International Standard ISO 2787

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Rotary and percussive pneumatic tools — Performance tests

Machines pneumatiques rotatives, percutantes et roto-percutantes — Essais de fonctionnement

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2787 was developed by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, and was circulated to the member bodies in September 1982.

It has been approved by the member bodies of the following countries :

Austria	Germany, F. R.	Spain
Belgium	India	United Kingdom
Czechoslovakia	Mexico	USA
Egypt, Arab Rep. of	Netherlands	
France	Poland	

No member body expressed disapproval of the document.

This second edition cancels and replaces the first edition (i.e. ISO 2787-1974).

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Annexes

Rotary and percussive pneumatic tools — Performance tests

0 Introduction

This International Standard shows how information on hand-held pneumatic rotary tools, percussive tools and percussive tools with rotation should be obtained and presented.

Such information is valuable for the following purposes :

a) to enable manufacturers of pneumatic rotary and percussive tools to offer their products under similar technical specifications;

b) to help users to compare different tools and to select the right type and size for a specific task;

c) to instruct test personnel about how performance tests shall be carried out, according to specified conditions described in this International Standard.

1 Scope and field of application

This International Standard specifies a method of performance tests and technical conditions for the supply of pneumatic tools and gives detailed instructions on the measurement of power output and air consumption and means of adjusting the measured values to specified conditions.

2 References

ISO 31, *Quantities, units and symbols.*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 1180, *Shanks for pneumatic tools and fitting dimensions of chuck bushings.*[1]

ISO 2944, *Fluid power systems and components — Nominal pressures.*

ISO 3857/1, *Compressors, pneumatic tools and machines — Vocabulary — Part 1 : General.*

ISO 3857/3, *Compressors, pneumatic tools and machines — Vocabulary — Part 3 : Pneumatic tools and machines.*

ISO 5167, *Measurement of fluid flow by means of orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full.*

ISO 5391, *Compressors, pneumatic tools and machines — Classification.*[2]

ISO 5393, *Rotary pneumatic tools for threaded fasteners — Performance test.*

ISO 6544, *Hand-held pneumatic assembly tools for installing threaded fasteners — Reaction torque and torque impulse measurements.*

1) At present at the stage of draft. (Revision of ISO/R 1180-1970.)

2) At present at the stage of draft.

3 Definitions

3.1 Definitions of some general physical terms

3.1.1 total pressure : The pressure measured on the stagnation point when a moving gas stream is brought to rest and its kinetic energy is converted by an isentropic compression from the flow condition to the stagnation condition. It is the pressure usually measured by a Pitot tube. In a stationary body of gas the static and the total pressures are numerically equal.

3.1.2 static pressure : The pressure measured in a gas in such a manner that no effect on measurement is produced by the gas velocity.

3.1.3 dynamic (velocity) pressure : The total pressure minus the static pressure.

3.1.4 atmospheric pressure : The absolute pressure of the atmosphere measured at the test place.

3.1.5 gauge (effective) pressure : The pressure measured above the atmospheric pressure.

3.1.6 absolute pressure : The pressure measured from absolute zero, i.e. from an absolute vacuum. It equals the algebraic sum of atmospheric pressure and gauge pressure.

3.1.7 free air : Air at the atmospheric conditions of the site.

3.1.8 total temperature : The temperature which would be measured at the stagnation point if a gas stream were brought to rest and its kinetic energy converted by an isentropic compression from the flow condition to the stagnation condition.

The temperature rise at stagnation of the gas stream can be neglected if the gas velocity around the measuring point is lower than 30 m/s.

3.2 Definitions concerning rotary air motor torque performance

3.2.1 static starting torque : The torque that continues to be developed by the motor in response to an application of fluid pressure when the torque load is sufficient to prevent rotation.

NOTE — The value may depend upon the angular position of the motor shaft. The maximum static starting torque is the value obtained when the angular position of the motor shaft is in the most advantageous location. The minimum static starting torque is the value obtained when the angular position of the motor shaft is in the least advantageous location.

3.2.2 dynamic starting torque : The peak torque delivered by the output shaft of the motor in response to an application of fluid pressure when the torque load is sufficient to prevent rotation.

NOTE — The dynamic starting torque will often be in excess of the static starting torque where lost motion exists between the motor shaft and the load, allowing rotation and momentum to develop prior to application of the load.

3.2.3 brake loaded torque : The continuous torque delivered at a constant speed.

3.2.4 maximum brake loaded torque : The maximum continuous torque that can be delivered at a constant speed.

3.2.5 static stall torque : The torque that continues to be developed after a load has stalled the motor.

NOTE — The value may depend upon the angular position of the motor shaft in the stalled position. The maximum static stall torque is the value obtained when the angular position of the motor shaft is in the most advantageous location. The minimum static stall torque is the value obtained when the angular position of the motor shaft is in the least advantageous location.

3.2.6 dynamic stall torque : The peak torque delivered by the output shaft when a load is applied that stalls the motor.

NOTE — The peak torque will vary, depending upon the rate of deceleration caused by the load.

4 Symbols and units

These are in accordance with ISO 31 and ISO 1000.

4.1 General rules for letter symbols

The use of the letter symbols given in 4.2 and 4.3 is recommended. The list is formulated in line with the following seven principles :

a) the same symbols shall be used for the same quantities regardless of the system of units;

b) for any one quantity a single symbol shall be used with subscripts to indicate readings other than the primary one;

c) the same symbols shall be used for a given concept regardless of the number of special values which occur;

d) letter subscripts shall be used to denote values under special conditions;

e) numerical subscripts shall be used to denote values at different points of a cycle;

f) symbols shall be confined if possible to roman letters;

g) where possible, capital letters shall be used for absolute quantities.

4.2 Letter symbols and units

Symbol	Quantity	Unit
D	Piston diameter	mm
d	Pipe or hose internal diameter	mm
e	Impact	J
F	Force	N
L	Length	m or mm
M	Torque	Nm
m	Mass	kg
P	Power	kW
N	Number of tools	—
n	Shaft speed	min^{-1}
f	Blow rate	Hz
p	Absolute pressure	bar*
p_e	Gauge pressure (effective pressure) — $p_e = p - p_b$	bar
p_b	Atmospheric pressure	bar
q_V	Volume flow rate	l/s
s	Standard deviation	—
S	Stroke	mm

4.3 Subscripts

0	Ambient conditions
av	Average value
max	Maximum value
min	Minimum value
s	Starting conditions (n or f = 0)
i	No-load conditions
P	Conditions at stated power output

* 1 bar = 10^5 Pa.

5 Classification of pneumatic tools

5.1 Description of the pneumatic tools

	Symbol	Explanatory comments
5.1.1 Type of pneumatic tool		Manufacturer's type designation
5.1.2 Standard equipment		Pneumatic tool including tool holder as well as all devices for the prevention of accidents and noise but without working tools, coupling hose fitting, hose and support
5.1.3 Mass of the pneumatic tool	m	Mass of the normally equipped tool defined as in 5.1.2
5.1.4 Dimensions of the pneumatic tool		In all cases the overall length of the pneumatic tool will be shown together with such other dimensions as are appropriate to the particular type of pneumatic tool
5.1.5 Piston diameter and mass	D m_p	Dimension of the striking piston at its largest outside diameter and its mass
5.1.6 Theoretical piston stroke	S	Possible axial movement of the piston in the working chamber with the tool shank fully inserted
5.1.7 Recommended hose, inner diameter and length	d L_h	Smallest inside diameter and length of the supply hose and of the necessary fittings

	Explanatory comments
5.1.8 Type and dimensions of the working tool	According to ISO 1180
5.1.9 Tool shank and chuck bushing	According to ISO 1180
5.1.10 Tool retainer	
5.1.11 Special and optional features	Flushing, dry suction, etc.

5.2 Tool performance data

	Symbol
5.2.1 Compressed air pressure for which test data are valid (recommended compressed air pressure)	p
5.2.2 Power output	P
5.2.3 Air consumption at given power output	q_{VP}
5.2.4 Air consumption, no-load	q_{Vi}
5.2.5 Rotational speed at given power output	n_P
5.2.6 Torque at given power output	M_P
5.2.7 Starting torque	
maximum	$M_{s\,max}$
minimum	$M_{s\,min}$

NOTE — It should be clearly stated which starting torque is referred to according to 3.2.

5.2.8 Rotational speed under no-load or blow rate under no-load	n_i f_i
5.2.9 Impact energy	e
5.2.10 Blow rate	f
5.2.11 Maximum tightening torque	M_a

5.3 Data to be given for different types of tool

In principle, all data in accordance with 5.1 and 5.2 which are applicable to the pneumatic tool under consideration shall be given in the description of the tool.

5.3.1 Percussive pneumatic tools without rotation

- Type of pneumatic tool (5.1.1)
- Standard equipment (5.1.2)
- Mass of the pneumatic tool (5.1.3)
- Dimensions of the pneumatic tool (5.1.4)
- Piston diameter and mass (5.1.5)
- Theoretical piston stroke (5.1.6)
- Recommended hose, inner diameter and length (5.1.7)
- Type and dimensions of the working tool (5.1.8)
- Tool holder (5.1.9)
- Tool retainer (5.1.10)
- Recommended compressed air pressure (5.2.1)
- Air consumption under load (5.2.3)
- Impact energy (5.2.9)
- Blow rate (5.2.10)

5.3.2 Percussive pneumatic tools with rotating device (for example, rock drills)

- Type of pneumatic tool (5.1.1)
- Standard equipment (5.1.2)
- Mass of the pneumatic tool (5.1.3)
- Dimensions of the pneumatic tool (5.1.4)
- Piston diameter and mass (5.1.5)
- Theoretical piston stroke (5.1.6)
- Recommended hose, inner diameter and length (5.1.7)
- Type and dimensions of the working tool (5.1.8)
- Tool holder (5.1.9)
- Tool retainer (5.1.10)
- Special and optional features (5.1.11)
- Recommended compressed air pressure (5.2.1)
- Air consumption under load (5.2.3)
- Impact energy (5.2.9)
- Blow rate (5.2.10)
- Rotational frequency (5.2.10)

5.3.3 Rotary pneumatic tools

- Type of pneumatic tool (5.1.1)
- Standard equipment (5.1.2)
- Mass of the pneumatic tool (5.1.3)
- Dimensions of the pneumatic tool (5.1.4)
- Type and dimensions of the working tool (5.1.8)
- Tool holder (5.1.9)
- Tool retainer (5.1.10)
- Special and optional features (5.1.11)
- Recommended compressed air pressure (5.2.1)
- Power output, maximum (5.2.2)
- Air consumption under load (5.2.3)

- Air consumption at no-load (5.2.4)
- Rotational speed under load (5.2.5)
- Rotational speed at no-load (5.2.8)

5.3.4 Pneumatic screwdrivers and nutrunners

- Type of pneumatic tool (5.1.1)
- Standard equipment (5.1.2)
- Mass of the pneumatic tool (5.1.3)
- Dimensions of the pneumatic tool (5.1.4)
- Type and dimensions of the working tool (5.1.8)
- Tool holder (5.1.9)
- Tool retainer (5.1.10)
- Special and optional features (5.1.11)
- Recommended compressed air pressure (5.2.1)
- Power output, maximum (5.2.2)
- Air consumption at no-load (5.2.4)
- Maximum starting torque (5.2.7)
- Rotational speed at no-load (5.2.8)

6 Methods for measurement of tool performance data

6.1 General rules for performance test on pneumatic tools

6.1.1 All measurements carried out in compliance with this International Standard shall be performed by competent persons and with accurate instrumentation which is calibrated against existing standards or standard methods.

6.1.2 The performance of pneumatic tools is affected by different ambient conditions such as atmospheric pressure and temperature. Moreover, the temperature of the compressed air influences the behaviour of the tool. Test conditions should be in the range of values given below :

- Atmospheric pressure 960 ± 100 mbar
- Ambient temperature 20 ± 2 °C
- Compressed air temperature 20 ± 5 °C

During the test run with the tool, the temperature shall be kept as close as possible to the test conditions. Any deviation shall be stated in the test report. Tests shall be avoided if the atmospheric pressure deviates from the given conditions.

6.1.3 In general pneumatic tools shall be tested at an effective (gauge) air pressure of 6,3 ± 0,15 bar. If the tool has been designed for a different pressure (for example 4 bar) this may be used and shall be stated in the test report. The working pressure shall be maintained under all test conditions.

6.1.4 The point of pressure measurement (see also 6.2.4) depends on the type of tool used.

6.1.4.1 Rotary tools

The compressed air working pressure shall be measured immediately upstream of the tool.

6.1.4.2 Percussion tools

With regard to pulsating air flow during performance tests, the length of the connecting hose from the point of pressure measurement to the tool shall be at least 3 m and preferably close to this figure. Hose diameter shall be stated in the test report.

6.1.5 All performance data concerning pressure, number of revolutions and blows, power output and blow energy etc., shall refer to the same running conditions unless stated otherwise.

6.1.6 During the test run of the tool, the quality and quantity of lubricant recommended by the manufacturer shall be used.

6.1.7 Due to manufacturing tolerances, even tools of the same type give different performance data. To obtain performance data for the type, it is necessary to test a number of tools (minimum five) and state the arithmetical average value.

6.2 Pressure

6.2.1 Accurate measurement of the compressed air pressure to the pneumatic tool is of very great importance since the tool performance is strongly influenced by this factor.

6.2.2 For measurement of air pressure, gauges of any suitable type could be used. The gauges selected shall be of such size and quality that 0,5 % pressure difference of full scale reading can be read easily. The pressures to be read shall fall between one-fourth and three-fourths of full scale reading. The pressure gauge shall be checked and calibrated as often as necessary to make certain that sufficient accuracy is attained. For the calibration, dead-weight gauges can be used.

6.2.3 The compressed air pressure to the tool shall be measured as total pressure at the inlet of the tool hose as specified in the description of the tool, 5.1.7. This means that the air shall be at rest without any velocity or have a velocity small enough to give a negligible dynamic pressure. This means, in turn, that the velocity of the air at the point of the supply line where the pressure is to be measured shall not be higher than 15 m/s at 7,3 ± 0,15 bar absolute pressure. In order to avoid the effect of pressure drop due to supply line losses, pressure measurements shall be carried out with the tool running.