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AMENDMENT 1
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Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration —

Part 2: Practical guidance for measurement at the workplace

AMENDMENT 1

Vibrations mécaniques — Mesurage et évaluation de l'exposition des individus aux vibrations transmises par la main —

Partie 2: Guide pratique pour le mesurage sur le lieu de travail

AMENDEMENT 1

Reference number
ISO 5349-2:2001/Amd.1:2015(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 4, *Human exposure to mechanical vibration and shock*.

ISO 5349 consists of the following parts, under the general title *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration*:

— *Part 1: General requirements*

— *Part 2: Practical guidance for measurement at the workplace*

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Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration —

Part 2: Practical guidance for measurement at the workplace

AMENDMENT 1

AMENDMENT 1

Page 1, Clause 2.

Replace the clause with the following, thereby updating the normative references.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

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

ISO 5805, *Mechanical vibration and shock — Human exposure — Vocabulary*

ISO 8041, *Human response to vibration — Measuring instrumentation*

ISO 22867, *Forestry and gardening machinery — Vibration test code for portable hand-held machines with internal combustion engine — Vibration at the handles*

ISO 28927 *(all parts), Hand-held portable power tools — Test methods for evaluation of vibration emission*

Page 7, 6.1.2.2

Replace the subclause with the following.

6.1.2.2 Vibration magnitude

Hand-held machines can produce high vibration magnitudes. A pneumatic hammer, for example, can generate a maximum acceleration of 20 000 m/s^2 to 50 000 m/s^2. However, much of this energy is at frequencies well outside the frequency range used in this part of ISO 5349. Therefore, the accelerometer chosen for the measurement has to be able to operate at these very high vibration magnitudes and yet still respond to the much lower magnitudes in the frequency range from 6,3 Hz to 1 250 Hz (one-third-octave band mid-frequencies). For the use of mechanical filters to suppress vibration at very high frequencies, see Annex C.

Page 7, 6.1.3

Replace the subclause with the following.

6.1.3 Location of accelerometers

Vibration measurements in accordance with ISO 5349-1 should be made at or near the surface of the hand (or hands) where the vibration enters the body. Preferably, the accelerometer should be located

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at the middle of the gripping zone (e.g. halfway along the width of the hand when gripping a machine handle), it is at this location that the most representative evaluation of the vibration entering the hand is obtained. However, it is generally not possible to locate transducers at this point; the transducers will interfere with the normal grip used by the operator.

Measurements directly under the hand are usually only possible using special mounting adaptors (see Annex D). Such adaptors should fit under the hand, or between the fingers. For most practical measurements, the accelerometers are mounted on either side of the hand or on the underside of the machine handle adjacent to the middle of the hand. With adaptors that fit between the fingers, the transducers should be mounted as close as possible to the surface of the machine handle to minimize amplification of rotational vibration components. They should not have any structural resonances that would affect the measured vibration.

It is possible to get differences in vibration measurement across the width of the hand, particularly for hand-held machines with side handles, such as angle grinders, and especially where these handles are flexibly mounted. In these cases, it is recommended that two accelerometers positions be used, located one on each side of the hand; the average of the two vibration measurements is then used to estimate vibration exposure.

For many hand-held machines, specific measurement locations and axes have been defined for the measurement of vibration emission by ISO 22867, ISO 28927, and other International Standards for declaration of vibration emission; these measurement locations are summarized in Annex A as examples of measurement locations. The measurement locations defined in vibration emission standards are designed for a particular type of measurement and are not necessarily suitable for the evaluation of vibration exposure. However, in some circumstances, it may be appropriate to ensure that workplace measurements of vibration are made using locations and axes compatible with those used for emission measurements.

NOTE The ISO 28927 series of standards defines the preferred measurement location as being as close as possible to the hand between the thumb and the index finger, where an operator normally holds the machine. While this measurement position could be suitable for emission testing, it is not invariably suitable for workplace exposure assessment.

Page 8, 6.1.4.1

Replace the subclause with the following.

6.1.4.1 General

The accelerometers should be rigidly attached to the vibrating surface. Annex D gives details of some mounting methods. A method shall be chosen which gives an adequate coupling to the vibrating surface, does not interfere with the operation of the machine, and does not itself affect the vibration characteristics of the vibrating surface. The mounting method chosen is dependent on the particular measurement situation; each method has its own advantages and disadvantages.

The mounting system should have a flat frequency response across the range of frequencies being measured, i.e. it should not attenuate or amplify and should not have any resonances in this frequency range. The mounting system should be securely attached to the vibrating surface, and should be carefully checked before and after measurement.

The mounting of accelerometers on a machine or hand-held workpiece is necessarily intrusive and can have some effect on how the operator works. The mounting of the transducers should be arranged so that the operator can work as normally as possible. It is important, prior to measurements, to observe how a machine or hand-held workpiece is held, to identify the best location and orientation of the accelerometers. The location (or locations) and orientation of the transducers should be reported.

It is very important to avoid interfering with the machine controls or with the safe operation of the machine. It is often the case on machines, that the best measurement location is where the on-off switch is positioned. Care shall be taken to ensure that the machine controls are not (and will not become) impeded by transducers, mountings or cables.

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Page 8, 6.1.4.2

Replace the subclause with the following.

6.1.4.2 Attaching to surfaces with resilient coatings

When a machine handle has a soft outer coating, the vibration transmission properties of the coating are dependent on the force with which the mounting system is attached. In such cases, care shall be taken to ensure that the resilient material does not affect the measurement of vibration. If the coating is not thought to be providing reduction in vibration exposure, either

— remove the resilient material from the area beneath the transducers, or

— firmly attach the transducers using a hose clamp or similar device that fully compresses the resilient material.

In most cases, this approach is adequate. However, it does not account for the vibration transmission properties of the resilient coating.

Generally, resilient materials on machine handles are not intended to provide vibration reduction but to provide a good grip surface. Resilient coatings do not usually affect the frequency-weighted vibration magnitude.

If the resilient coating provides some reduction in vibration exposure, for example, if it is a thick layer of resilient material, then attach the transducer to an adaptor (see D.2.4) that is held against the vibrating surface by the normal hand grip of the operator (the adaptor can be held in position using adhesive tape wrapped lightly around the machine handle and adaptor). This type of measurement is difficult, but it could give a better indication of the actual vibration exposure.

NOTE It is possible for poorly selected resilient materials to amplify the vibration at certain frequencies.

Page 12, 6.3.2

Delete "(see also DIN 45671-3)".

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Page 16, Annex A

Replace Annex A with the following.

Annex A
(informative)
Examples of measurement locations

A.1 Introduction

It is not always practical to make measurements at the surface of the hand(s) where the vibration enters the body in the middle of the gripping zones as described in 6.1.3; for example, on machines with a closed or open bow grip or a pistol grip, the location of the trigger can make measurement halfway along the handle impossible. In practice, the measurement location usually has to be to one side of the hand. The location of machine controls and hand guards can also affect where it is possible to attach accelerometers. Figure A.1 shows examples of measurement locations for some common machines, controls, and work tasks.

A.2 Measurement locations used in vibration type test standards

Table A.1 lists, as examples, the measurement locations specified in ISO 22867 and in the ISO 28927 series. These International Standards specify laboratory methods for measuring the vibration at the handles of different hand-held machines for the purpose of determining vibration emission values.

ISO 28927 series requires that measurements be made at the gripping zones, where the operator normally holds the machine and applies the feed force. These International Standards define a prescribed transducer location for both hands, to be as close as possible to the hand between the thumb and index finger. A secondary location is also defined, as being on the side of, and as close as possible to, the inner end of the handle where the prescribed location is found. The prescribed and secondary transducer positions are identified as positions “1” and “2” in Table A.1. The secondary position is used when the prescribed location is not accessible or when use of that location would prevent correct operation of the machine.

The locations shown in Table A.1 are suitable for emission testing, but might not be appropriate for the measurement of workplace exposure. In addition, the orientation of the axes X, Y, Z, shown in the pictures also cannot match the basicentric coordinate system discussed in Part 1 of this International Standard. The objectives of an exposure measurement are very different to those of a type test. For evaluation of vibration exposure, the location of the accelerometers shall be based on where the hand actually holds the machine, rather than where the machine is held during a type test. The principal requirement of the vibration type test standards is that measurements are made in the main gripping zone where the operator normally holds the machine and applies the feed force.

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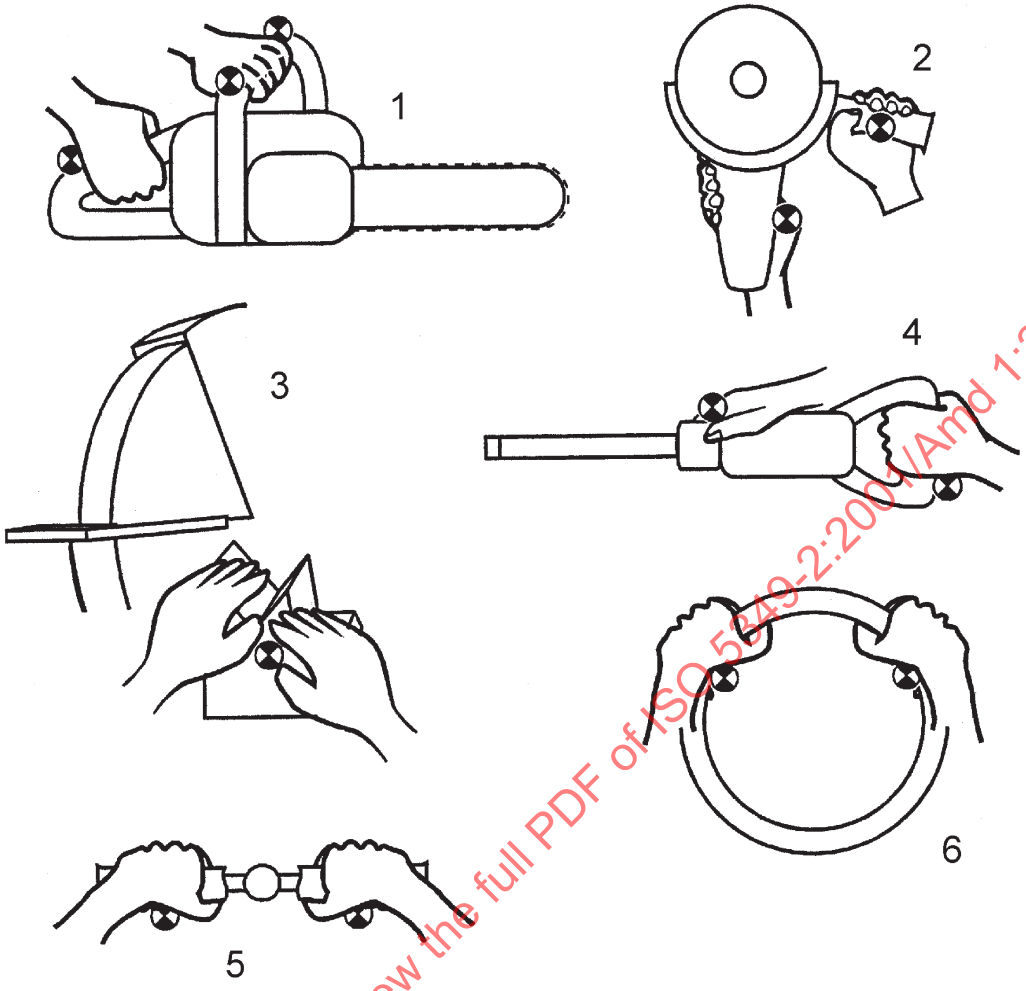

Key

1 chainsaw
2 angle grinder
3 pedestal grinding
4 chipping hammer
5 hand-guided machine
6 steering wheel
⊕ measurement location

Figure A.1 — Examples of practical measurement locations for some common machines, controls and work tasks

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Table A.1 — Examples of accelerometer locations on machines used in ISO 22867 and ISO 28927 for vibration type testing

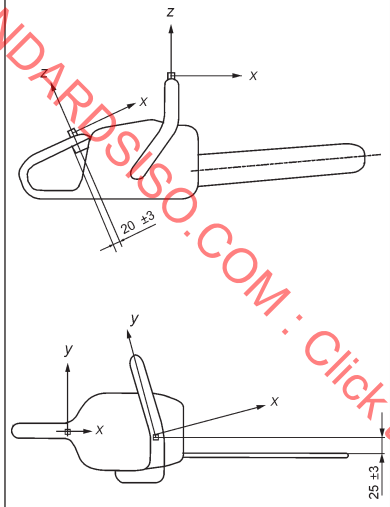
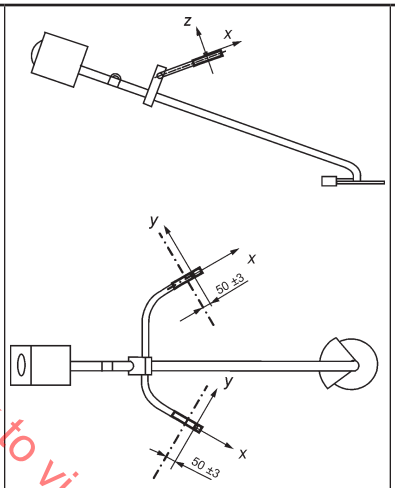
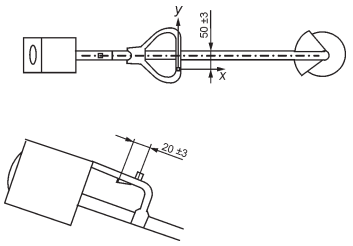
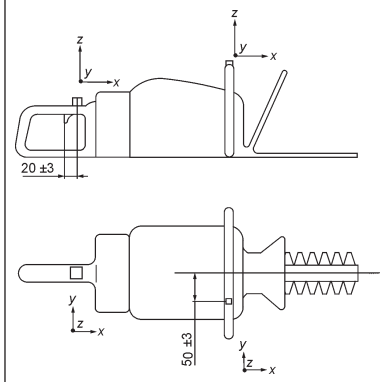
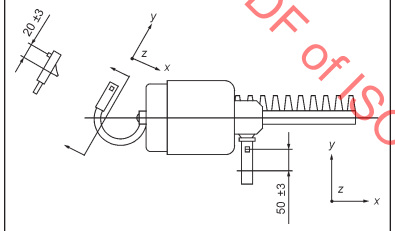
ISO standard	Type of machine	Mounting locations			Application to work-place measurement
ISO 22867:2011	Forestry and gardening machinery machines with internal combustion engine	 Chainsaw	 Brush-cutter or grass-trimmer with bicycle-type handles	 Brush-cutter or grass-trimmer with loop-type handle	When a chainsaw is used on its side, the measurement position on the top of the front handle shown here is not suitable. Workplace measurements should be made as close as possible to the centre of the gripping zone at the time of use of the machine. When the saw is used on its side, the hand position is moved around to the side of front handle. The transducer position must also be moved to follow this hand movement.
		 Hedge trimmer	 Hedge trimmer with lateral rear and front handles		

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Table A.1 *(continued)*

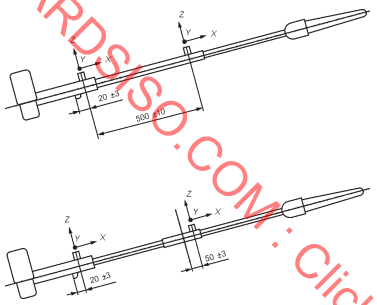
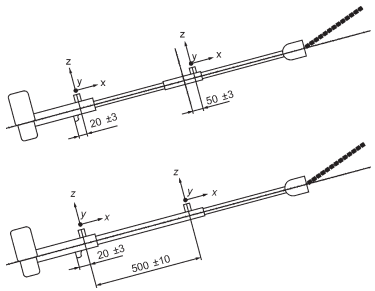
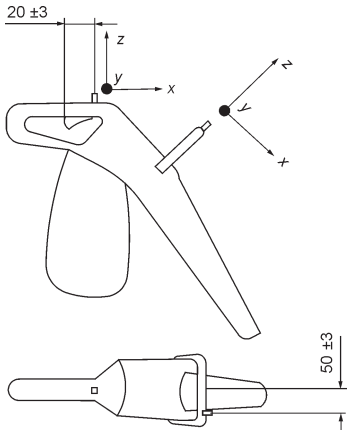
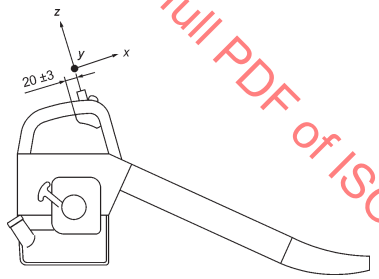
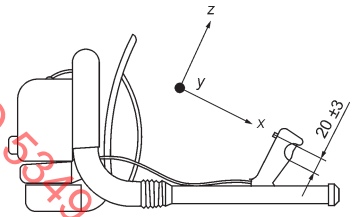
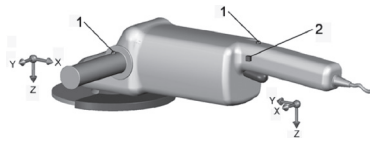
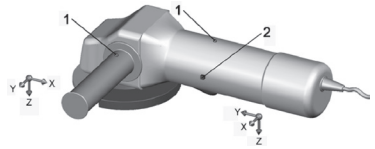
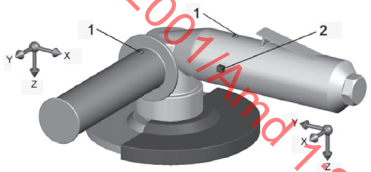
ISO standard	Type of machine	Mounting locations			Application to work-place measurement
ISO 22867:2011 (continued)	Forestry and gardening machinery machines with internal combustion engine	 Pole-mounted powered pruner	 Long-reach hedge trimmer		
		 Hand-held blower/vacuum with dual handles	 Hand-held blower with single handle	 Backpack blower/vacuum	
ISO 28927-1:2009	Angle and vertical grinders	 Electrical angle grinder with separate main handle	 Electrical angle grinder whose motor serves as main handle	 Pneumatic angle grinder whose motor serves as main handle	For workplace measure-ments, use of the prescribed location on the side handle (support handle) is likely to underestimate real workplace exposures.

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Table A.1 *(continued)*

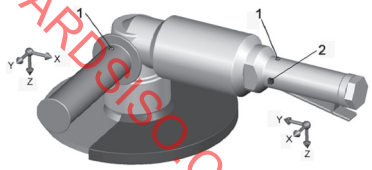
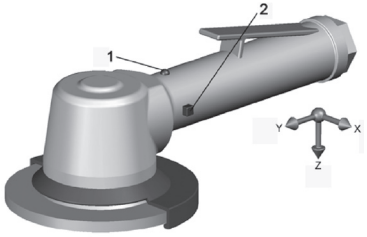
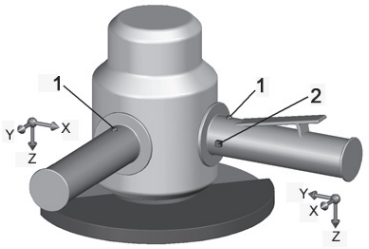
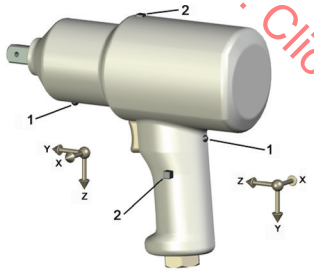
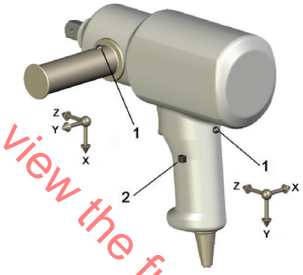
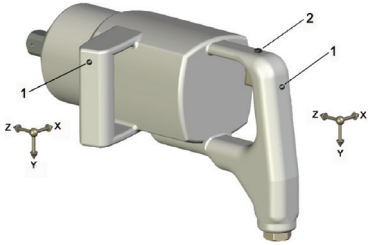
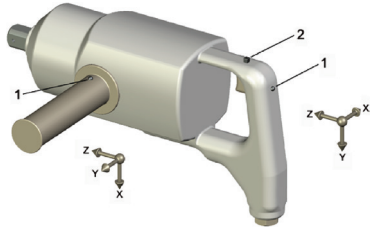
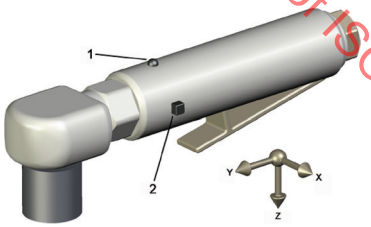
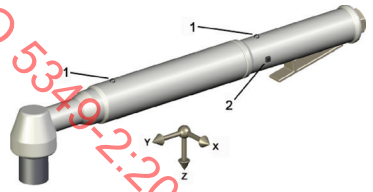
ISO standard	Type of machine	Mounting locations			Application to workplace measurement
ISO 28927-1:2009 (continued)	Angle and vertical grinders	 Pneumatic vertical grinder with separate main handle	 Angle grinder intended for one-handed operation	 Pneumatic vertical grinder	Workplace measurements should be made at the centre of the gripping zone of the side handle.
ISO 28927-2:2009	Wrenches, nutrunners and screwdrivers	 Impact wrench/impulse nutrunner with pistol grip	 Impact wrench/impulse nutrunner with pistol grip and support handle	 Impact wrench/impulse nutrunner with bow grip and bow shaped support handle	For workplace measurements, use of the prescribed location on the side handle (support handle) is likely to underestimate real workplace exposures. Workplace measurements should be made at the centre of the gripping zone of the side handle.
		 Impact wrench/impulse nutrunner with bow grip and straight support handle	 Ratchet wrench	 Angle nutrunner	

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Table A.1 *(continued)*

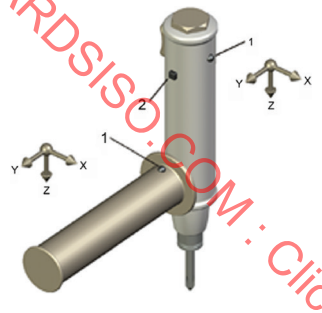
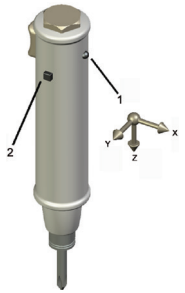
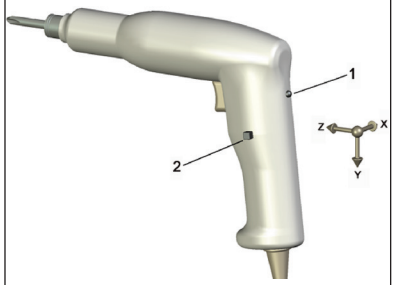
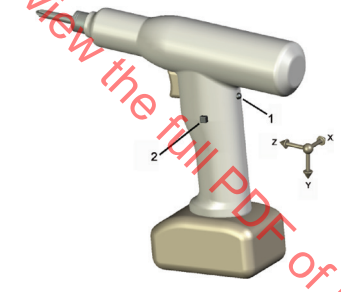
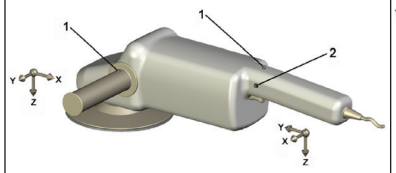
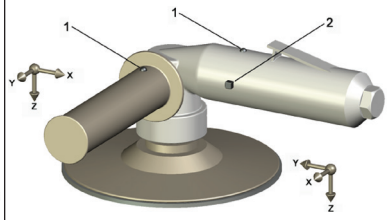
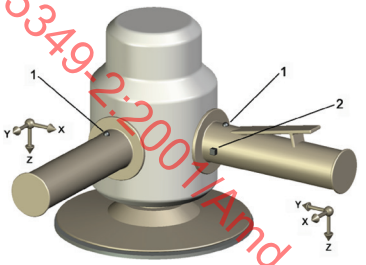
ISO standard	Type of machine	Mounting locations			Application to workplace measurement
ISO 28927-2:2009 (continued)	Wrenches, nutrunners and screwdrivers	 Straight screwdriver with support handle	 Straight screwdriver		For workplace measurements, use of the prescribed location on the side handle is likely to underestimate real workplace exposures. Workplace measurements should be made at the centre of the gripping zone of the side handle.
		 Screwdriver with drill-type pistol grip	 Screwdriver with balanced pistol grip		
ISO 28927-3:2009	Polishers and rotary, orbital and random orbital sanders	 Angle rotary sander/polisher with separate main handle	 Angle rotary sander/polisher where the motor serves as main handle	 Vertical sander/polisher	For workplace measurements, use of the prescribed locations on the side handles or the trigger handle of the vertical sander/polisher is likely to underestimate real workplace exposures.

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Table A.1 *(continued)*

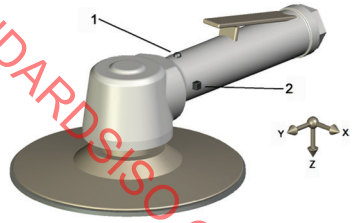
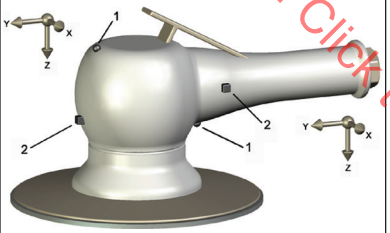
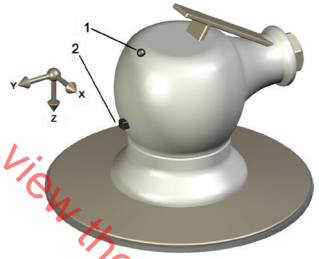
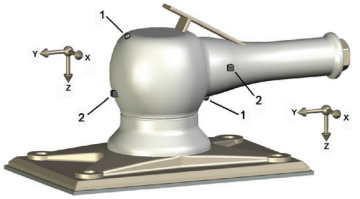
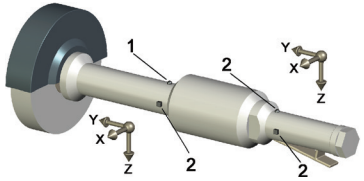
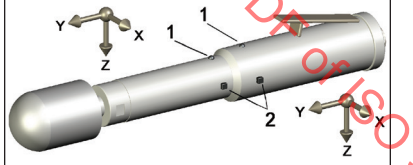
ISO standard	Type of machine	Mounting locations			Application to workplace measurement
ISO 28927-3:2009 (continued)	Polishers and rotary, orbital and random orbital sanders	 Angle sander/polisher intended for one-handed operation			Workplace measurements should be made at the centre of the gripping zone of the side handle.
		 Random orbital sander	 Palm sander	 Orbital sander with rectangular pad	
ISO 28927-4:2010	Straight grinders	 Straight grinder with type 1 wheel	 Straight grinder with type 18 wheel		For workplace measurements, use of the prescribed location on the front hand-position is likely to underestimate real workplace exposures. Workplace measurements should be made at the centre of the gripping zone.

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Table A.1 *(continued)*

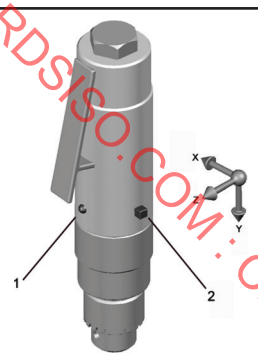
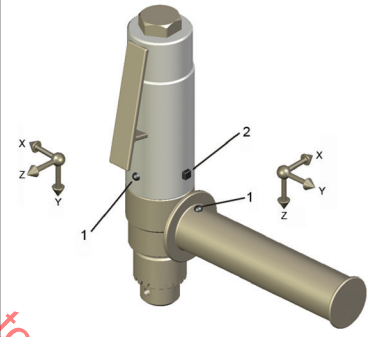
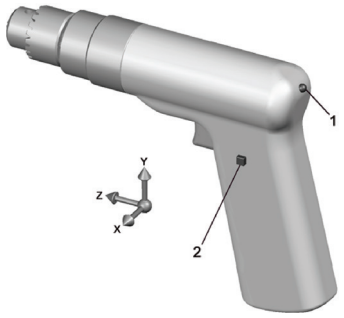
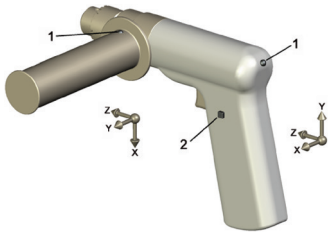
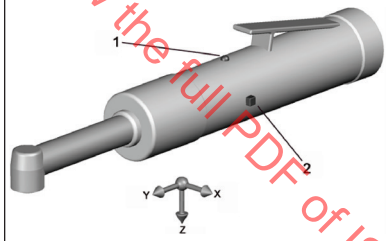
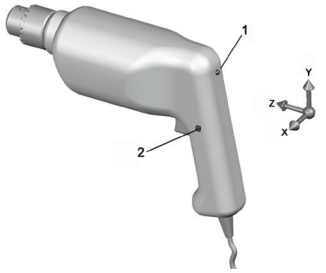
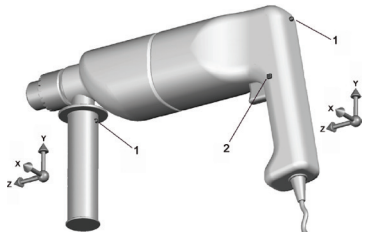
ISO standard	Type of machine	Mounting locations			Application to workplace measurement
ISO 28927-5:2009	Drills and impact drills	 Straight drill	 Straight drill with support handle	 Drill with pistol grip	For workplace measurements, use of the prescribed location on the side handle is likely to underestimate real workplace exposures. Workplace measurements should be made at the centre of the gripping zone of the side handle.
		 Drill with pistol grip and second handle	 Angle drill	 Impact drill	
		 Impact drill with second handle			

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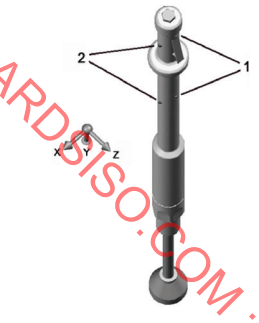
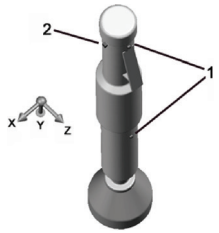
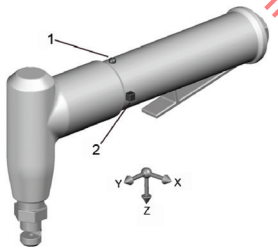
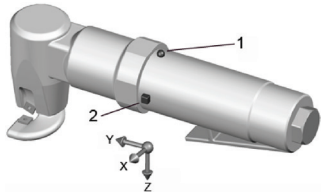
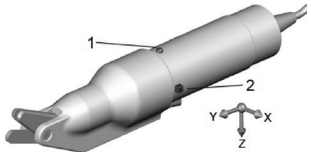
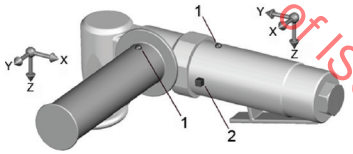
Table A.1 *(continued)*

ISO standard	Type of machine	Mounting locations			Application to work-place measurement
ISO 28927-6:2009	Rammers	 Rammer for use on floors	 Rammer for use on benches		
ISO 28927-7:2009	Nibblers and shears	 Nibbler	 Shears with pistol grip	 Shears for circular cutting	
		 Shears with straight handle	 Shears for circular cutting with support handle		For workplace measure-ments, use of the prescribed location on the side handle is likely to underestimate real workplace exposures. Workplace measurements should be made at the centre of the gripping zone of the side handle.

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