



BSI Standards Publication

## Hand-held portable power tools — Test methods for evaluation of vibration emission

---

Part 1: Angle and vertical grinders — Cupped wire brushes (ISO 28927-1:2009)

## National foreword

This British Standard is the UK implementation of EN ISO 28927-1:2009+A1:2017. It is identical to ISO 28927-1:2009, incorporating amendment 1:2017. It supersedes BS EN ISO 28927-1:2009, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee MCE/8/-/2, Hand-held, non-electric power tools - Safety.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2017  
Published by BSI Standards Limited 2017

ISBN 978 0 580 90316 8

ICS 25.140.01; 13.160; 25.140.10

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2009.

### Amendments/corrigenda issued since publication

| Date             | Text affected                                                       |
|------------------|---------------------------------------------------------------------|
| 30 November 2017 | Implementation of ISO amendment 1:2017 with CEN endorsement A1:2017 |

English Version

Hand-held portable power tools — Test methods for  
evaluation of vibration emission — Part 1: Angle  
and vertical grinders — Cupped wire brushes (ISO  
28927-1:2009)

Machines à moteur portatives — Méthodes  
d'essai pour l'évaluation de l'émission  
de vibrations — Partie 1: Meuleuses  
verticales et meuleuses d'angles — Broses  
métalliques creuses (ISO 28927-1:2009)

Handgehaltene motorbetriebene Maschinen —  
Messverfahren zur Ermittlung der  
Schwingungsemission — Teil 1: Winkelschleifer  
und Vertikalschleifer (ISO 28927-1:2009)

This European Standard was approved by CEN on 14 December 2009.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

## European foreword

This document (EN ISO 28927-1:2009) has been prepared by Technical Committee ISO/TC 118 "Compressors and pneumatic tools, machines and equipment" in collaboration with Technical Committee CEN/TC 231 "Mechanical vibration and shock" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 8662-4:1995.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives.

For relationship with EU Directives, see informative Annex ZA and ZB, which are integral parts of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

### Endorsement notice

The text of ISO 28927-1:2009 has been approved by CEN as EN ISO 28927-1:2009 without any modification.

---

## Foreword to amendment A1

This document (EN ISO 28927-1:2009/A1:2017) has been prepared by Technical Committee ISO/TC 118 "Compressors and pneumatic tools, machines and equipment" in collaboration with Technical Committee CEN/TC 231 "Mechanical vibration and shock" the secretariat of which is held by DIN.

This Amendment to the European Standard EN ISO 28927-1:2009 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2017, and conflicting national standards shall be withdrawn at the latest by November 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZA and ZB, included in EN ISO 28927-1:2009.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands,

Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**Endorsement notice**

The text of ISO 28927-1:1/Amd 1:2017 has been approved by CEN as EN ISO 28927-1:2009/A1:2017 without any modification.

## **Annex ZA** (informative)

### **Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC, amended by Directive 98/79/EC**

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 98/37/EC, Machinery, amended by Directive 98/79/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive, except ER 1.7.4 d) and 2.2, and associated EFTA regulations.

**WARNING Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.**

## **Annex ZB** (informative)

### **Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC**

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirement of that Directive, except ER 2.2.1.1, and associated EFTA regulations.

**WARNING** Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

## Contents

Page

|                                                                                                      |            |
|------------------------------------------------------------------------------------------------------|------------|
| <b>Foreword</b>                                                                                      | <b>vii</b> |
| <b>Introduction</b>                                                                                  | <b>ix</b>  |
| <b>1 Scope</b>                                                                                       | <b>1</b>   |
| <b>2 Normative references</b>                                                                        | <b>1</b>   |
| <b>3 Terms, definitions and symbols</b>                                                              | <b>1</b>   |
| 3.1 Terms and definitions                                                                            | 2          |
| 3.2 Symbols                                                                                          | 2          |
| <b>4 Basic standards and vibration test codes</b>                                                    | <b>3</b>   |
| <b>5 Description of the family of machines</b>                                                       | <b>3</b>   |
| <b>6 Characterization of vibration</b>                                                               | <b>5</b>   |
| 6.1 Direction of measurement                                                                         | 5          |
| 6.2 Location of measurements                                                                         | 5          |
| 6.3 Magnitude of vibration                                                                           | 8          |
| 6.4 Combination of vibration directions                                                              | 8          |
| <b>7 Instrumentation requirements</b>                                                                | <b>8</b>   |
| 7.1 General                                                                                          | 8          |
| 7.2 Mounting of transducers                                                                          | 9          |
| 7.2.1 Specification of transducer                                                                    | 9          |
| 7.2.2 Fastening of transducers                                                                       | 9          |
| 7.3 Frequency weighting filter                                                                       | 9          |
| 7.4 Integration time                                                                                 | 9          |
| 7.5 Auxiliary equipment                                                                              | 9          |
| 7.6 Calibration                                                                                      | 9          |
| <b>8 Testing and operating conditions of the machinery</b>                                           | <b>10</b>  |
| 8.1 General                                                                                          | 10         |
| 8.2 Operating conditions                                                                             | 10         |
| 8.2.1 Pneumatic machines                                                                             | 10         |
| 8.2.2 Hydraulic machines                                                                             | 10         |
| 8.2.3 Electrical machines                                                                            | 10         |
| 8.3 Other quantities to be specified                                                                 | 10         |
| 8.4 Attached equipment, work piece and task                                                          | 11         |
| 8.4.1 Test wheel                                                                                     | 11         |
| 8.4.2 Feed force                                                                                     | 12         |
| 8.4.3 Test procedure                                                                                 | 13         |
| 8.5 Operators                                                                                        | 14         |
| <b>9 Measurement procedure and validity</b>                                                          | <b>14</b>  |
| 9.1 Reported vibration values                                                                        | 14         |
| 9.2 Declaration and verification of the vibration emission value                                     | 14         |
| A1 9.3 Correction factor                                                                             | 15         |
| <b>10 Measurement report</b>                                                                         | <b>15</b>  |
| <b>Annex A (informative) Model test report for vibration emission of angle and vertical grinders</b> | <b>16</b>  |
| <b>Annex B (normative) Determination of uncertainty</b>                                              | <b>18</b>  |
| <b>Annex C (normative) Design of test wheel</b>                                                      | <b>20</b>  |
| <b>Bibliography</b>                                                                                  | <b>28</b>  |

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 28927-1 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

This first edition of ISO 28927-1, together with ISO 28927-4, cancels and replaces ISO 8662-4:1994, of which it constitutes a technical revision. The most important changes are

- vibration measurement in three axes and at both hand positions,
- new transducer positions,
- improved definition of transducer positions and orientation,
- straight grinders dealt with specifically by ISO 29827-4,
- rotational speed raised to no-load free running speed, and
- test wheels modified and their specification improved.

ISO 28927 consists of the following parts, under the general title *Hand-held portable power tools — Test methods for evaluation of vibration emission*:

- *Part 1: Angle and vertical grinders*
- *Part 2: Wrenches, nutrunners and screwdrivers* <sup>1)</sup>
- *Part 3: Polishers and rotary, orbital and random orbital sanders* <sup>2)</sup>
- *Part 4: Straight grinders* <sup>3)</sup>
- *Part 5: Drills and impact drills* <sup>4)</sup>

---

1) Replaces ISO 8662-7, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 7: Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action*. All screwdrivers and nutrunners except for one-shot tools now covered.

2) Replaces ISO 8662-8, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 8: Polishers and rotary, orbital and random orbital sanders*.

3) Together with Part 1, replaces ISO 8662-4, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 4: Grinders*

4) Replaces ISO 8662-6, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 6: Impact drills*. Non-impacting drills now covered.

- *Part 6: Rammers* <sup>5)</sup>
- *Part 7: Nibblers and shears* <sup>6)</sup>
- *Part 8: Saws, polishing and filing machines with reciprocating action and small saws with oscillating or rotating action* <sup>7)</sup>
- *Part 9: Scaling hammers and needle scalers* <sup>8)</sup>
- *Part 10: Percussive drills, hammers and breakers* <sup>9)</sup>
- *Part 11: Stone hammers* <sup>10)</sup>

---

5) Replaces ISO 8662-9, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 9: Rammers*.

6) Replaces ISO 8662-10, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 10: Nibblers and shears*.

7) Replaces ISO 8662-12, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 12: Saws and files with reciprocating action and saws with oscillating or rotating action*.

8) Together with Part 11, replaces ISO 8662-14, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 14: Stone-working tools and needle scalers*.

9) Replaces ISO 8662-2, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 2: Chipping hammers and riveting hammers*, ISO 8662-3, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 3: Rock drills and rotary hammers*, and ISO 8662-5, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 5: Pavement breakers and hammers for construction work*. Chipping and riveting hammers, rock drills and rotary hammers all covered.

10) Together with Part 9, replaces ISO 8662-14, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 14: Stone-working tools and needle scalers*.

## Introduction

This document is a type-C standard as stated in ISO 12100.

When requirements of this type-C standard are different from those which are stated in type-A or -B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

The vibration test codes for portable hand-held machines given in ISO 28927 are based on ISO 20643, which gives general specifications for the measurement of the vibration emission of hand-held and hand-guided machinery. ISO 28927 specifies the operation of the machines under type-test conditions and other requirements for the performance of type tests. The structure/numbering of its clauses follows that of ISO 20643.

The basic principle for transducer positioning first introduced in the EN 60745 series of European standards is followed, representing a deviation from ISO 20643 for reasons of consistency. The transducers are primarily positioned next to the hand in the area between the thumb and the index finger, where they give the least disturbance to the operator gripping the machine.

It has been found that vibrations generated by grinders vary considerably in typical use. This is largely due to the variances in the unbalance of the machine with the grinding wheel mounted. The unbalance also changes when the wheel is worn through operation.

In order to provide a method that gives good measurement reproducibility, the procedure adopted in this part of ISO 28927 uses a test wheel of known unbalance mounted on a machine and run under no-load conditions. The unbalance for the different types of test wheel are chosen to give vibration values that are as far as possible in accordance with ISO 20643. The procedures of ISO 5349 are required whenever exposure at the workplace is to be assessed.

Underestimation of the vibration for machines equipped with technical means to automatically reduce unbalances is taken into account by multiplying the vibration values of such machines with a correction factor of 1,3. <sup>[A1]</sup> For grinders that are intended to be used with cupped wire brushes, the vibration value is obtained by using a correction factor of 1,6. <sup>[A1]</sup>

The values obtained are type-test values intended to be representative of the average of the upper quartile of typical vibration magnitudes in real-world use of the machines. However, the actual magnitudes will vary considerably from time to time and depend on many factors, including the operator, the task and the inserted tool or consumable. The state of maintenance of the machine itself might also be of importance. Under real working conditions the influences of the operator and process can be particularly important at low magnitudes. It is therefore not recommended that emission values below 2,5 m/s<sup>2</sup> be used for estimating the vibration magnitude under real working conditions. In such cases, 2,5 m/s<sup>2</sup> is the recommended vibration magnitude for estimating the machine vibration.

If accurate values for a specific work place are required, then measurements (according to ISO 5349) in that work situation could be necessary. Vibration values measured in real working conditions can be either higher or lower than the values obtained using this part of ISO 28927.

Higher vibration magnitudes can easily occur in real work situations, caused by the use of excessively unbalanced grinding wheels, worn flanges or bent spindles.

The vibration test codes given in ISO 28927 supersede those given in ISO 8662, whose parts have been replaced by the corresponding parts of ISO 28927 (see Foreword).

NOTE ISO 8662-11, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 11: Fastener driving tools*, and ISO 8662-13, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 13: Die grinders*, could be replaced by future parts of ISO 28927.

*This page deliberately left blank*

# Hand-held portable power tools — Test methods for evaluation of vibration emission —

## Part 1:

## Angle and vertical grinders — Cupped wire brushes (ISO 28927-1:2009)

### 1 Scope

This part of ISO 28927 specifies a laboratory method for measuring hand-transmitted vibration emission at the handles of hand-held power-driven angle and vertical grinders. It is a type-test procedure for establishing the magnitude of vibration in the gripping areas of a machine fitted with a specified test wheel and run under no-load conditions. The method has been established for surface grinding tasks only. Cutting and sanding generally create lower vibrations. It is intended that the results be used to compare different models of the same type of machine.

This part of ISO 28927 is applicable to hand-held machines (see [Clause 5](#)), driven pneumatically or by other means, intended for grinding, cutting-off and rough sanding, with bonded, coated and super-abrasive products [\[A1\]](#) and with wire brushes [\[A1\]](#) for use on all kinds of materials. [\[A1\]](#) It is not applicable to die grinders or straight grinders. [\[A1\]](#)

NOTE To avoid confusion with the terms “power tool” and “inserted tool”, *machine* is used for the former throughout this document.

### 2 Normative references

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

ISO 2787:1984, *Rotary and percussive pneumatic tools — Performance tests*

ISO 5349:2001 (all parts), *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration*

ISO 5391:2003, *Pneumatic tools and machines — Vocabulary*

ISO 17066:2007, *Hydraulic tools — Vocabulary*

ISO 20643:2005, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

EN 755-2:2008, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 2: Mechanical properties*

EN 12096:1997, *Mechanical vibration — Declaration and verification of vibration emission values*

### 3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 5391, ISO 17066 and ISO 20643, and the following terms, definitions and symbols, apply.