American National Standard

for Outdoor Power Equipment –
Portable, Handheld, Internal-Combustion-Engine-Driven Cut-Off Machines – Safety Requirements

ANSI B175.4-2006

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American National Standard
for Outdoor Power Equipment –

Portable, Handheld, Internal-Combustion-Engine-Driven Cut-Off Machines – Safety Requirements

Sponsor

Outdoor Power Equipment Institute

Approved January 30, 2006

American National Standards Institute, Inc.

Abstract

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Foreword (This foreword is not part of American National Standard ANSI B175.4-2006.)

This standard replaces the withdrawn ANSI B7.5-1990, *American National Standard Safety code for the construction, use, and care of gasoline-powered, hand-held, portable, abrasive cut-off machines.*

The B 175.4 Standards Development Committee developed this standard. The Committee is comprised of several organizations and individuals that evaluate or manufacture these products and accessories.

A summary of the principle changes included in this standard is as follows:

- The new standard covers maximum wheel diameters up to 16 inches rather than 14 inches as described in the withdrawn ANSI B7.5-1990.
- New important technical specifications and test procedures were added, such as detailed noise and vibration requirements.
- During the development of this standard, an attempt to harmonize it globally with relevant ISO, CEN, and ANSI standards was considered and implemented where appropriate. In this regard, some of the clauses of this standard are identified as optional as they may only apply to certain market requirements.
- Concerning the maximum speed for cut-off machines, the definitions of ANSI B7.1-2000 apply, i.e., to define a maximum spindle speed, which correlates to the maximum speed of the cut-off wheel. Usually this maximum wheel speed is calculated from the maximum peripheral speed of the existing wheels, i.e., 100 m/s. Under these circumstances, clause 8 of ANSI B7.1-2000 for Special Speeds is applicable.
- Requirements for heat protection were added.
- Requirements were defined for the strength of the wheel guard. The test requirements are identical to those in EN 1454.
- A requirement has been added, by which the mounting of the wheel assembly shall not become loose when a defined torque is applied to the cut-off wheel in both directions.
- The clause on marking was transferred from ANSI B7.5 with several additions. Additions concern safety markings and optional noise labelling.
- In an informative annex (annex F), several symbols were added.

There are six annexes in this standard. Annexes A - E are normative and are considered part of the standard. Annex F is informative and is not considered part of the standard.

Suggestions for improvements of this standard are welcome. They should be sent to B175.4 c/o OPEI, 341 South Patrick Street, Alexandria, VA 22314.

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The following organizations, recognized as having interest in the standardization of safety requirements for cut-off machines, were contacted prior to the approval of this revised standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposal to ANSI:

AEM/SMI (Association of Equipment Manufacturers' Masonry and Concrete/ Saw Manufacturers Institute)
Concrete Sawing & Drilling Association
Dolmar Germany
Echo, Inc.
Homelite
Husqvarna AB/Partner Industrial
Piedmont Technical Associates
Power Tool Institute
Saint-Gobain Abrasives
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American National Standard
for Outdoor Power Equipment –

Portable, Handheld, Internal-Combustion-Engine-Driven Cut-Off Machines – Safety Requirements

1 Scope and purpose

This standard applies to portable, hand-held gasoline powered-machines, which use a rotating cut-off wheel that is center-mounted on and driven by a spindle shaft, that are designed for cutting construction materials such as asphalt, concrete, stone, and metal.

NOTE – The requirements in this standard apply to machines using up to 16 in (410 mm) cut-off wheels, which was the State-of-the-Art at the time this standard was developed. If the machine is designed for larger than 16-inch cut-off wheels, the requirements of this standard must be considered. The requirements listed may apply to machines designed for larger cut-off wheels.

Cut-off wheel design and safety specifications are not included in this standard.

1.1. Purpose

This standard establishes the minimum manufacturer requirements to reduce the risk of injury associated with the use of portable, hand-held gasoline powered machines using a rotating cut-off wheel.

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 B7.1-2000, *Safety requirements for the use, care, and protection of abrasive wheels*

ANSI B175.1-2000, *Power tools for gasoline-powered chain saws – Safety requirements*

ANSI S1.4-1983 (R2001), *Specification for sound level meters*

ANSI Z87.1-2003, *Practice for occupational and educational eye and face protection*

ANSI/UL 969-2001, *Marking and labelling systems*

IEC 651:1979, *Sound level meters*

ISO 5349, *Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration – Part 1: General requirements*

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ISO 7914: 2000, *Forestry machinery – Portable chain saws – Mechanical handle clearance and sizes*

SAE J184-1998, *Qualifying a sound data acquisition system*

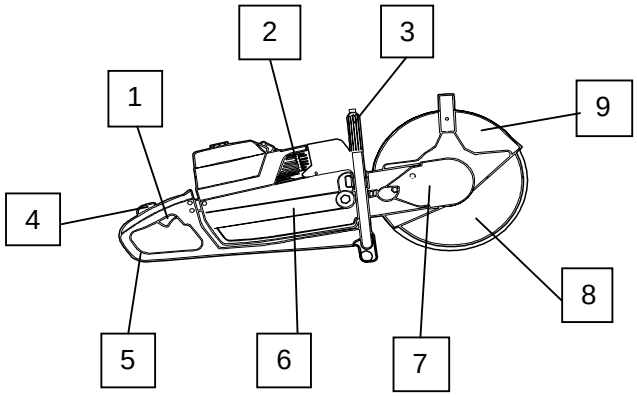
SAE J335 -1994, *Multi-position small engine exhaust system fire ignition suppression*

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3 Definitions



1 = Throttle control 2 = Muffler 3 = Front handle

4 = Throttle control lock-out 5 = Rear handle 6 = Clutch cover

7 = Transmission cover(s) 8 = Cut-off wheel 9 = Wheel guard

Figure 1 – Cut-off machine

3.1 Cut-off wheel
An abrasive wheel designed to be used on portable handheld cut-off machines with dimensions and provisions as given in this standard.

NOTE – Speeds of abrasive cut-off wheel(s) used on portable handheld cut-off machines in this standard correspond to clause 8 of ANSI B7.1, *Special Speeds exceeding standard speeds of 80 m/s.*

3.2 Arbor hole
The center hole of the cut-off wheel used for mounting the wheel on the machine spindle.

3.3. Blotter
Compressible discs or washers usually of blotting paper stock, plastic, cardboard or gasket material, used between the wheel and flanges when mounting.

3.4 Choke control
A control that is used to enrich the carburettor fuel/air mixture to aid starting.

3.5 Clutch
A device for connecting and disconnecting a driven member to and from a rotating source of power.

3.6 Wheel guard
A partial enclosure intended to deflect cutting debris, as well as pieces of the cut-off wheel in the event that the wheel is broken in operation.

3.7 Flange assembly
A device provided to clamp and drive the cut-off wheel.

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3.7.1 Flange contact surface
The area between the inner and the outer lines on the flange, which form the contact surface between the flanges and the cut-off wheel.

3.8 Handle
A device designed to facilitate control of the machine in all operating positions foreseen by the manufacturer.

3.8.1 Front handle
A handle located at the top or towards the front of the engine housing.

3.8.2 Rear handle
A handle located on the housing towards the rear of the power source housing.

3.9 Reactive forces
Gyroscopic forces
Forces caused by the rapid spinning of the cut-off wheel that results in the opposition to directional change when the cut-off machine is rotated in the sideways direction

b Rotational forces
Forces caused when the upper portion of the rotating cut-off wheel contacts a foreign object and/or when the cut-off wheel is pinched or bound that may result in the unexpected rapid upward and rearward motion of the cut-off machine towards the operator

Climbing and pulling
Forces caused when the cut-off wheel is pinched or bound and the cut-off machine unexpectedly moves in a vertical or forward direction.

3.10 Maximum depth of cut
The depth to which the cut-off wheel can enter the work piece as measured from the outside diameter of the wheel to the outside diameter of the flange (see dimension t in Figure 2).

3.11 Wheel clearance
The distance from the cut-off wheel guard to the outer edge of the cut-off wheel (see dimension x in Figure 2).

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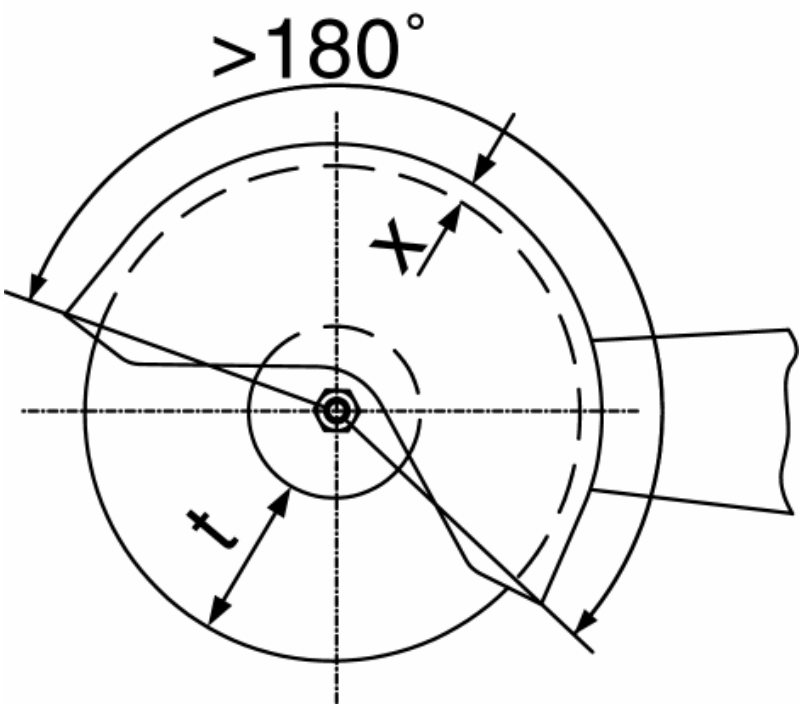


Figure 2 – Cutting equipment – Depth of cut

3.12 Muffler
Device for reducing engine exhaust noise and directing the exhaust gases.

3.13 Operating/cutting position(s)
Figure 3 depicts one of the typical cutting positions and the plane of the cut-off wheel.

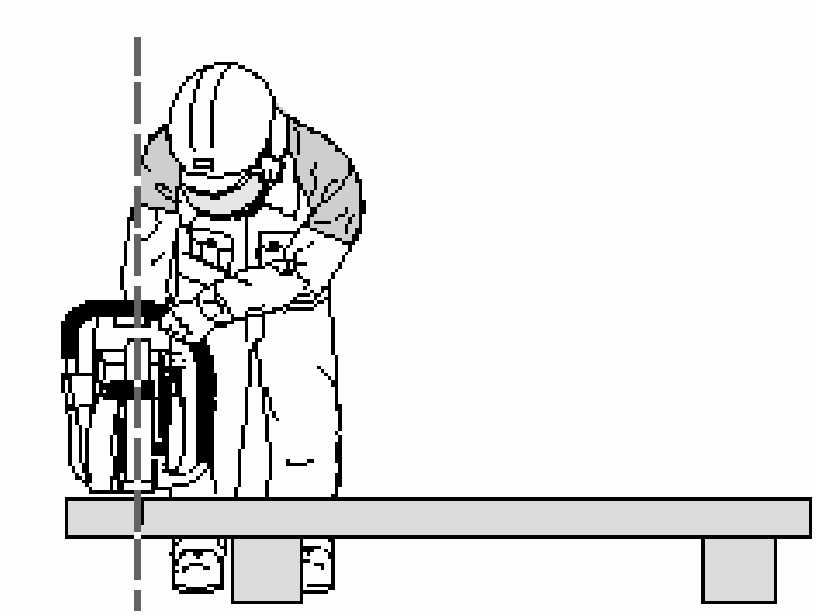


Figure 3 – Typical cutting position

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3.14 Primer/Purger
A device in the fuel system for supplying extra fuel or evacuating air to aid starting.

3.15 Reducing bushing
An insert or device used to reduce the arbor hole size in an abrasive cut-off wheel so that it can be mounted correctly on a smaller diameter wheel mount or spindle.

3.16 Speeds

3.16.1 Idle speed
Engine speed as recommended by the manufacturer, at which the engine runs reliably and the cut-off wheel does not rotate.

3.16.2 Rated speed
The engine speed where maximum power occurs as determined by the manufacturer.

3.16.3 Maximum spindle speed
Speed at which the spindle rotates with full open throttle and no load as determined by the manufacturer.

3.16.4 Maximum wheel speed
Maximum permitted speed of a new cut-off wheel as marked on the cut-off wheel.

3.16.5 Maximum peripheral wheel speed
The peripheral speed of the new cut-off wheel corresponding to its maximum wheel speed.

3.17 Shall
The term that indicates a mandatory requirement.

3.18 Should
The term that indicates a permissive requirement.

3.19 Spindle
Shaft of the cut-off machine, which supports, retains and drives the cut-off wheel in connection with the flanges.

3.20 On/off or stop control
A device for stopping the engine.

3.21 Throttle lock
A device for temporarily setting the throttle in a partially open position, to aid starting.

3.22 Throttle lockout
A device that prevents the unintentional operation of the throttle until manually released.

3.23 Throttle control
A device for controlling the engine speed.

3.24 Throttle control linkage
A mechanism that transmits motion from the throttle control to the throttle control valve.

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3.25 Transmission cover(s)
A device(s) between the engine and the cutting equipment to prevent contact with the transmission.

4 Safety Requirements

4.1 Speeds
Engine speed shall be limited so that it is not possible to operate the machine in excess of maximum spindle speed as specified in the operator's manual.

4.2 Handles
Machines shall be designed so that they have a handle for each hand. These handles shall be designed so that they conform to the dimensions and clearances, except distances B and C, given in ISO 7914:2002 and ANSI B175.1-2000, 5.2.3.1.

Cut-off machines with a system to isolate machine vibration from the handles shall be designed so that the operator can maintain control even in the case of full failure of the vibration isolation system. This can be demonstrated by the ability to hold the machine in accordance with Figure 3 and to stop the engine after severing all vibration isolators.

4.3 Engine stopping device
The engine shall be fitted with a stopping device, which brings it to a final stop and does not depend on sustained manual effort for its operation. This device shall be positioned so that it can be operated while the machine is being held with both hands by the operator wearing protective gloves. The purpose and method of operation of the device shall be marked clearly and durably. The color of the stopping device shall clearly contrast with the background.

4.4 Throttle control and lockout
The cut-off machine shall be equipped with a continuous-pressure throttle control system that will discontinue the power to the cut-off wheel when pressure is released.

When released, the throttle control shall return to the idle position and shall be retained in that position by the throttle lockout, which automatically engages. If a throttle lock is provided for cold starting, it shall be such that the lock has to be engaged manually and is automatically released when the throttle control is operated.

A throttle control linkage shall be designed so that a force equal to three times the machine dry weight without accessories and/or cut-off wheel applied in any direction to the rear handle shall not increase the engine speed to a point where the clutch engages and the cut-off wheel movement begins.

4.5 Clutch
The cut-off machine shall have a clutch so designed that the wheel does not move when the engine rotates at any speed less than 1.25 times the idle speed.

4.6 Exhaust direction
The exhaust shall be directed away from the machine and away from the operator when operating the machine in the typical cutting positions (see Figure 3).

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4.7 Cutting debris discharge

The machine shall be designed so that the main stream of cutting debris from the cut-off wheel is not directed towards the operator's face or upper body in the normal cutting positions as described in Figure 3 and in the operator's manual.

4.8 Fuel tanks and oil tanks

4.8.1 Tank openings and caps

The fuel tank and, if provided, oil tank filler openings shall be located so that they will not be unduly obstructed by the cut-off machine components. Each cap or opening shall be clearly and durably identified. If only the caps are identified, they shall not be interchangeable. Each cap shall have a retainer that prevents separation from the machine.

The minimum diameter of the fuel tank filler hole shall be 0.79 in (20 mm). The design of the caps shall be such that no leakage occurs while the machine is being used at normal operating temperature, in all working positions, and while being transported.

4.8.2 Fuel tank ventilation

If the fuel system is equipped with a ventilation-system, it shall not leak under normal operation. Evaporation through the tank ventilation system is not regarded as leaking.

4.9 Ignition circuit

All high voltage parts of the ignition circuit, including spark plug terminals, shall be designed to prevent direct operator contact.

4.10 Transmission cover(s)

The transmission shall be designed to prevent operator contact with any moving part other than the cut-off wheel during normal operation.

4.11 Heat protection

The temperature for the accessible parts of the machine as well the guard of the cylinder shall not cause a hazard for the operator.

The engine cylinder and muffler shall be protected against unintentional contact during normal operation of the machine if the distance is less than 4.7 in (120 mm) from the grip, measured from the averted side of the next grip (see Figures 6 and 7) and having less than 3.1 in (80 mm) for the lateral area at the front grip (see Figure 7).

The engine cylinder and muffler within this protection area are considered accessible if they can be reached by the test cone (see Figure 4) and if the area contacted is more than 1.5 in^2 (10 cm^2).

It also applies to the area of the engine cylinder or muffler, which can be contacted by the extension of a straight line between the outer side of the front handle above the machine and the outer edge of the housing over the muffler (see dimension > 0 in Figure 5).

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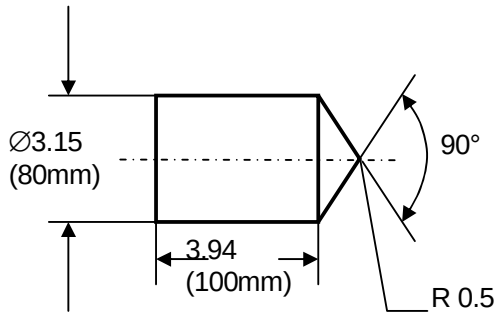
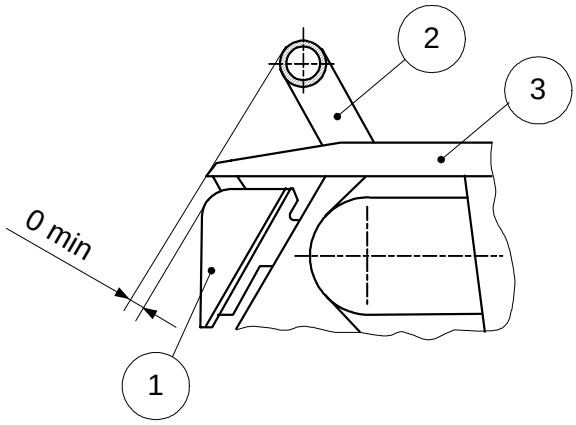


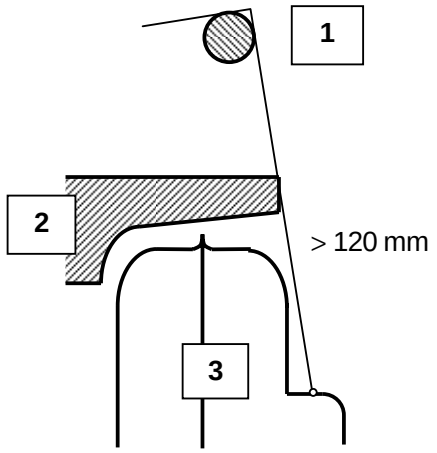
Figure 4 – Test cone



1 = Muffler 2 = Front handle 3 = Shroud of the cut-off machine

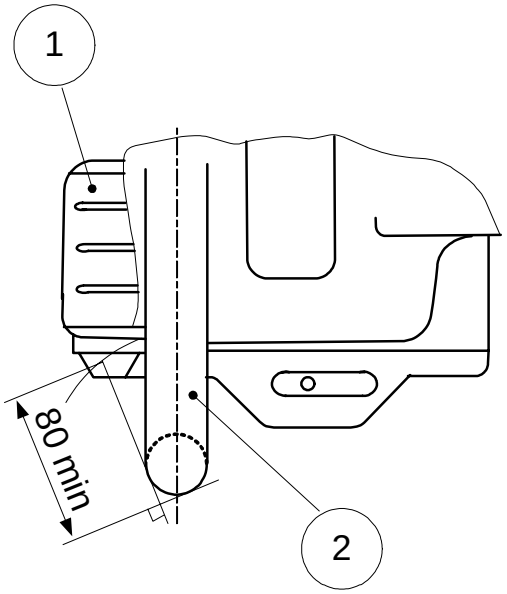
Figure 5 – Shielding of cylinder and muffler

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1 = Front handle 2 = Engine body 3 = Muffler

Figure 6 – Distance to cylinder and muffler – Front area



1 = Muffler 2 = Front handle

Figure 7 – Distance to cylinder and muffler – Lateral area

4.12 Cut-off wheel guard performance

Every machine shall be equipped with a cut-off wheel guard that meets the following requirements:

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- The cut-off wheel guard and its fixing components shall remain functionally intact when the tests in Annex D have been performed. Deformation and superficial damage can be accepted if the integrity of the guard is not compromised.

- The guard shall require the use of a tool(s) for attachment or removal. The cut-off-wheel guard shall enclose the entire wheel except for the part that is necessarily exposed for cutting. This enclosure shall cover no less than 180° of the circumference of the wheel (see Figure 2).

- The radial clearance (X) between the periphery of a new wheel at the greatest diameter specified by the manufacturer, and the inside of the guard that shall not allow the mounting of the next larger size wheel (see Figure 2).

- If the guard can be rotated around the wheel, tool(s) shall not be required to complete the adjustment.

4.13 Dust suppression

The machine shall incorporate a provision to mount a device for dust suppression.

4.14 Spindle thread and flange locking device

Both of the flanges shall be provided with a positive means of drive to ensure that any acceleration or deceleration shall not transfer movement to the fastening device.
The fastening method shall provide secondary retention not acted upon by rotational forces or torque. This requirement shall be verified in accordance with Annex E.

4.15 Flange assembly

The machine shall be equipped with two flanges made of steel or other material having comparable physical properties.

The flanges shall comply with the dimensions given in Table 1 or Table 2. Flanges that conform to Table 1 shall be always being provided with the machine. Optionally, flanges with dimensions that conform to Table 2 can be provided and shall be marked “For super abrasive (diamond) cut-off wheel only”.

Both flanges shall have the same outer diameter and the same contact surface. The flanges shall have a recess in the area of the arbor hole (d_a). After the flanges are mounted and secured according to the manufacturer’s recommendations, the radial width shall be as specified in Table 1. The flanges shall have a positive locking method to the spindle to prevent flange rotation on the spindle. In addition, the flange assembly shall meet the requirements given in Annex E.

Flanges mounted as shown in Figure 8 and loaded with the tightening torque as specified by the manufacturer, shall not allow a 0.002 in (0.05 mm) gauge to be inserted at any point around the flange circumference between the radial bearing area of the flange and the surface of the steel plate. The contact surface of the flange shall be flat after loading. Blotters shall not be used during this test.

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4.15.1 Flanges for composite (non-metal) wheels

The flanges for composite wheels shall comply with the dimensions given in Table 1.

Table 1 – Minimum Flange dimensions for Composite Wheels (see also Figure 8)

Wheel diameter (D)	Minimum flange size (d_f)	Minimum radial width of the bearing surface (r)	Minimum recess (e)
inches (mm)	inches (mm)	inches (mm)	inches (mm)
<10 (<260)	2.5 (63.5)	0.31 (7.9)	0.06 (1.5)
10 – 12 (260 – 310)	3.0 (76.2)	0.31 (7.9)	0.06 (1.5)
12 – 14 (310 – 360)	3.5 (88.9)	0.38 (9.7)	0.06 (1.5)
14 – 16 (360 – 410)	4.0 (101.6)	0.38 (9.7)	0.06 (1.5)

4.15.2 Flanges for diamond (steel core) wheels

The flanges for super abrasive (diamond) wheels shall comply with the dimensions given in Table 2.

Table 2 – Minimum Flange dimensions for Diamond Wheels (see also Figure 8)

Wheel diameter (D)	Minimum flange size (d_f)	Minimum radial width of the bearing surface (r)	Minimum recess (e)
inches (mm)	inches (mm)	inches (mm)	inches (mm)
≤10 (≤260)	1.48 (37.5)	0.24(6)	0.06(1.5)
>10 – ≤12 (>260 – ≤310)	1.77(45)	0.28(7.2)	0.06(1.5)
>12 – ≤14 (>310 – ≤360)	2.07(52.5)	0.33(8.4)	0.06(1.5)
>14 – ≤16 (>360 – ≤410)	2.36(60)	0.38(9.6)	0.06(1.5)

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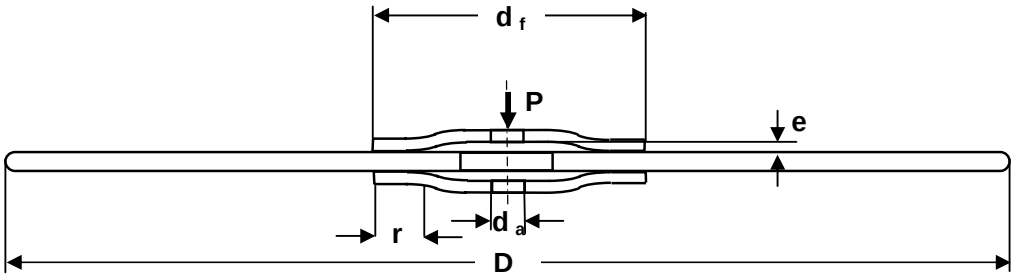


Figure 8 – Typical flange dimensions

5 Sound levels

5.1 Sound level at the ear of the operator

5.1.1 Limits

If the A-weighted sound pressure level measured at the operator's ear exceeds 90 dB(A), the instruction manual shall provide instructions for the use of hearing protection and the power head shall be marked using either text or symbols indicating that operators should always use hearing protection.

5.1.2 Method of measurement of the sound level at the ear of the operator

The sound levels shall be measured in accordance with Annex A.

5.2 Sound level for bystanders

If the sound level for bystanders is marked on the machine, the sound level shall be measured in accordance with Annex B.

6 Vibration

6.1 Vibration limits

The frequency weighted vibration total value a_{hv} (Weighted Acceleration Sum) is the vector sum of the vibration values for the three measured axes of vibration: For each handle, this value shall not exceed 10 m/s².

6.2. Method of measurement of hand-transmitted vibration

The vibration values shall be measured in accordance with Annex C.

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7 Operator manual(s)

7.1 General

Every cut-off machine shall be supplied with information about its design and intended use, tests, inspections, removal, and installation of cut-off wheels and any conditions necessary to reduce the risks when the cut-off machine is being adjusted, operated, maintained, or cleaned.

Comprehensive instructions and information on operation/operator maintenance and the safe use of the machine, including protective equipment, important safety features of the machine, and training, shall be provided as described in 7.4.

NOTE – Terms used in all documentation should be in accordance with clause 3.

7.2 Technical data

For each machine model, the following technical data shall be made available to the operator (unless identified as optional):

- Dry weight of the machine without cut-off wheel and accessories, (lbs) (kg); Volume of the fuel tank, (oz) (cc);

- Cut-off wheel
  - Outside diameter D, (in) (mm)
  - Arbor hole diameter, (in) (mm)
  - Wheel fastener tightening torque, (ft-lbs) (Nm)
  - Wheel type limitations, (if applicable)
  - Minimum flange diameter (in)(mm)

- Spindle
  - Spindle diameter, (in) (mm)
  - Max spindle speed, (rpm) (1/min)

- Engine
  - Displacement, (cid) (cc)
  - Rated power and measurement standard (optional), (hp) (kW) according to ISO 7293
  - Rated speed and measurement standard (optional), (rpm) (1/min)
  - Idle speed, (rpm) (1/min)

- Sound pressure level (dB(A)) at the operator's ear, (optional);

- Sound pressure level measured at 50 ft (15 m) in dB(A), (optional);

- Vibration total value a_{hv} (WAS) at each handle (m/s^2), (optional).

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7.3 Usage information

The operator's manual shall include the following information:

- General description, identification and nomenclature of principal parts by means of an illustration;
- Initial adjustments and checks including the tightening torque of the cut-off wheel;
- Selection and mounting of cut-off wheels for the type of work to be carried out;
- Starting and stopping procedures;
- Fuel filling procedure, fire precautions and fuel storage;
- Adjusting and securing of the cut-off wheel guard;
- Maintenance procedures including the tools (if any) required,
- Pre- and post-operating instructions;
- Troubleshooting information;
- Recommendations for storage of machine;
- Idle speed adjustment procedure and information that the cut-off wheel shall not rotate at idle;
- General operating techniques.

7.4 Precautions and warnings

Instructions on safe use of the machine in the operator's manual shall include the following:

- General aspects of safety, especially the following:
  - Hazards associated with the machine and its operation;
  - The need to obey safety instructions;
- Recommendation that a first-time operator should obtain practical instruction before using the machine, in addition to reading and understanding the operator's manual;
- Warning not to operate the machine when tired or under the influence of any substance, e.g., drugs or alcohol, that can impair vision, dexterity or judgment;
- Warning not to cut asbestos or asbestos-containing materials;
- Warning about silica and other potentially hazardous substances and hazardous material handling; Instruction to use dust-suppression devices when appropriate;
- Instruction regarding the use of suitable personal protective equipment e.g., eye protection, hearing protection, clothing and dust protection;

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- Direction to use the machine only with both hands and having the correct grip on the front and rear handles;

- Warning against hazardous operating positions; such as being in the plane of the cut-off wheel;

- Warning about the risks of reactive forces (such as climbing, pulling and rotational reactions) and recommendations for reducing the risk from reactive forces;

- Warning against the use of cutting attachments not designated by the manufacturer for use on the machine; especially blades designed for cutting wood;

- Warning against the use of wheels that are rated for speeds lower than the maximum spindle speed of the machine;

- Warning to test each new wheel for structural integrity immediately after installation for approximately 1 minute at maximum speed without cutting, and to keep bystanders away;

- Advice to inspect the cut-off wheel for cracks, distortion or unbalance prior to use and immediately after striking any unintended object;

- Instruction that cracked or broken guards shall be replaced prior to further use;

- Warning about fire risks including but not limited to fuelling, smoking, fuel spillage and sparks when cutting and having adequate fire extinguishing equipment available when appropriate;

- Precautions for safe transporting of the machine, both during use or to and from the job site;

- Precautions relative to the cutting job, including but not limited to:
  - Hidden hazards such as electrical cables, water and gas pipes and flammable substances;
  - Safe working distances by bystanders;
  - Ventilation of exhaust gases, such as carbon monoxide, and dust in closed environments;

- Advice to comply with all local and national ordinances;

- Warning about the need to follow the wheel manufacturer's safety instruction;

- Warning about excessive exposure to vibration with an explanation of the risk of white finger disease.

8 Marking

8.1 General

Markings shall be of good contrast to their background. If embossed, the height of the embossed feature shall be at least 0.02 in (0.5 mm).

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8.1.1 The marking shall be durable, legible, and located in a readily visible position on the unit and shall resist the anticipated service conditions, e.g., the effects of fuel, abrasion, temperature, moisture and other climatic exposure. If adhesive labels are used, they shall comply with ANSI/UL 969, including exposure to gasoline.

8.1.3 The information and/or instructions provided by the markings shall be clearly readable from a distance of 20 in (500 mm).

8.1.4 Where appropriate, markings shall be placed conveniently adjacent to the related controls concerned.

8.2 Basic markings

Every machine shall be marked with at least the following wording or by symbols:

- Manufacturer‘s name, trade name or other recognized symbol of the manufacturer, and address (optional);
- Model or type identification;
- The manufacturer‘s identification, e.g., the serial number or lot number;
- The maximum spindle speed;
- Limitations on wheel diameter, mounting arbor hole and thickness;
- Start/stopping device, fuel cap (or filling opening), choke/primer/purge control and heated handle switch (if provided);
- Respirators (if necessary), hearing and eye protection are required; eye protection should comply with ANSI Z87.1
- A mark indicating the direction of wheel rotation;
- A prominent or suitable mark stating: “WARNING! Read and follow all safety precautions in the operator’s manual. Failure to follow these instructions could result in serious or fatal injury.” (Verbatim or suitably paraphrased);
- A warning that the machine may create sparks when in use;
- A warning about the risk of reactive forces;
- A warning not to use circular saw blades.

NOTE – All symbols used must be explained in the operator’s manual. Recommendations are given in Annex F.

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8.3 Sound level for bystander

If applicable, the sound level, as reported in B.3.7, shall be clearly and durably marked on the machine and identified as decibels (dB(A)) using simple block characters at least 0.25 in (6 mm) high.

a) If a machine may be equipped with more than one type of whee,l as recommended by the manufacturer, the highest sound level shall be marked;
b) The wording “measured at 50 feet (15 m) per ANSI B175.4-2006”, shall accompany the numerical noise level.

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Annex A
(normative)

Method of sound pressure measurement at the ear of the operator

A.1 Scope
This annex specifies a method for measuring the sound pressure level at the operator‘s ear emitted by portable, hand-held, combustion engine driven cut-off machines.

A.2 Measured quantities
The values to be measured shall be A-weighted sound pressure levels, in decibels, determined with the frequency weighting "A" and slow response as defined in IEC 651.

A.3 Measurement of noise in free field

a) The test site shall be an open space having a radius of at least 10 m, which shall be completely free from obstructions, which might influence the measurements. The ground throughout the test site shall be relatively plane and acoustically hard, i.e., reflecting. Suitable ground surfaces are hard packed soil, gravel, asphalt, or concrete;
b) No person including the observer shall approach closer than 2 m to the operator;
c) The ambient sound level at the point of measurement (including wind effects) coming from sources other than the unit being tested shall be at least 10 dB(A) lower than the sound level of the unit;
d) Measurements shall be made only when wind gusts are below 12 miles per hour (5.4 m/s);
e) The ambient air temperature shall be 41°F (5°C), or greater at the time of test.

A.4. Measurement in an anechoic chamber (Alternate method)

a) An anechoic or semi-anechoic chamber may be used for conducting a sound level test provided the test results do not vary more than ±1 dB(A) from the free field test results. If the variation exceeds ±1 dB(A), the correction between the anechoic chamber measurement and free field sound measurement shall be applied to the result obtained from the anechoic chamber;
b) Sound levels for distances exceeding the dimensions of the chamber; may be calculated from measurements taken in the chamber, if sufficient data is available to substantiate such calculations.

A.5 Unit conditions
The unit shall be tested with the loading device as described in Figures A.1 and A.2. The engine shall be tested warm with the carburettor adjusted according to manufacturer's recommendations.

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A.6 Instrumentation

A.6.1 Measuring equipment

The following instrumentation shall be used:

a) A microphone. Suitable measuring devices are sound level meters meeting or exceeding the requirements of a Type 1 instrument in accordance with IEC 651. It is recommended that a microphone with a diameter not greater than ½ inch (13 mm) be used for the measurements. A wind screen attachment to the microphone may be used, provided that this is allowed for, if necessary, in the calibration and does not alter the measured sound level by more than ±0.5 dB(A) as a consequence of its effect on the omnidirectional characteristics of the microphone;
b) Either of the following systems may be used:
   1) A precision sound level meter that meets the Type I requirements of ANSI S1.4 for direct measurements;
   2) A data acquisition system that meets the requirements of SAE J184 and a sound level calibrator (see B 2.6.2.3(d)).

A.6.2 Calibration

a) Before and after each series of measurements, an acoustical calibrator with an accuracy of at least +0.5 dB(A) shall be applied to the microphone to check the calibration of the entire measuring system at one or more frequencies in the range from 200 to 1000 Hz;
b) The calibrator shall be checked at least once every year to verify that its output is within specifications;
c) In addition, an acoustical and electrical calibration of the instrumentation system over the entire frequency range of interest shall have been conducted within two years of its use;
d) The measuring equipment shall be allowed to reach a steady state (stabilized) temperature before it is calibrated;
e) An engine speed indicator shall be used to check the speed of the engine. It shall have an accuracy of ±3% of measured value.

A.7 Microphone position

The location of the machinery respective to the microphone shall be 27.5 in ± 0.39 in (700 mm ± 10 mm) above the top of the front handle and vertically above the center line between the outer edge of the rear and front handles. The microphone shall be in the plane of the cut-off wheel, see figure A.1.

A.8 Test procedure

A.8.1 Test conditions

All readings shall be taken at rated speed with full open throttle and in a normal operating position as described in Figure A.1. The engine speed is controlled with the loading device as shown in Figure A.2.

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A.8.2 General

a) Four measurements shall be taken;
b) The variation of four values shall not be greater than three dB(A). If this variation is exceeded, the test shall be repeated until four tests fall within a variation of three dB(A). This sequence may not be consecutive;
c) The results and their arithmetic average are to be recorded.

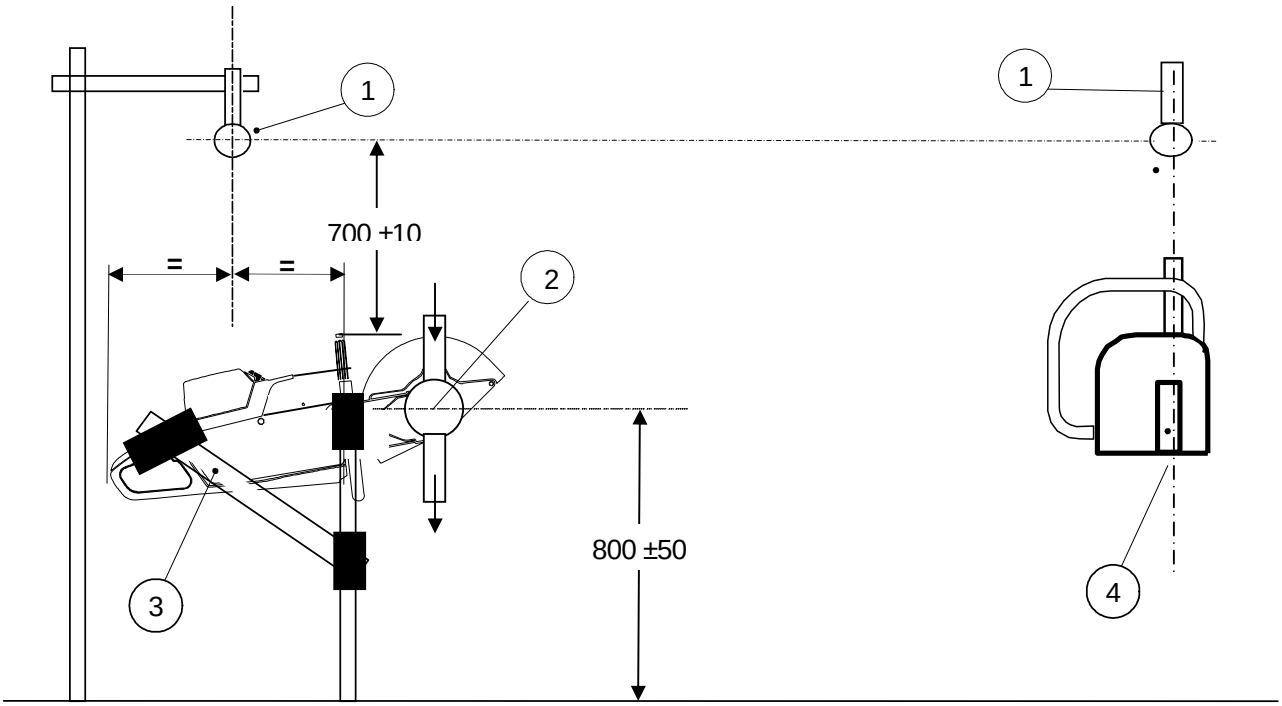


Figure A.1 – Test fixture set-up for sound pressure measurement

Table A.1 – Table for reporting measurement results out of the sound pressure measurements at the operator's ear position

Operating conditions	Number of revolutions	A – weighted sound pressure levels dB				
		Test				Arithmetic mean
		1	2	3	4	
Full load						

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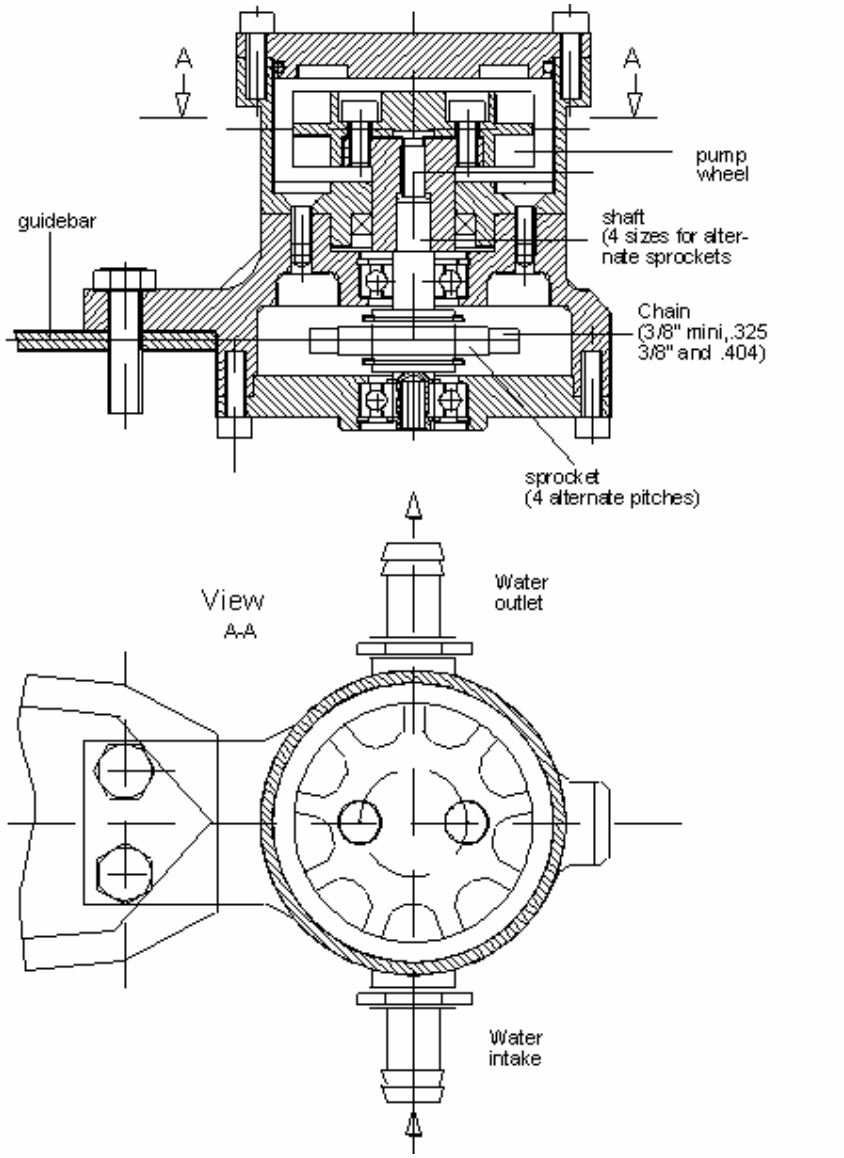


Figure A.2 – Typical loading device for sound measurements

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Annex B
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Sound measurement for bystanders (optional)

B.1 Introduction
The purpose of this Annex is to establish bystander sound level test procedures for handheld cut-off machines. It covers the instrumentation, test site, machine operation, and measurement method for determining the bystander sound level of cut-off machines.

NOTE – Metric units are included for information only.

B.2 Instrumentation
The following instrumentation shall be used:

a) A microphone. Suitable measuring devices are sound level meters meeting or exceeding the requirements of a Type 1 instrument in accordance with IEC 651. It is recommended that a microphone with a diameter not greater than ½ in (13 mm) be used for the measurements. A wind screen attachment to the microphone may be used, provided that this is allowed for, if necessary, in the calibration and does not alter the measured sound level by more than ±0.5 dB(A) as a consequence of its effect on the omnidirectional characteristics of the microphone.

b) Either of the following systems may be used:
   1. A precision sound level meter that meets the Type I requirements of ANSI S1.4 for direct measurements;
   2. A data acquisition system that meets the requirements of SAE J184;
   3. A sound level calibrator (see B.2.6.2.3(d)).

B.3 Test site

B.3.1 Measurement of sound in a free field

B.3.1.1 The test area shall be a flat, open space with a reflecting surface such as concrete and be free of any large reflecting surfaces, such as signboards and buildings, for a minimum distance of 100 feet (30 m) from the cut-off machine and the microphone.

B.3.1.2 The ambient sound level at the point of measurement (including wind effects) coming from sources other than the cut-off machine being tested shall be at least 10 dB(A) lower than the sound level of the cut-off machine.

B.3.1.3 Measurements shall be made only when the wind is less than 5 mph (2.25 m/s*),* with gusts less than 12 mph (5.4 m/s*),* with the wind in the direction away from the microphone toward the machine being tested.

B.3.1.4 The ambient air temperature shall be 41°F (5°C), or greater at the time of test.

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B.3.2 Measurement of sound level in sound room (alternate method)

B.3.2.1 An anechoic or semi anechoic chamber may be used for conducting sound level tests. If the variation exceeds ±1 dB (A) from the free-field test results, the correlation between the sound room measurement and free-field sound measurement shall be applied to the result obtained from the sound room. The correlation shall be confirmed with tests in free field conditions and tests in the anechoic chamber based on identical machines and under equivalent conditions as specified in the applicable clauses of this standard.

B.3.2.2 Sound levels for distances exceeding the dimensions of the chamber may be calculated from measurements taken in the chamber, provided sufficient data is available to substantiate such calculations. A floor covering in the chamber shall be reflecting.

B.3.3 Operation

B.3.3.1 The cut-off machine shall be adjusted in accordance with manufacturer's instructions, including the operating speed or carburetor setting.

B.3.3.2 Operator
The cut-off machine shall be operated by a person of medium height and build, in the manner recommended by the manufacturer. The operator shall wear typical and appropriate working clothes without acoustical absorbent or reflecting surfaces.

B.3.3.3 The cut-off machine shall be evaluated with each of the cut-off wheels recommended by the manufacturer.

B.3.3.4 The guard and wheel shall be mounted in accordance with the manufacturer's instructions.

B.3.3.5 All readings shall be taken with the machine running at the maximum engine power speed and in a normal operating position.

B.3.3.6 Prior to the test, the machine shall be run-in and warmed up in accordance with the manufacturer's instructions.

B.3.4 Measurements

B.3.4.1 The sound level meter shall be set for slow response and the A-weighting network.

B.3.4.2 Measurements shall be taken at every 45 degrees (8 different positions) with the microphone 50 feet (15 m) from the operator and 4 feet (1.2 m) above ground (see Figure B.1). The microphone shall be positioned with its axis of highest sensitivity generally parallel to the ground and pointed toward the operator. Five readings should be taken at each position at least 5 seconds apart. Each reading may be an average of minimum 2 seconds duration. The arithmetic average of the five readings is to be used in the calculation of the reported sound level. If the test data at each position vary more than 3 dB(A), the test shall be repeated until five readings are within 3 dB(A). These readings do not have to be consecutive.

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- *Weather*. The effect of ambient weather conditions on the performance of all instruments should be taken into consideration.

- *Equipment Installation*. Proper signal levels, terminating impedances, and cable lengths on multi-instrument measurement systems should be checked.

- *Calibration.*
  - Proper acoustical calibration procedures shall be observed.
  - Field calibration shall be made immediately before and after each test sequence. Either an external-calibrator or internal- calibration means is acceptable.
  - All test results shall be considered invalid if the recheck by external calibration is not within 0.5 dB(A) of the initial calibration.

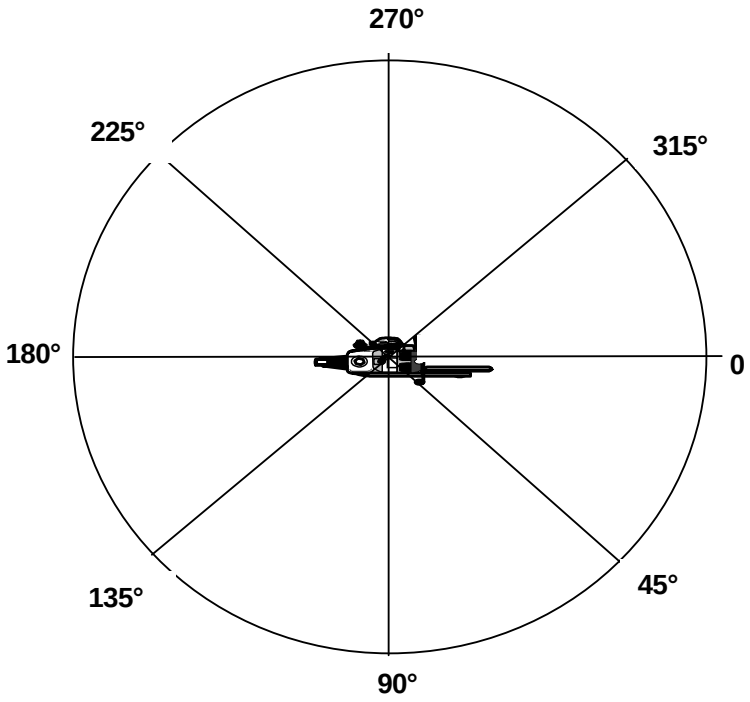


Figure B.1 – Measuring locations

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B.3.5 Test data to be recorded

The recorded test data shall include the following:

- Geographical location;
- Date and time;
- Names of the operator, sound level meter reader, and observer;
- Weather conditions, including ambient temperature and wind velocity;
- Make, type, and serial number of measuring equipment;
- Make, model, displacement, and serial number of the machine being tested;
- Type of cut-off machine and all attachments;
- All sound level readings taken (see Table B.1);
- Engine speed (rpm) [1/min];
- Documentation of microphone, machine, and guard orientation;
- Ambient sound level;
- Date of most recent calibration of the acoustical calibrator.

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Table B.1 – Reporting sound data

Measuring position	Individual test reading at each position dB(A)						Arithmetic average dB(A) of readings
	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	
0°							
45°							
90°							
135°							
180°							
225°							
270°							
315°							
Reported average of the measuring positions:							

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Annex C
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Method of vibration measurement

C.1 Introduction
This annex provides general advice for the measurement of the vibration at the handles. The following clauses give more details, which are necessary for the measurements of the Weighted Acceleration Sum on the handles of engine driven cut-off machines.

C.2 Scope
This annex specifies a method for measuring the weighted acceleration emitted by the handles of a portable, hand-held, internal combustion cut-off machine.

C.3 General
The measurements in the three axes shall be made at or clearly related to the surface of the hand where the energy enters the body. As the hands of the person are in direct contact with the vibrating surface of the handgrip, the transducer should be fastened to the vibrating structure.

C.4 Data acquisition and processing

C.4.1 Frequency weighted vibration total value a_{hv}
The acceleration in three perpendicular directions shall be picked up by accelerometers and processed to form an overall vibration value a_{hv}, in accordance with Figure C.1.

Mathematically, $a_{h,w}$ is the mean square of the root (RMS) of the weighted signals from each direction. The weighting filters shall have the characteristics given in ISO 5349. The frequency weighting factors are given in ISO 5349-1, Table A.2

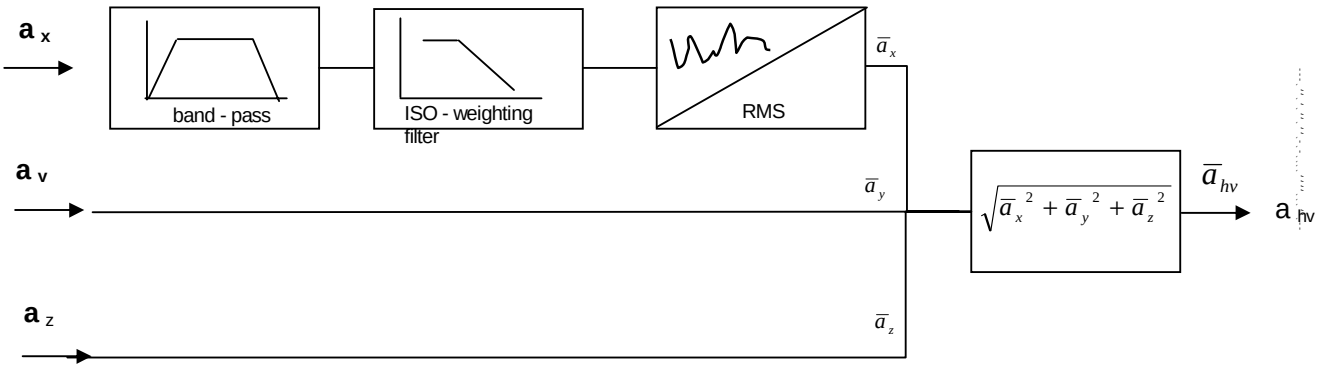


Figure C.1 – Vibration total value a_{hv}

NOTE – The three different acceleration directions may be measured at different times.

C.4.2 Weight of accelerometers
The total mass of the accelerometer(s) giving the acceleration at one measuring position shall not exceed 25 g including the mounting but excluding the cables.

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C.4.3 Fastening of the accelerometers (transducers)
For fastening of accelerometers, see Figure C.2.

C.4.4 Positioning of accelerometers
The different directions of accelerometers and measuring positions are shown in Figure C.2. The center of gravity of the accelerometers shall be positioned at a maximum distance of 0.79 in (20 mm) from the contour described by taking a section through the handle defined by the lines Z and Y for the rear handle and the lines Z and X for the front handle.
At the front handle, the accelerometers shall be placed at the right end of that portion of the handle intended to be grasped. At the rear handle, the accelerometers shall be placed on the top of the handle surface 0.79 in (20mm) in front of the rear portion of the throttle control (see Figure C.2).

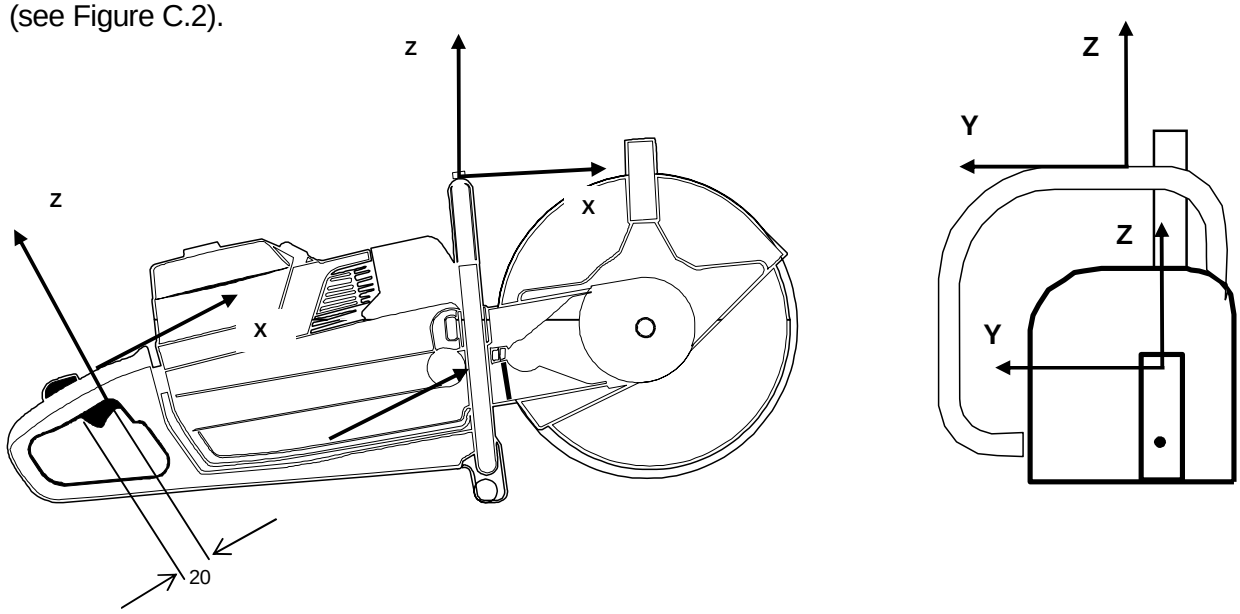


Figure C.2 – Accelerometer positions

C.5 Accuracy of the measuring equipment

C.5.1 Measuring equipment
The accuracy of the measuring equipment excluding accelerometer mounting shall be within ±10% in the frequency range 8 Hz to 1500 Hz.

C.5.2 Electrical noise
Special care shall be taken to avoid electrical noise generated by the cut-off machine (a suppressed spark plug is recommended). When the cut-off machine is running at the test place with the accelerometers free from contact with the machine but near to it (at a maximum distance of 0.79 in (20 mm) from the measuring positions) the electric noise shall not exceed 5% of the maximum measured value reported.

C.5.3 Engine speed indicator
An engine speed indicator shall be used to check the speed of the engine. It shall have an accuracy of ±3% of the reading. The indicator and its engagement with the cut-off machine shall not affect the operation during the test.

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C.6 Rotational frequency range and measured value

All readings shall be taken with the machine running at the maximum engine power speed with the machine in a normal operating position. The speed shall be controlled with the throttle control.

C.6.1 Measuring interval

Each measured value shall be taken as the RMS-value over 2 s (equal to 1 s RC-detector time constant or time weighting characteristic S "slow" in accordance with IEC 651:1979). The rotational frequency shall be kept within ± 3,5 s-1 of the nominal rotational frequency during the registration.

C.6.2 Reported vibration total value a_{hv} (WAS)

Each reported value of $a_{h,v}$ shall be the RMS-value of at least five measured values in accordance with clause C.6.

C.7 Measuring object

Measurements shall be carried out on a normal production cut-off machine. The engine shall be run-in and warmed up before the test commences, carburetor set and ignition timed according to the instructions of the manufacturer. The tank shall be at least half-full. The unit shall be evaluated with a diamond wheel with an unbalance of 0.35 oz.in. +.015/-0 oz.in. (250 gmm +10/-0 gmm).

C.8 Measuring conditions

The cut-off machine shall be operated in an upright position. A relaxed grip on the handle sufficient to maintain proper control shall be employed, consistent with daylong use of the cut-off machine.

C.9 Test report

The test report shall include the following information:

a) Reference to this standard;
b) Date and place of measurement;
c) Observer and operator;
d) Description of the cut-off machine:
   - Manufacturer;
   - Model (type);
   - Serial number;
   - Type of handle coating.
e) Measuring equipment;
f) Height and weight of the operator;
g) Description of the accelerometer mounting;
h) Procedure to obtain the vibration total value a_{hv} (see C.4.1);
i) Table with test data.

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Annex D
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Determination of the strength of cut-off wheel guards

D.1 Introduction

If the cut-off machine is intended for use with abrasive cut-off wheels, the test shall be performed with a non-reinforced wheel of the maximum size and thickness specified by the manufacturer and running at the maximum spindle speed . During this test, the machine is hanging horizontally on ropes affixed to the front and the rear handle. The wheel shall be burst with a projectile fired at the wheel or by another suitable method. The projectile shall hit the wheel in the middle of dimension t ± 1 in (25 mm) (see 3.10 and Figure 2). The test shall be carried out until three separate wheel bursts are accomplished using the same guard.

WARNING: This test creates flying debris and wheel fragments, and shall only be carried out in a properly constructed and equipped test facility. The test shall be performed inside a fully protected enclosure, which can contain all of the cut-off wheel fragments and other debris.

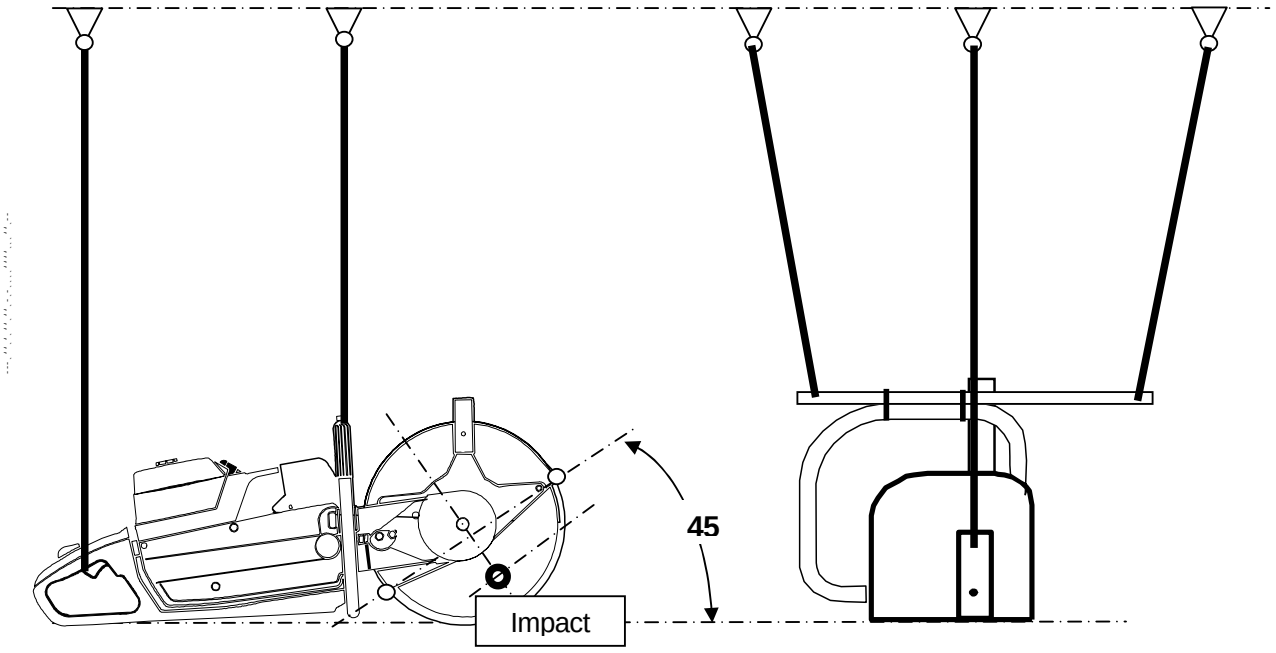


Figure D.1 – Test setup for strength tests with cut-off wheel guards

The test shall be performed inside of a fully protected enclosure, which can contain all of the cut-off wheel fragments, and other debris. Adjust the guard such that the open exposure of the wheel is in an angle of 45 degrees to the horizontal.

NOTE – Manufacturers may elect an alternate mounting system, provided it would not result in a less-stringent test method.

Caution: Any person performing tests in accordance with this standard shall be appropriately trained in the type of work to be carried out. All national regulatory conditions and health and safety requirements must be followed.

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D.2 Test Result

After three consecutive tests, the guard shall be inspected. It shall have maintained its structural integrity such that the guard can continue to be used for all applicable operations.

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Annex E
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Retention test for cut-off wheels

The cut-off wheel shall be installed according to the manufacturer‘s recommendation.

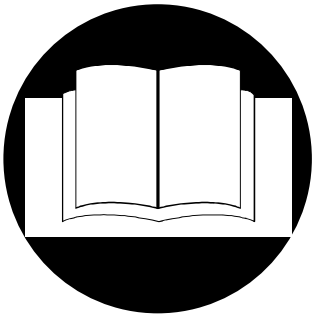
The locking of the flanges to the spindle shall be verified by the following tests:

a) Attach the cut-off wheel and flanges to the spindle with a tightening torque according to the manufacturer’s operator’s manual;
b) Lock the spindle and apply a rotational torque to the cut-off wheel as a tangential force to the circumference of the cut-off wheel;
c) The torque shall be M = 0.4 * V * k where:
   V= engine displacement in cubic centimetre;
   M= torque in Nm;
   k = gear ratio (engine/spindle speed);
d) Repeat the test five times in the normal rotational direction, then five times in the opposite direction of rotation and observe for any movement. Any movement should be considered a failure of the retention test.

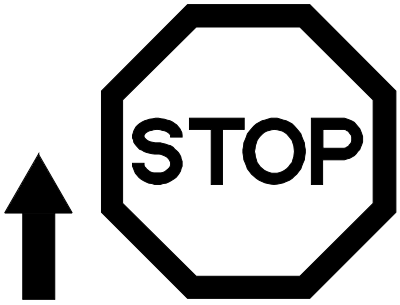
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Annex F
(informative)

Recommended Symbols



Symbol 1: Read the Operator's Manual(s)



Symbol 2: Stopping Device



Symbol 3: Wear Hearing Protection

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Symbol 4: Wear Eye Protection

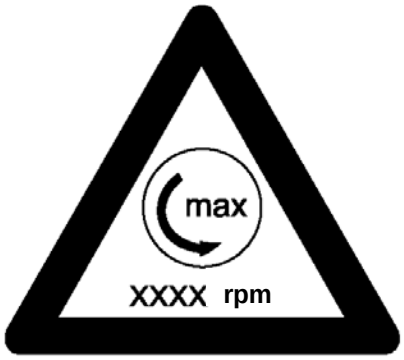


Symbol 5: Wear a Dust Respirator

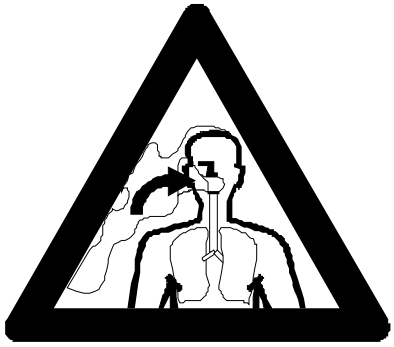


Symbol 6: Combination Symbol for Protective Equipment

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Symbol 7: Maximum Spindle Speed



Symbol 8: Hazardous Dust and Gas Emissions

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Symbol 9: Fire Risk because of Sparks



Symbol 10: Rotational Forces

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