial turf equipment, which is customarily used by hired operators, from consumer, agricultural, and industrial applications.

Although the standard has potential application to many machines, the B71.4 Subcommittee considered the application of this standard only to the following machines designed and marketed for commercial turf use:

- Pedestrian-controlled, ride-on, mounted, semi-mounted, and towed rotary, reel, and flail powered turf mowers;
- Pedestrian-controlled, ride-on, mounted, semi-mounted, and towed flail power rake debris pickup units, aerators, sand groomers, sweepers, and other commercial turf care products;
- Ride-on turf tractors and pedestrian-controlled turf tractors; and
- Rotary, reel, and flail powered turf mower and flail powered rake attachments for ride-on and pedestrian-controlled turf tractors.

The manufacturer of aftermarket parts, attachments and accessories is responsible for ensuring standard compliance.

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3 Definitions

The definitions represent a collection of existing definitions from other standards and unique new definitions necessary to describe commercial turf equipment and explain the requirements of ANSI B71.4. Definitions are used extensively to provide uniformity within the document and to avoid unnecessary duplication of descriptions. Careful consideration was given to the meaning of each definition to clarify the usage in the requirements. In the event of a question of interpretation or inconsistency within the document, the definitions in clause 3 will prevail. Every effort was made to utilize existing definitions. Where modifications or new definitions were necessary, the objective was to avoid conflicts with similar existing definitions.

4 General requirements

The intent of the general requirements clause is to address requirements that are common to all units. This avoids the need to repeat these requirements for each product category. This format also allows the flexibility of applying the standard to new types of products without the need to revise the entire standard.

4.1 Guarding and shielding

These requirements are intended to apply to those potential hazard areas that are accessible to the operator during normal operation from the positions that normally may be used by the operator.

Many of the power transmission components and the moving machinery parts of turf equipment are inaccessible because of their location. This standard recognizes inaccessible locations as acceptable guarding.

The term "inadvertent contact" is identical to the "minimize inadvertent contact" terminology in the OSHA standards on guarding agricultural equipment, such as OSHA 1928.57. The terminology was considered appropriate to describe the degree of guarding needed to provide reasonable protection without creating the interpretation problem associated with absolute terms.

4.1.1 This subclause lists various potential hazard areas. The letters listed by each paragraph refer to specific parts of the original list.

a) "Moving traction elements" is intended to include those components that normally come in contact with the ground to propel the machine. This would include such items as tire and wheel assemblies (including the attachment to the axle). Contacting the rotating tire would not normally be considered hazardous. However, if contact were possible near a shear point or pinch point with other parts of the machine or ground, this could be considered a hazard.

b) Rotating grass screens, as used on air-cooled engines, that are smooth (punch burr away from external surface) would generally not be considered as creating a hazard.

f) This provision from ASAE 318.7 has been modified to avoid the confusion of interpreting "locking means." This is not intended to include those items identified in 4.1.1(a).

h) The requirements of this subclause have been changed to harmonize with EN 563: 1994.

4.1.2 Due to the possibility of varied hazard locations, guards, or shields, the structural strength and integrity requirements are not precisely defined. A shield or guard protecting a hazard area that can be accessed by reaching upward will have a lesser structural requirement than a shield or guard located lower or in an area on which a person could step or jump. Judgment must be exercised in determining the adequacy of the requirement as currently practiced through OSHA requirements. Guards or shields should be able to withstand the force indicated only under normal operation or maintenance.

4.1.3 This requirement is intended to apply to power-driven components of the machine that may be accessed with the engine running after a drive such as the PTO is disengaged. It is not intended to apply to servicing the engine compartment.

Visibility of rotating components is difficult to test for and is subjective. It is suggested that visibility as well as audible indication of rotation be subjected to a test by a number of subjects to determine adequacy of such means of compliance with these requirements.

4.1.5 and 4.1.6 These subclauses are intended to provide additional operator warnings about operation of the machine with all guards in place and working.

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4.2 Labels and instructions

Several studies, such as the Heinrich study, indicate that unsafe acts are the primary cause of accidents. Heinrich found that 88% of industrial accidents (from a study of 75 000 accidents) were caused by unsafe acts. Operator instructions, warnings, and training requirements are essential supplements to the machine safety specifications.

4.2.1.2 This standard recognizes that commercial turf equipment may require unique operator skills and training. Therefore, specific instructions must be provided in the operator's manual and instructions must be on the machine advising the operator to read the manual.

4.2.2 Identification

The nameplate requirement is intended to ensure that a U.S. source of replacement parts for critical safety-related elements of the equipment is available. Commercial equipment accumulates high usage hours and is subject to continuous maintenance and often repeated reconditioning. Other instructional and warning labels are typically available as replacement parts for reconditioning.

4.2.3 Label durability requirements

The label weathering requirements recognize the higher operating exposure hours of commercial equipment. These minimum requirements apply to all methods of labeling the product (such as adhesive, silkscreen, metal plates), which may deteriorate with exposure.

4.2.4 Operation, service, and maintenance instructions

4.2.4.1 General requirements

Instructions for the safe operation of the mower must be supplied with the equipment to maximize the possibility that these instructions will reach the operator. It is not intended that the examples given be all-inclusive. The instructions provided should be tailored to the specific mower design and the manufacturer's recommendations for its use. These instructions may vary from manufacturer to manufacturer as long as the basic hazards identified in the instructions are addressed.

4.2.4.2 Stored-energy devices

Large complex commercial turf equipment often includes power-assist mechanical or pressurized liquid systems that may retain this energy after the unit is shut down. The provision requires a warning about this condition to anyone disconnecting or disassembling the device and providing instructions for de-energizing the system.

4.2.4.3 Hydraulic devices

These provisions are intended to warn of the possible hazard of hydraulic leaks both while the equipment is operating and after shutdown. Particularly, 4.2.4.3(b) warns of a possible hazard of pressurized hydraulic fluid penetrating the skin if a hand or other body part is exposed to the escaping fluid. Use of the hand to look for a leak is a typical example. The use of a piece of paper or cardboard is a safer, more effective technique.

4.2.4.4 Pressurized components

This subclause addresses, but is not limited to, hydraulic system elements and requires that these elements be shielded or located so that, if a rupture occurs, the fluid is not discharged in a hazardous manner onto the operator. ISO 3457, EN 474-1, EN 1553, and EN 836 were reviewed and found to have the same requirements for pressure and temperature. The pressure of 5000 kPa (700 psi) is the maximum working pressure recorded at the component; it is not intended to be an instantaneous spike recordable with electronic instrumentation.The distance ranged from 1000 mm (39 in) from the operator in EN 474-1 and EN 1553 to 500 mm (19.5 in) from the operator in ISO 3457. The main purpose of the safety distance is to protect the operator from hydraulic injection. A 500-mm (19.5-in) safety distance is sufficient to avoid hydraulic injection, and ISO 3457 has been in use since 1986. A safety distance of 500 mm (19.5 in) from the operator zone in most cases will provide more than 1000 mm (39 in) distance from the operator in the normal operating position.

4.3 Requirements for low-voltage electrical components

The principal objective is the elimination of electrical short-circuiting and sparking, which could be a source of ignition of combustible material.

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4.4 Operator zone

4.4.1 Operator position

The normal operating position (defined in 3.24) and the operator zone (illustrated in figures 1 and 2) are based on Dreyfuss anthropometric data and are consistent with SAE J833 and J898. The figures have been simplified to provide relatively straightforward dimensional layouts covering the full range of the 90th percentile male population and to include the 50th percentile of the female population. Deviations from the anthropometric body dimensions are offset by the flexibility of the human body under actual operating conditions. The normal operating position is in the operator zone and is the actual body position of the operator when operating the machine. This specific space is occupied by the operator 100% of the time when the machine is in use. The operator zone is a larger space that represents the maximum space into which the extremities of the operator can reach in the normal operating position. This significantly larger space is intended to identify the maximum range for the operator controls and is zoned to be protected from intrusion by mowing components. Within this zone, the operators are to be protected against inadvertent contact with potential hazards, such as hot surfaces and rotating drive components.

The operator zone was compared to operator zones in other safety standards (ANSI B71.1, ANSI/OPEI B71.3, SAE J898, and CPSC 16/CFR Part 1205) and appears to be representative of the space allocation needed for this complex equipment. The operator zone is a combination of a hazard zone and operator control location. All areas of the operator zone do not represent locations that are convenient to the operator as required for control locations. The objective of the operator zone is to identify the maximum space that should be covered by the operator safety considerations; a total zone is not intended to represent preferred operator control locations. Control locations within the operator zone are considered design requirements outside the scope of this standard. SAE J898 is suggested as a reference for recommended control locations. (Operator noise and other air-contaminant exposure are not addressed in the present standard. These are covered by separate OSHA requirements and all commercial turf equipment would be expected to meet the OSHA noise and air-contaminant exposure requirements.)

4.4.3 Moving components

This subclause addresses the potential hazard created by crushing, shearing, pinching, or entrapping action of linkages or articulated components, such as, but not limited to, power-lift arms, over-center controls, and relative movement of two machine sections. Controls that can cause unstable displacement of the operator, such as, but not limited to, tiller-bar steering and handlebars of sulky units that cause the operator to lean excessively and lose his/her balance are unacceptable.

4.4.5 Finger probe requirements

The operator of commercial equipment may operate the machine in the normal operating position for extended periods of time and may place his/her fingers anywhere within the operator's range of reach to overcome fatigue and boredom. This subclause addresses the potential hazard with a performance requirement**.**

4.5 Operator's controls (also applies to 5.1 and 6.1)

Requirements common to all controls are covered in 4.5, with additional requirements specifically relating to pedestrian-controlled units in 5.1 and those for ride-on units in 6.1. A wide selection of control options are allowed with uniformity in their direction of movement, location, and expected result. These control requirements were extracted from the control requirements in ANSI B71.1, ANSI/OPEI B71.3, ASAE S318, ASAE S335.4, ISO 3789-3, ISO 5395-3 and SAE J898 for similar agricultural and light industrial equipment.

4.5.3 Space between controls shall be sufficient to allow operation without unintentional actuation of adjacent controls or causing a pinch point.

4.5.4 This requirement is identical to the requirement in ISO 5395-3. The requirement in ANSI B71.1 is identical for ride-on units, but does not require a key for pedestrian-controlled units. The requirements in ANSI/OPEI B71.3 are identical for all pedestrian-controlled and ride-on units but are not restricted to electric-powered or electric-start units.

4.5.6 This subclause specifies a starting control for a self-propelled mower to minimize the possibility of the mower running away during starting. Traction operator-presence-equipped units are exempt since they require the operator to be in the operator zone.

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4.5.7 The direction of motion of engine speed controls is generally consistent with ISO 3789-3 and ASAE S335.4. This requirement also allows the use of pull-type controls as used on larger stationary engines in applications in which it is not necessary to vary the speed of the engine during normal operation. Machine speed is generally varied by variable speed traction units. The PTO-driven portion of the machine usually runs at a fixed speed and is either "on" or "off." This type of control has been used for many years and is understood by the trade.

4.5.8 Operator-presence control requirements are consistent with consumer-type mowers.

4.5.8.1 The requirement to stop the implement/attachment drive independently, or stop both the engine and the implement/attachment drive, is comparable to ANSI B71.1. Stopping of the implement/attachment drive is for the protection of an operator intentionally leaving the operator's position while the implement/attachment drive is in operation.

Operator-presence controls for the implement/attachment drive are not intended to protect bystanders from run-over or other accidents. Also, they are not intended to protect the operator from sudden access to the blades, which would occur because of jumping or falling from the machine. A Lanyard-type operator-presence control would be one type considered adequate to meet this requirement. Towed ground-driven or self-powered units are not covered by this subclause as those units are not within the control of the propelling machine manufacturer. The optional audible/visible warning is consistent with OSHA requirements for agricultural equipment. The requirement for traction drive Operator Presence Control (OPC) is intended to address runover-type accidents associated with machine movement when the operator leaves the normal operator position. This requirement does not allow the machine traction drive to be operational when the operator is out of the normal operator position. A Lanyard-type operator-presence control and an engine-kill operator-presence control are two types considered adequate to meet this requirement.

4.5.8.2 This subclause provides the requirement for automatically stopping the element when the operator leaves the operator's position. This is required to prevent operator injury resulting from inadvertent contact with driven elements. The OPC is not intended to protect the operator from sudden access to the blades, which could occur because of slipping, stumbling, or falling. Two separate and distinct actions are required to prevent inadvertent starting of the implement/attachment by accidental contact with the control means. For engine kill controls, one action is starting the engine and another action is activating the operator-presence control. An independent control for the traction drive allows the machine to be transported without engagement of the implement/attachment. The requirement for traction-drive OPC is intended to address runover-type accidents associated with machine movement when the operator leaves the normal operator position. This requirement does not allow the machine traction drive to be operational when the operator is out of the normal operator position. A Lanyard-type operator-presence control and an engine-kill operator-presence control are two types considered adequate to meet this requirement.

4.5.8.3 This subclause recognizes that the operator may be intermittently displaced from the operator's position. Operator-presence controls need to allow for these normal operational movements.

4.5.8.4 Ride-on and pedestrian-controlled tractors are sometimes used for stationary operation using the PTO to drive miscellaneous equipment. This application should be convenient for the operator, but still allow for reactivation of the operator-presence control when normal operation resumes. This bypass requires an intentional action on the part of the operator to overcome the normal operator-presence control shutoff device.

4.5.8.5.1 The operator is required to maintain continuous actuation of the control while being able to shift body position without inadvertently triggering the control means. By placing the machine on the 15-degrees-test surface, angled both to the right and to the left, the manufacturer can demonstrate that the approximate 5th percentile adult operator can operate the critical controls of the machine on a slope.

4.5.8.5.2 During the operation of a machine that is on a slope and is equipped with a seat switch, the normal tendency of the operator is to lean into the slope as well as shift the seating position toward the uphill side of the seat, a maneuver that actually improves stability. There is concern that this action could cause premature shutdown of the mower resulting in an irritation to the operator. The test may demonstrate the adequacy of a seat sensor when operating across moderate slopes up to 15 degrees. The 15-degree tilt in each direction is intended to reduce inadvertent shutoff of the blade drive.

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5 Pedestrian-controlled units

5.1 Operator's controls – Self-propelled

5.1.1 Traction-drive control

This subclause addresses the requirements of a traction-drive control for self-propelled pedestrian-controlled units.

5.1.2 Ground speed and direction controls

The requirements are unique to the present standard and are necessary to address the use of multispeed mechanical devices and variable-speed devices used on commercial turf pedestrian-controlled equipment.

5.1.2.3 This requirement addresses hand-operated combination variable-speed and direction controls as used on many hydraulic-drive pedestrian-controlled rotaries. This requirement allows a mechanism that will lock the control in the neutral position.

5.2 Braking requirements and tests

5.2.2 Service brake requirements

These requirements establish the need for a braking system based on the operator's ability to hold the unit on a 30% (16.7-degree) test slope with a force not to exceed 222 N (50 lbf). A unit requiring more than 222 N (50 lbf) will need both a service brake system(s) and a parking brake system(s). The 222-N (50-lbf) requirement is within the range of 5th percentile male operator's capability. Some drive train systems have the ability to stop the machine with very low control force; however, when left in a park condition test in accordance with 5.2.5, the machine would descend the slope at a rate of about 1.6 km/h (0.1 mi/h). This is a very slow rate and the machine could be easily controlled by the operator. This movement is not considered a hazardous situation and an additional service brake system, other than that provided in the drive train, would not be required.

5.2.4 Parking requirements

This subclause delineates the requirements for the parking brake system. The hill-holding requirement on a 30% (16.7-degree) slope is consistent with the ride-on unit requirements. The contribution of built-in machine drive friction for holding the machine on a hill is described in 5.2.4.1. All the parking brake requirements address the large-size pedestrian-controlled units available for commercial turf use.

5.2.5 Parking brake test

The possibility of belt creep or bypass leakage in hydrostatic units is addressed in 5.2.5.4.

5.3 Handle structure

5.3.3 Upstop bypass

This subclause provides for an automatic locking of the handle in the operating position to ensure compliance with 5.3.2.

5.3.4 Folding handles

This requirement allows for use of a handle that can be shortened for storage.

5.4.8 Stability

The longitudinal stability requirements address the balance of controllability and traction in uphill operation versus downhill and side slope operation. A pedestrian-controlled mower with a sulky is unique in that the operator can influence the stability of the traction unit. When going downhill, the weight transfers to the front tires and takes the weight and traction off of the rear tires. Excess weight on the front of the machine will degrade directional controllability on a side slope.

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6 Ride-on units, ride-on turf tractors, and attachments

6.1 Operator's controls

6.1.1.3 This subclause adds new brake control requirements for lever-steer-type machines. On these machines, the braking and drive functions are combined. Movement of the controls in a direction opposite that of machine travel to engage the service brakes has the following advantages:

- Short reaction time with operator's hand in place on the levers;

- Increased brake reliability with dual drive/dual brake system; and

- Human tendency to react away from a hazard corresponds with direction of lever(s) motion required to apply service brakes.

6.1.2 Traction drive controls

The requirement of 6.1.2.1 to 6.1.2.4 are consistent with ANSI B71.1, ANSI/OPEI B71.3, ASAE S335.4, and ISO 3789-3. ASAE S335.4 does not permit right foot operation.

6.1.2.5 This standard provides for an automatic return to neutral when the foot control is released and also provides for a traction drive cruise control as long as it is disengaged when the service brake is applied.

6.1.3 Ground speed and direction control - 6.1.3.1, 6.1.3.2, 6.1.3.3

The requirements of these subclauses are consistent with those of ANSI B71.1, ANSI/OPEI B71.3, and ASAE S335.4. Variations in the neutral position are consistent with requirements listed in ANSI B71.1 and ANSI/OPEI B71.3, but are optional in this standard.

6.1.3.4 These requirements are consistent with ANSI B71.1, ANSI/OPEI B71.3, and ASAE S335.4, except that the present standard requires a neutral position, whereas ANSI B71.1 and ANSI/OPEI B71.3 require only that the controls stay in position or move to a slower speed. ASAE S335.4 provides an additional option of a U-type control with the lever moving forward for both forward and rearward travel and laterally for neutral. This was considered to be inconsistent with the usage covered by the present standard.

6.1.3.5 These requirements address foot-actuated controls used for combination directional and variable-speed control, and are consistent with ANSI B71.1, ANSI/OPEI, and ASAE S335.4.

6.1.3.5(a) This requirement is consistent with ANSI B71.1, ANSI/OPEI B71.3, and ASAE S335.4.

6.1.3.5(b) These requirements are consistent with ANSI B71.1, ANSI/OPEI B71.3, ASAE S335.4 and ISO 3789-3, which restricts two pedal controls to the right foot.

6.1.3.5(c) This requirement also allows for a fore-and-aft position on the pedals with the rear pedal for reverse travel.

6.1.3.6 This passive neutral position may be located by the operator through a secondary change in the direction of motion. Alternatively, the neutral position may be defined by springs or other centering devices that exert force toward the neutral position from either the forward or reverse direction. The forces toward the neutral position must be graduated so that detectable pressure must be exerted by the operator to move the control mechanism out of the neutral range. An adequately detectable neutral position is one where the operator can consistently and directly return to, locate, and position the control in the neutral position during operation. Hydraulic directional control systems typically demonstrate creep when the fluids are cold and when wear or abuse causes the adjustment linkages to change.

6.1.4 Slope control test

This performance test addresses the "loss of control" on slopes sometimes associated with the single-pedal drive control between the point of brake disengagement and drive engagement. The test also addresses overly aggressive drive engagement devices. The speed at which the machine is allowed to roll back, or is driven back, is not considered critical for this test and therefore is not specified.

6.1.5 Attachment-driven (power-takeoff) control

The requirements of 6.1.5.1 – 6.1.5.4 are consistent with ANSI B71.1, ASAE S335.4, and ISO 3789-3.

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6.1.6 Lift controls

The requirements of 6.1.6.1 and 6.1.6.2 are consistent with ANSI/OPEI B71.3, ASAE S335.4, and ISO 3789-3. The direction of movement is identical in all standards. The differences are the provisions for a two-pedal lift control in 6.1.6.3 and the requirement of a key for power lifts in ANSI/OPEI B71.3 and ISO 3789-3.

6.1.7 Steering control

The steering control requirements of 6.1.7.1, 6.1.7.2, and 6.1.7.3 are consistent with ASAE S335.4, except for differences in language.

6.3 Stability requirements and tests for ride-on units and ride-on turf tractors

These requirements address the potential stability hazard without the need for additional roll protection. In OSHA 1928.57, roll protection, including seatbelts, on agricultural tractors is required, but this requirement excludes tractors under 14.9 kW, certain low-profile tractors when rollover protection creates other hazards, and all self-propelled special turf equipment. The requirements in this subclause ensure that machines with various wheel and machine configurations are tested under the worst possible stability conditions. For machines that provide a positive stop through an attachment or implement, some exceptions to the test acceptance requirements are allowed.

6.3.5.2.1 Due to manufacturing tolerance, it is difficult to assure that more than three wheels of a rigid frame propelling unit will be in exactly the same plane. The three points of a rigid frame propelling machine that define the plane critical to the stability tests are usually two downhill tires and the lowest of the uphill tires. If the other uphill tire(s) is above this plane, the angle of its lift-off would not be indicative of impending tip-over and the shim would merely bring the surface up to the equivalent level of the tire footprint. (In an extreme case, one of the tires of a rigid frame propelling machine may not be touching the ground on a horizontal surface.) If the angle that the first uphill tire lifted off was indicative of impending tip-over, the shim would cause the same lift-off at a lower tilt table angle.

6.3.5.2.2 The exception criteria allows for the unique types of commercial equipment that are designed to perform differently from a typical-type unit. These machines, due to their individual designs, are permitted to experience lift-off only if lift-off is in a controlled manner, does not pose a hazard to the operator, and does not exceed the conditions described in the standard.

6.3.5.3.1 See 6.3.5.2.1.

6.3.5.4.3 The longitudinal stability requirements address the balance of controllability and traction in uphill operation with the catcher full and downhill operation with the catcher empty. When going downhill, the weight transfers to the front tires and takes weight and traction off of the rear drive tires.

6.3.5.5.3 The longitudinal stability requirements address the balance of controllability and traction in uphill operation versus downhill operation. When going downhill, the weight transfers to the front tires and takes weight and traction off of the rear drive tires. These units are unique in that steering control is lost if the drive wheels lose traction.

6.4 Braking requirements and tests for ride-on units and ride-on turf tractors

These requirements establish maximum factors for braking systems. They were established after review of U.S. and international standards.

6.5 Lighting and marking for ride-on units and ride-on turf tractors used on public roads

These requirements provide consistent legally acceptable lighting for slow-moving vehicles.

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6.6 Lateral upset operator protection recommendations and tests for ride-on mowing equipment

6.6.1 General requirements

The mass of 655 kg (1436 lb) matches the lower mass limit in existing Australian standards AS 1636 Parts 2 & 3. These standards use a lower mass limit of 560 kg without an operator. It is less than the lower mass limit of OECD Codes VI &VII, which use an unladen mass of 600 kg. These codes set the requirements for the rollover protection system (ROPS) on tractors for road homologation in Europe. The limited accident data that is available on turf equipment also indicates that the severity of injury from rollovers is low under this mass limit.

6.6.2 Test equipment

A platform is used to eliminate the advantage of the lower portion of the deck contacting the ground as the machine is tilted and provides a conservative value for the tip angle.

6.6.3 Test conditions

The same conditions as required for other tests in the standard.

6.6.4 Test procedure

6.6.4.2 This method gives a more realistic measurement of the actual stability of the machine for overturns than the lift-off of the upper wheels when using a tilt table. It is difficult to measure the tip angle of extremely stable machines on a tilt table because of slide-out. This method has been in use and proven in measuring the tip angle of narrow tractors in Europe. A platform is used to eliminate the advantage of the lower portion of the deck contacting the ground as the machine is tilted and provides a conservative value for the tip angle.

6.6.4.3 Restraints should be used to prevent the machine from tipping over center. The angle measurement should be taken at the equilibrium point.

6.6.5 Test acceptance

The lower mass limit is based on existing standards and limited information on severity of injury from rollovers. The 40-degree tip angle recommendation was determined by measuring existing machines that are extremely stable and have a low incident rate of overturns. An operator-protective device, other than a rollbar-type ROPS, may be used.

7 Implements

7.1.1 Tongue

This subclause requires a warning of possible upward movement of the tongue of trailing units that, when loaded or partially loaded, may actually exert an upward force and create a potential hazard if disconnected in this mode.

8 Functional components

8.1 General requirements

8.1.1 Stopping time

The requirements for stopping functional components within seven (7) seconds, the option of an audible or visible warning and provisions for a 5-minute run in a period immediately prior to testing has been reinstated from ANSI B71.4-1984. It was inadvertently omitted when OPC Stopping Time was added.

8.1.3 Guarding

The guarding requirements for functional components are consistent with ASAE S318 and OSHA requirements for agricultural equipment.

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8.1.4 Cutting elements

Mowers with one or more blades may be of multiple-piece construction with a replaceable cutting element including pivotable attachment means that may be subject to wear. Since compliance with this requirement can be determined only by extensive testing, the manufacturer must evaluate whether wearing out of the element could result in a failure causing sudden loss of parts that could eject from the machine and cause injury. The method of fastening could affect the failure mode.

8.1.5 Blade tip speed

This requirement is consistent with that of ANSI B71.1.

8.1.6.1 This requirement is intended to prevent inadvertent lowering of the cutting units while transporting the equipment. Mechanical latches and hydraulic means, including pilot-operated check valves, shall be considered as satisfying this requirement.

All mowers except those with a blade tip circle diameter of 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades. Subclauses 8.3.2 through 8.3.7 apply to these mowers.

8.3.3 Probe tests

8.3.3.1 Foot probe test

The foot probe shown in figure 9 is similar to the one shown in ISO 5395-3. Its use establishes a performance requirement on the housing for the mowers. The foot probe represents a composite of extremes of the adult foot.

8.3.3.3 Test Procedures

Foot probing is similar to ANSI B71.1. One exception is that probing or labeling of the front opening is required. For certain commercial applications, the material density and height being cut requires that the front opening be somewhat different from the front opening allowed on consumer machines. This provision of the standard recognizes those conditions, while at the same time adding the requirement of a foot probe in the front opening or posting of a label advising the operator of the hazard of blade contact.

8.3.7 Thrown objects test

This test was developed to determine the propensity of the mower to throw objects. To determine whether the mower will pass the test even after field use, the test is to be performed after the structural integrity test.

8.3.7.6.1 The test requirements were changed to harmonize with the 2002 changes to ISO 5395.

Mowers with the blade tip circle diameter of 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades.

8.3.8 Impact tests

These tests are modifications of the tests in SAE J232 and are intended to minimize the potential injury to the operator or bystander should the mower's functional component strike an immovable object. The immovable object in this test is represented by a steel rod 50.8 mm (2 in) in diameter, which is the same as the rod specified in SAE J232. The contact height above the ground by the blade with the test rod was raised from 50.8 mm (2 in) as required in SAE J232 to 76 mm (3 in) since many of the large mowers cannot be lowered to 50.8 mm (2 in) without modification.

In SAE J232, the test rod is required to be placed in "firm ground." "Firm ground" is not well defined; consequently, the test rod may not be held uniformly secure for repeatable test results and also may not provide sufficient resistance for a solid impact. For this test, a test rod fixture was developed (figure 12) and placed in concrete so that repeated tests could be run with the same test fixture and so the test rod could be held safely and with uniform rigidity. The test rod fixture in figure 12 is shown as a minimum specification. The gussets can be made larger as well as different in shape; the steel plate can be made thicker and have any practical shape; the concrete can be made square instead of round; whatever is most practical.

Mowers with multipiece blades (that is, with free-swinging end blades) are positioned relative to the test rod so that contact is made with the test rod near the end of the blade and also near the blade holder connection. Impact contact of the test rod near the end of the blade tests for blade integrity. Impact contact of the test rod by the blade near the blade holder causes the blade to rotate forward around the test rod and "kick back" the blade holder,

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consequently imposing the highest loads possible to the blade, blade holder connection, and mower drive. This test therefore represents the most severe test of the integrity of the blade-to-blade holder connection and of the mower drive.

The impact test of 8.3.3.1 would not be adequate for the large mowers, since the test rod may be cut off and consequently would not provide a sufficiently severe test to represent abusive field conditions. Injection of the test rod in the blade path in a manner similar to 8.3.3.1 is not practical due to high injection energy and could endanger the personnel loading the fixture.

Target placement around the mower catches objects from the blade, blade holder, fractured gear boxes, and other parts that may not otherwise be detected by the test inspector.

8.3.9 Unbalance test

This test is the same as the missing-blade unbalance test of SAE J232 except that the mower is to be surrounded by a target. The purpose of the target is to catch objects that may not otherwise be detected by the test inspector. The unbalance test of 8.3.3.2, which is based on a formula involving only the length of the mower blade tip circle diameter without regard to mower blade revolutions per minute, is adequate for mowers with the length of the blade tip circle diameter less than 775 mm (30.5 in). For larger mowers, this formula yields a smaller unbalance than the acceptable range of unbalance that occurs during manufacturing and consequently would not be adequate for testing the larger mowers.

This test is much more severe than the test used in 8.3.3.2 and represents a test of mower integrity in the event that a blade is fractured or, for multipiece blade construction, one entire blade assembly is lost. The blade fracture or loss of one blade assembly is possible on larger mowers, since they are capable of being operated under very severe mowing conditions. The extreme unbalanced condition caused by removal of a cutting element will not allow continued operation of the mower, thus warning the operator of a problem. This test provides reasonable protection against other components of the mower failing in a hazardous manner before the operator can shut off the mower.

8.3.10 Structural integrity tests

The purpose of these tests is to ensure that the blade enclosure and shields have sufficient strength to resist puncture or deformation by large objects that could be thrown by the mower blade and could result in an unsafe discharge of material. Rods were selected for this test because they are readily available, inexpensive, and have sharp edges that would puncture inadequate housings and shields. Moreover, in view of the relatively low blade passage frequency of the larger mowers, rods have a greater potential for positive blade contact over a ball or cube when injected into the blade path.

As the length of the blade is increased, its width and thickness are also increased, resulting in a heavier blade that is capable of throwing larger, heavier objects. Consequently, two different sizes of test rods were selected, and thus the test objects are more representative of the actual mass of objects that could be thrown by the mower blade.

The deformations of housings and shields were reviewed on many mowers that had excellent safety records under a wide variety of mowing conditions. Tests were conducted on similar mowers to those operated in the field to determine the number of test rods necessary for similar mower housing and shield conditions. The results of the test indicated that 12 rods introduced in each of the eight positions and contacted by the blade were sufficient to generate similar housing and shield deformation experienced by the mowers in actual field use.

In the test described in 8.3.5.1 for all mowers except those with a blade tip circle diameter of 775 mm (30.5 in) or greater and blade thickness of 8 mm (0.312 in) or greater for one or more blades, steel balls are used. For this size of mower, steel balls are adequate since the blade passage frequency is relatively high and since the bottom of the mower is sealed by a steel plate, resulting in repeated blade and ball contact before the ball is discharged. Sealing of the bottom of the mower is appropriate since this size of mower is usually set to cut close to the ground. Also, since the blade enclosure is close to the ground and these mower types are generally used on groomed lawns, large objects are not allowed to enter the mower, or generally are not present. On larger mowers, the shields are movable to allow heavy brush and, inadvertently, relatively large foreign objects to enter the blade path.

8.3.11 Structural integrity test – Grass collection system

The purpose of this test is to ensure that the grass catcher can resist penetration by objects that the mower is capable of throwing. This test is limited to the blade nearest the discharge opening, since this offers the most severe test condition for the grass catcher.

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8.3.12 Thrown objects test

This test was developed to determine the propensity of the mower to throw objects. To determine whether the mower will pass the test even after field use, the test is to be performed after the structural integrity test.

8.3.12.1 Test equipment

Considerable research was conducted to determine the best test projectile. Comparison tests were conducted using test projectiles consisting of sixpenny nails, twentypenny nails, 1-inch roofing nails, 3-inch finishing nails, 2-1/2-inch finishing nails, and 5/8-inch rods x 70 mm (2.75 in) long. Sixpenny nails were selected because

- they showed better repeatability in test results;
- more were ejected than the larger objects;
- they are dimensionally consistent;
- they are a commercially available test projectile; and
- considerable research had been completed with favorable results with sixpenny nails in the thrown objects tests described in ANSI B71.1 and the CPSC 7(b)/Consumers Union proceedings on power mowers at Wichita State University and Research Triangle Institute.

Uncoated sixpenny nails are recommended, since the coating from the coated nails tends to coat the inside of the introduction tube and cause erratic introduction velocity. Sand, sod, and artificial turf were tested to determine the most desirable material for the base of the test fixture. Sand was chosen as the test fixture base for the following three reasons:

- Due to the higher number of hits and punctures obtained by its use, sand represents a somewhat more severe testing condition but still seems to correlate well with sod and controls unwanted ricochets;
- Graded sand is an easier fixture base material to duplicate from one fixture to another. Sand, a low-cost material, is almost universally available; and
- Sod not only varies widely with types, but also with seasons and limits testing to acceptable seasons. Sod is sensitive to moisture conditions. Sod erodes rapidly with testing and is difficult to maintain.

A layer of sand at least 76 mm (3 in) deep is placed on the floor of the test enclosure. It is moistened before any and all tests are conducted to prevent the sand and dust from being blown around during testing. It does not appear that the moisture content has any significant effect on the test results.

The mower is completely encircled by a wall of target material at a distance of 1220 to 2440 mm (48 to 96 in) from the blade tip circle. The 350-lb double-wall cardboard was chosen due to its similarity to the strength of the human epidermis as shown in the wound ballistics test conducted by the Medical Department, United States Army. This test was conducted by Lieutenant General Leonard D. Heaton, Surgeon General, United States Army, in 1962. Target material is specified as 350-lb double-wall corrugated to make it consistent with that specified in ANSI B71.1. In addition, it is more readily available than 350-lb single-wall corrugated material. However, 350-lb single-wall corrugated material has been retained as an alternative since the previous versions of this standard have utilized it.

8.3.12.4 Scoring

Data is collected after each run at a particular hole. A run consists of 150 nails dropped one at a time, approximately half point first and half headfirst. Considerable previous work has been done documenting the difference between target strikes (hits) and target penetrations (punctures) by many organizations in the United States such as UL, CPSC, and CU. Target strikes and target penetrations are differentiated by the velocity of the impact and consequently the severity of the injury resulting from each. A target strike (as defined in 3.35) is likely only to bruise human tissue, whereas a target penetration (as defined in 3.34) would lacerate human tissue, thus causing more severe damage.

An evaluation of the thrown objects test conducted in conjunction with the preparation of this standard produced a sample size of 150 nails per hole at three repetitions, using the coefficient of variation analysis method to give statistically repeatable results.

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The operator may make notations of the ejection point of the test object as it leaves the mower deck for each hole. This has proved helpful in determining places in the shielding that do not prevent nails from being ejected. After the sample size is determined, the data are recorded and analyzed for each spindle. This procedure shows the tendency of each spindle to throw objects and evaluates the effectiveness of its shielding. Considerable work was done in selecting and verifying a sample size that would provide repeatable results. Background information and analysis techniques were obtained from CU and CPSC tests as well as from subcommittee members.

8.3.12.5 Test acceptance

Data was collected by recording the number of hits between the blade line and 305 mm (12 in) above the blade line, then between 305 mm and 915 mm (12 in and 36 in) above the blade line, and then above the 915 mm (36 in) line. Most of the hits and a much higher percentage of punctures occurred at the level from the blade line to 305 mm (12 in) above, with considerably less at the second level and very few hits above 915 mm (36 in).

The fact that the number of hits per run varied widely in the higher levels also made the results less meaningful and much harder to duplicate. After consideration of other standards that have recorded various heights of hits, there has been no data presented to demonstrate that higher trajectories are more dangerous or less dangerous than lower trajectories. It has been proven that anything that is ejected in a direction downward from the blade will normally stop or lose energy when it hits turf or sod. In evaluating the danger levels of hits above the blade line, the following questions and theories arose:

- If a projectile is ejected at perhaps a 30-degree angle upward or greater, wouldn't a bystander have to be in a small area and very close to the mower to be in the possible range in which he/she could be hit? Wouldn't most of the projectiles go over his/her head and, when they are descending, wouldn't the velocity be spent to the point where they would not create a very serious hazard?
- Since those projectiles coming straight off the end of the blade generally in a straight or slightly upward direction have a greater chance of having very high velocity, as verified by target punctures, why wouldn't this be the most hazardous area as opposed to the higher elevation of recorded hits? This would seem especially true if the mower were running on a slight slope so that its blade line formed an upward angle relative to the level and thus would be ejecting projectiles into possible pedestrian zones. If they are of a high-velocity "line-drive" type of trajectory, they would have a higher chance of hitting a bystander(s) through a much greater range of distances from the mower.
- The fact that test projectiles were seldom known to go over the 1.8-m (6-ft) target wall on any of the models tested would indicate that the very steep angles are not a factor from a probability standpoint.
- It would seem, judging from the normal relative velocity of the projectiles, that the chances of a person being seriously injured in the face or upper portion of the body are greater for a person who is 9 m to 12 m (28 ft to 37 ft) from the machine and who is hit by a projectile emerging at perhaps 10 degrees above level than for a person who is a meter or so from the machine and who is hit by a ricochet at a 30-degree level.

In summary, it appears impossible to quantify which is the most dangerous area, both from a radial standpoint as well as a vertical angle, except for the operator zone. Since no justifiable quantifications can be developed for these relative hazards, establishing different safety levels on the various areas adds complexity and difficulty to the test. Therefore, all hits above the blade line are considered equal until such time as a valid, thorough field study over a wide variety of conditions and environments can show the relative danger level at the various heights.

The differentiation in penetration ability was retained in the standard. The exact pass/fail numbers were determined after considerable testing; however, further refinement may be necessary in the future.

Since the operator is in the operator position all of the time, the test allows for few hits and punctures. This corresponds to much of the work and rationale of other organizations. The location of the 915-mm (36-in) diameter cylinder for the rider unit is from CPSC and CU early proposals.

The location of the operator's zone for pull-type or mounted machines was determined by actually simulating the location of an operator on conventional towing units and then locating a zone on the target wall by means of the operator zone focal point. The 12-1/2-degree angle location on either side of a straight line between the center of the spindle and the operator's seat, and the lines between the center of the outer spindles and the operator zone focal point, and the 12-1/2-degree angles on each side of the lines, should take into account all normal movements of the operator when turning corners or shifting his regular sitting position.

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Acceptance criteria have been correlated with actual fleet highway mowing reports from the Departments of Transportation of Illinois and Florida. Laboratory test scores of the same units were correlated with field reports of incidents per million hours of usage to arrive at the acceptance criteria. Several rotary mower cutting units were subjected to the thrown objects test described in 8.3.7.5 (based on ANSI B71.1) and the thrown objects test described in 8.3.12.3. The test acceptance criteria for the two procedures showed reasonable correlation.

8.4 Requirements for flail mowers and flail power rakes

These requirements are consistent with requirements in SAE J1001 for industrial flail mowers and address the potential hazards associated with these products.

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Annex B
(informative)

Drop distance calculations

$f = 2n$ (...B1)

where

f is blade tip frequency, hertz;
n is blade speed, revolutions per second.

$$n = \frac{v}{60\pi d} \quad \text{(...B2)}$$

where

V is tip velocity, meters per minute;
d is blade diameter, meters.

$V_2 = fL$ (...B3)

where

V_2 is velocity of object at blade;
L is length of object plus blade thickness or fin height, meters.

$V_2^2 - V_1^2 = 2as$ (...B4)

where

V_1 is initial velocity = 0;
a is acceleration due to gravity, meters per second^2;
s is drop height, meters.

Equation B4 was derived from the following equations for uniformly accelerated motion:

$s = \bar{V}t$

$V_2 - V_1 = at$

$$\bar{V} = \frac{V_1 + V_2}{2}$$

where

s is distance traveled, meters;
t is time, seconds;
V_1 is initial velocity, meters per second;
V_2 is final velocity, meters per second;
V is average velocity, meters per second.

Since $V_1 = 0$, from Equation B4:

$V_2^2 = 2as$

Or

$$s = \frac{V_2^2}{2a} \quad \text{(...B5)}$$

Equations B1, B2, B3, and B5 may be combined as follows:

$$s = \frac{V_2^2}{2a} = \frac{(fL)^2}{2a}\frac{(2nL)^2}{2a}\frac{(2VL/60\pi d)^2}{2a}$$

$$= \frac{(0.0106VL/d)^2}{2a} = 5.777 \times 10^{-6}\left(\frac{VL}{d}\right)^2 \quad \text{(...B6)}$$

where

s is distance traveled, meters;
V is blade tip velocity, meters per minute;
L is length of object plus blade thickness or fin height, meters;
s is drop distance, meters.

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Annex C
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Safety pictorials

This annex provides safety pictorials that may be used to supplement on product safety information.

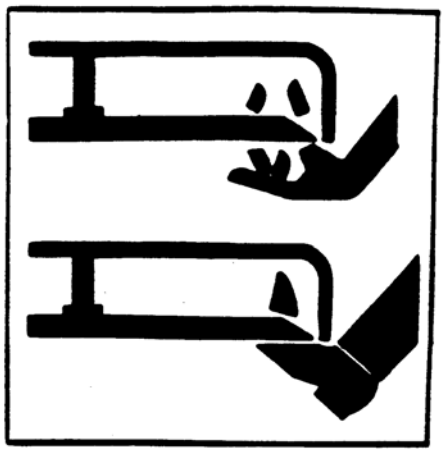


Figure C.1 - Severing of hand or foot – Rotary mower blade

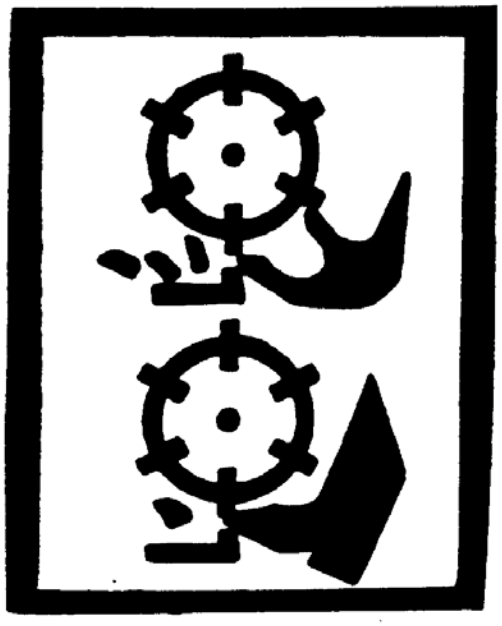


Figure C.2 - Severing of hand or foot – Reel mower blade

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Annex D
(informative)

Bibliography

ANSI B71.1-2003, *Outdoor power equipment – Walk-behind mowers and ride-on machines with mowers – Safety specifications*

ANSI/OPEI B71.3-1995, *Snow-throwers – Safety specifications*

AS 1636 Parts 2 & 3-1996, *ROPS criteria and tests for narrow tractors*

ASAE S318-APR88, *Safety for agricultural equipment*[5)]

ASAE S318.7-MAR84, *Safety for agricultural equipment*

ASAE S335.4-DEC96, *Operator controls on agricultural equipment*

ASTM F1667-2003, *Standard specifications for driven fasteners, nails, spikes, and staples*

CPSC special studies No. 14[6)]

CPSC special studies No. 64

CPSC 7(b) / Consumers Union Proceedings - Power mowers

CPSC 16/CFR Part 1205, *Safety standards for power lawn mowers*

CPSC special studies No. 24

EN 474-1: 1994, *Earth-moving machinery – Safety – Part 1: General requirements*

EN 836: 1997, *Garden equipment – Powered lawnmowers – Safety*

EN 1553: 1994, *Agricultural, forestry, landscaping and garden machinery – Common requirements – Safety*

ISO 3457: 1986, *Earth-moving machinery – Guards and shields – Definitions and specifications*[7)]

ISO 3789/3:1989, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment - Location and method of operation of operator controls - Part 3: Controls for powered lawn and garden equipment*

ISO 5395-3:1985 (add.1:1986), *Power lawn mowers, lawn tractors, and lawn and garden tractors with mowing attachments - Safety requirements and test procedures - Part 3: Requirements for rotary mowers*

OECD Code VI, *OECD standard code for the official testing of mid-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors*

5) ASAE standards are available from the American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085-9569.
6) CPSC publications are available from the U.S. Consumer Product Safety Commission, Washington, DC 20207-0001.
7) ISO standards are available from the American National Standards Institute, 25 West 43rd Street, New York, NY 10036.

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OECD Code VII, *OECD standard code for the official testing of mid-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors*

OSHA 1928.57, *Guarding of farm field equipment, farmstead equipment, and cotton gins*

SAE J232-DEC84, *Industrial rotary mowers*

SAE J833-MAY89, *USA human physical dimensions*

SAE J898-OCT87, *Control locations for off-road work machines*

SAE J1001-MAR87, *Industrial flail mowers and power rakes*

Uniform Vehicle Code, Section 12-215 (1975)

Fleet highway mowing report, Illinois Department of Transportation

Fleet highway mowing report, Florida Department of Transportation

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