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

**Part 1:
Angle and vertical grinders**

iTeh STANDARD PREVIEW
*Machines à moteur portatives — Méthodes d'essai pour l'évaluation de
l'émission de vibrations —
(standards.iteh.ai)*
Partie 1: Meuleuses verticales et meuleuses d'angles

ISO 28927-1:2009

<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 28927-1:2009

<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2009

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	2
3.1 Terms and definitions	2
3.2 Symbols.....	2
4 Basic standards and vibration test codes	3
5 Description of the family of machines	3
6 Characterization of vibration.....	5
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
7 Instrumentation requirements.....	8
7.1 General	8
7.2 Mounting of transducers	8
7.3 Frequency weighting filter.....	9
7.4 Integration time.....	9
7.5 Auxiliary equipment.....	9
7.6 Calibration	9
8 Testing and operating conditions of the machinery.....	9
8.1 General	9
8.2 Operating conditions	10
8.3 Other quantities to be specified.....	10
8.4 Attached equipment, work piece and task.....	10
8.5 Operators.....	13
9 Measurement procedure and validity.....	14
9.1 Reported vibration values	14
9.2 Declaration and verification of the vibration emission value	14
10 Measurement report	15
Annex A (informative) Model test report for vibration emission of angle and vertical grinders	16
Annex B (normative) Determination of uncertainty.....	18
Annex C (normative) Design of test wheel.....	20
Bibliography.....	26

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,
<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>
- 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 29827 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 screwdrivers¹⁾*
- *Part 3: Polishers and rotary, orbital and random orbital sanders²⁾*

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*.

- Part 4: Straight grinders³⁾
- Part 5: Drills and impact drills⁴⁾
- Part 6: Rammers⁵⁾
- Part 7: Nibblers and shears⁶⁾
- Part 8: Saws, polishing and filing machines with reciprocating action and small saws with oscillating or rotating action⁷⁾
- Part 9: Scaling hammers and needle scalers⁸⁾
- Part 10: Percussive drills, hammers and breakers⁹⁾
- Part 11: Stone hammers¹⁰⁾

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 28927-1:2009](https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009)

<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>

-
- 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.
- 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.

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 $2,5 \text{ m/s}^2$ be used for estimating the vibration magnitude under real working conditions. In such cases, $2,5 \text{ m/s}^2$ 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.

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

Part 1: Angle and vertical grinders

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 for use on all kinds of materials. It is not applicable to grinders used with wire brushes, nor is it applicable to die or straight grinders.

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.

3.1 Terms and definitions

3.1.1 grinder

machine driving a rotary output spindle adapted to carry an abrasive wheel/device for material removal

NOTE Adapted from ISO 5391:2003, definition 2.1.3.

3.1.2 angle grinder

grinder where the output spindle is at a given angle (usually a right angle) to the motor axis

[ISO 5391:2003, definition 2.1.3.3]

3.1.3 vertical grinder

grinder where the handle or handles are at an angle to the coaxially aligned motor and output spindle axis

[ISO 5391:2003, definition 2.1.3.2]

3.1.4 test wheel

aluminium wheel geometrically similar to a real grinding wheel, with holes on specified radii to give defined unbalances

iTeh STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>

<https://standards.iteh.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>

3.2 Symbols

Symbol	Description	Unit
a_{hw}	root-mean-square (r.m.s.) single-axis acceleration value of the frequency-weighted hand-transmitted vibration	m/s ²
a_{hv}	vibration total value of frequency-weighted r.m.s. acceleration; root sum of squares of a_{hw} values for the three measured axes of vibration	m/s ²
a_{hvmeas}	a_{hv} as measured during testing	m/s ²
a_{hvrat}	a_{hv} at rated no-load speed	m/s ²
$\overline{a_{hv}}$	arithmetic mean value of a_{hv} values of runs for one operator for one hand position	m/s ²
$\overline{a_h}$	arithmetic mean value of $\overline{a_{hv}}$ values for all operators for one hand position	m/s ²
$\overline{\overline{a_h}}$	arithmetic mean value of $\overline{a_h}$ values for one hand position on several machines	m/s ²
a_{hd}	declared vibration emission value	m/s ²
n_{meas}	measured no-load speed during testing with the test wheel mounted	r/min
n_{rat}	rated no-load speed: maximum rotational-speed of the machine according to the speed marking of the machine	r/min
s_{n-1}	standard deviation for a test series (for a sample, s)	m/s ²
σ_R	standard deviation of reproducibility (for a population, σ)	m/s ²
C_v	coefficient of variation for a test series	
K	uncertainty	m/s ²

4 Basic standards and vibration test codes

This part of ISO 28297 is based on the requirements of ISO 20643 and corresponds to its structure in respect of clause subjects and numbering except for the annexes.

Annex A presents a model test report, Annex B the means for determining the uncertainty, K , and Annex C specifies test wheel design.

5 Description of the family of machines

This part of ISO 28297 applies to hand-held machines fitted with guards, which are intended for grinding, cutting-off and rough sanding, with bonded, coated and super abrasive products for use on all kinds of materials.

For sanders without guards, see ISO 28927-3.

For applicable wheel types, as defined in ISO 603-14 and ISO 603-16, see Table 1.

The family of machines covered by this part of ISO 28297 comprises the following machines:

- angle and vertical grinders with type 27 wheels of diameters 80 to 300 mm; when the same guard is also used for type 41 cutting-off wheels then only the vibration value for the type 27 test wheel need be declared (see 8.4.1 for test wheel specifications);
- angle and vertical grinders with special guards for type 41 cut off wheels; the test shall be carried out using a type 27 test wheel (see 8.4.1 for test wheel specifications);
- angle and vertical grinders with special guards for stone cutting wheels; the test shall be carried out using the most appropriate wheel from the types described in Table 2;
- angle and vertical grinders for types 6 and 11 cup wheels with diameters 100 to 180 mm;
- angle and vertical grinders, as well as sanders, for fibre discs and flap wheels with diameters 80 to 300 mm.

Figures 1 to 6 show examples of typical grinders covered by this part of ISO 28927.

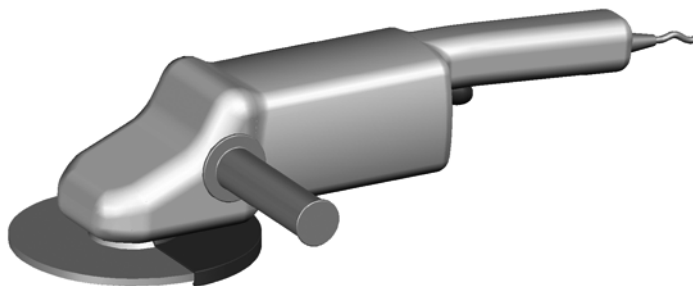


Figure 1 — Electrical angle grinder with separate main handle

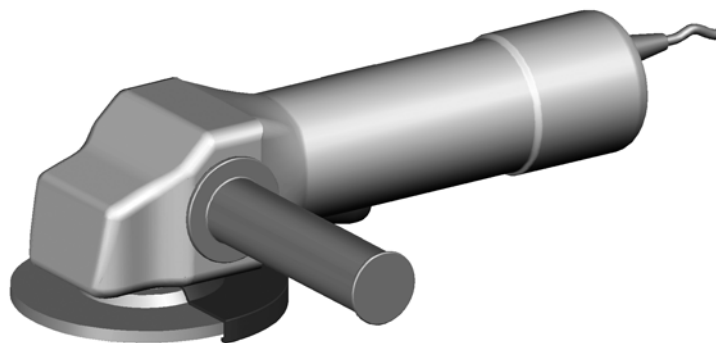


Figure 2 — Electrical angle grinder whose motor serves as main handle

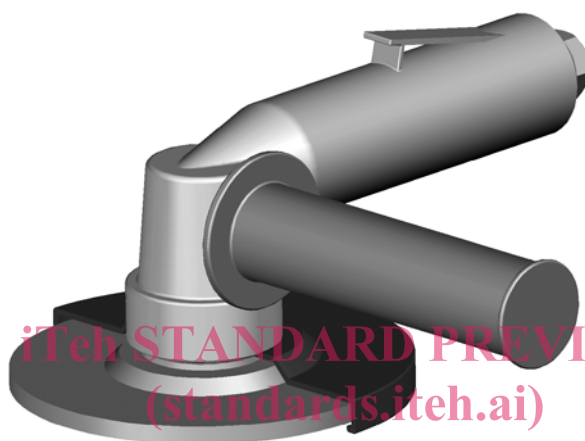


Figure 3 — Pneumatic angle grinder whose motor serves as main handle



Figure 4 — Pneumatic angle grinder with separate main handle

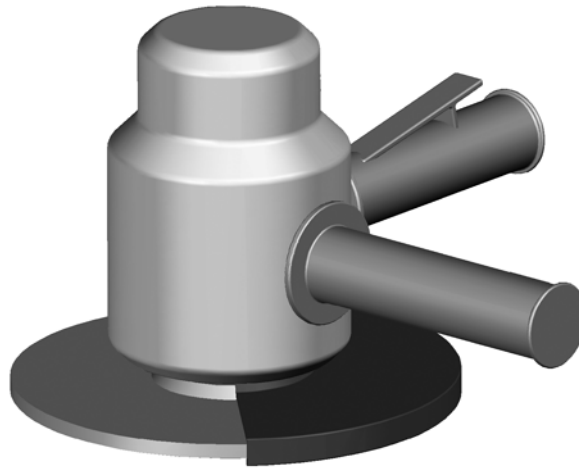


Figure 5 — Pneumatic vertical grinder

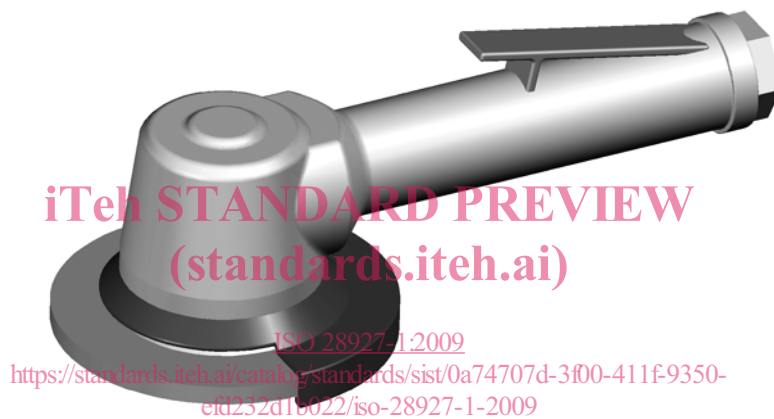


Figure 6 — Angle grinder intended for one-handed operation

6 Characterization of vibration

6.1 Direction of measurement

The vibration transmitted to the hand shall be measured and reported for three directions of an orthogonal coordinate system. At each hand position, the vibration shall be measured simultaneously in the three directions shown in Figures 7 to 12.

6.2 Location of measurements

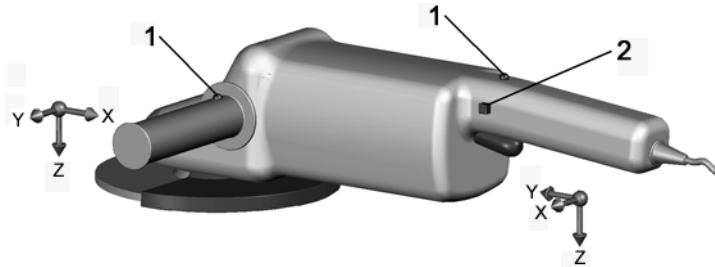
Measurements shall be made at the gripping zones, where the operator normally holds the machine and applies the feed force. For machines intended for one-handed operation, it is only necessary to measure at a single point.

The prescribed transducer location shall be as close as possible to the hand between the thumb and index finger. This shall apply to both hand positions, with the machine held as in normal operation. Whenever possible, measurements shall be made at the prescribed locations.

A secondary location is 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. If a prescribed location of the transducer cannot be used, this secondary location shall be used instead.

The prescribed or secondary locations shall also be used on anti-vibration handles.

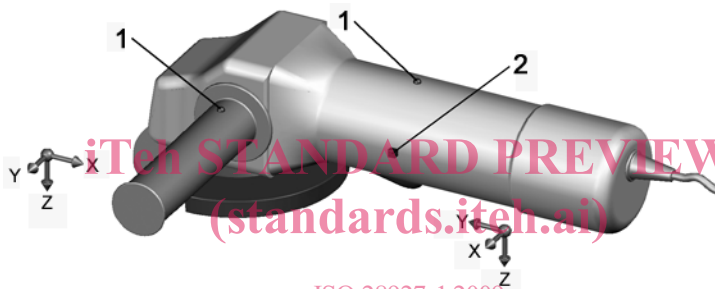
Figures 7 to 12 show the prescribed and secondary locations and measurement directions for the hand positions normally used for the different types of machines in this family.



Key

- 1 prescribed location
- 2 secondary location

Figure 7 — Measurement locations — Electrical angle grinder with separate main handle

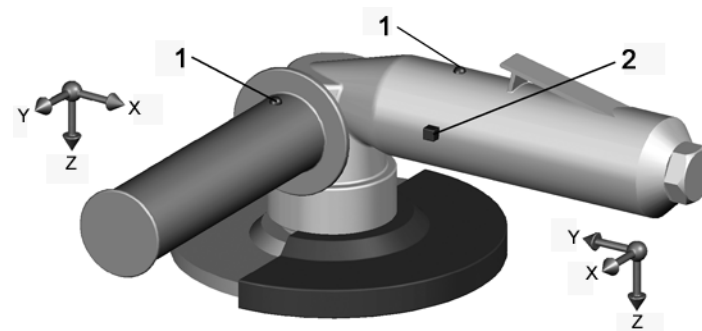


<https://standards.itech.ai/catalog/standards/sist/0a74707d-3f00-411f-9350-efd232d1b022/iso-28927-1-2009>

Key

- 1 prescribed location
- 2 secondary location

Figure 8 — Measurement locations — Electrical angle grinder whose motor serves as main handle



Key

- 1 prescribed location
- 2 secondary location

Figure 9 — Measurement locations — Pneumatic angle grinder whose motor serves as main handle