INTERNATIONAL STANDARD

ISO 8662-7

First edition
1997-07-01

Hand-held portable power tools — Measurement of vibrations at the handle —

Part 7:
Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action

Machines à moteur portatives — Mesurage des vibrations au niveau des poignées —

Partie 7: Clés, tournevis et serreuses à percussion, à impulsion ou à cliquet

Reference number
ISO 8662-7:1997(E)

Contents

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X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

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.

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.

International Standard ISO 8662-7 was prepared by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, subcommittee SC 3, *Pneumatic tools and machines*.

ISO 8662 consists of the following parts, under the general title *Hand-held portable power tools — Measurement of vibrations at the handle:*

— *Part 1: General*

— *Part 2: Chipping hammers and riveting hammers*

— *Part 3: Rock drills and rotary hammers*

— *Part 4: Grinders*

— *Part 5: Pavement breakers and hammers for construction work*

— *Part 6: Impact drills*

— *Part 7: Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action*

— *Part 8: Polishers and rotary, orbital or random sanders*

— *Part 9: Rammers*

— *Part 10: Nibblers and shears*

— *Part 11: Fastener driving tools (nailers)*

— *Part 12: Saws and files with reciprocating action and saws with oscillating or rotating action*

— *Part 13: Die grinders*

— *Part 14: Stone-working tools and needle scalers*

Annexes A and B of this part of ISO 8662 are for information only.

Introduction

This part of ISO 8662 specifies how a type test for the measurement of vibrations at the handles of wrenches, screwdrivers and nut runners with impact, impulse or ratchet action shall be performed. It supplements ISO 8662-1, which gives the general specifications for the measurement of vibrations at the handle of portable hand-held power tools. It specifies the operation of the power tool under type test and other requirements for the performance of the type test.

The power tools described in this part of ISO 8662 are used for tightening and untightening threaded fasteners, i.e. nuts and screws. The principle of the operation of these power tools is that the energy from the driving medium causes a rotor to transmit energy incrementally by impact or impulse from a rotary or oscillatory action to the output shaft. The clutch mechanisms and power tool geometry differ among different power tool types, and therefore give different types of force reaction and vibration to the operator's hand.

In impact and ratchet power tools, the clutches are generally all metallic. In impact power tools, the number of impacts on the output shaft per revolution of the motor is typically one or two, whereas in ratchet power tools this number is greater. The clutches of impulse power tools generally contain a fluid which is forced through one or more restrictive passageways each time the motor rotates relative to the output shaft.

The reproducibility determined from a great number of tests in which the power tools were operated in typical work situations was found to be poor, and the possibility of improving it is small. It was therefore concluded that the type test must be carried out using an artificial load, so chosen that the values measured correspond to those found in typical work situations. The reproducibility of the proposed method has been found to be good.

Higher vibration magnitudes can easily occur in real work situations, caused either by misalignment between the power tool and fastener, or by the use of universal joints or angle heads.

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Hand-held portable power tools — Measurement of vibrations at the handle —

Part 7:
Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action

1 Scope

This part of ISO 8662 specifies a laboratory method for measuring vibrations at the handles of wrenches, screwdrivers and nut runners with impact, impulse, rapping or ratchet action. It is a type-test procedure for establishing the vibration value at the handles of the power tools when operating on a specified load.

This part of ISO 8662 mainly covers power tools with 6,3 mm to 40 mm (1/4 in to 1 1/2 in) male or female square-drive output shafts; other drive geometries are also included. One-shot tools and stall-torque-type ratchet wrenches are excluded from this part of ISO 8662.

The power tools covered by this part of ISO 8662 may be pneumatically or hydraulically driven.

It is intended that the results be used to compare different power tools or different models of the same power tool. With the operation specified for the power tools, the values obtained will give an indication of those found in real work situations when the power tool and the head of the fastener are well aligned.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8662. All standards are subject to revision, and parties to agreements based on this part of ISO 8662 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 691:—[1], *Assembly tools for screws and nuts — Wrench and socket openings — Tolerances for general use.*

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

ISO 8662-1:1988, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General.*

1) To be published. (Revision of ISO 691:1983)

3 Quantities to be measured

Quantities to be measured are as follows:

a) the root-mean-square (r.m.s.) acceleration in accordance with ISO 8662-1:1988, 3.1, and presented as a weighted acceleration in accordance with ISO 8662-1:1988, 3.3 and as a frequency analysis in accordance with ISO 8662-1:1988, 3.2;

NOTE — Frequency analysis can be deleted if the absence of d.c.-shift can be proved by other means.

b) the air or hydraulic pressure;

c) the blow frequency;

d) the feed force;

e) the rotational frequency.

4 Instrumentation

4.1 General

The specifications for the instrumentation given in ISO 8662-1:1988, 4.1 to 4.6 apply.

4.2 Transducer

The specification for the transducer given in ISO 8662-1:1988, 4.1 applies.

NOTE — For light handles, for example made of plastics, care must be taken not to load the handle with too large a mass when mounting the transducer. If the handle acts as a mechanical filter, then a light transducer may be glued to the surface; in this case the mass of transducer and its mounting shall be less than 5 g.

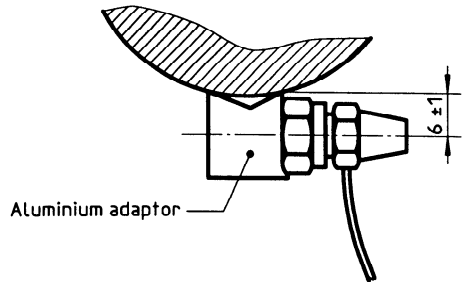
4.3 Mechanical filters

If piezoelectric accelerometers are used, the use of mechanical filters as specified in ISO 8662-1:1988, 4.3, is strongly recommended.

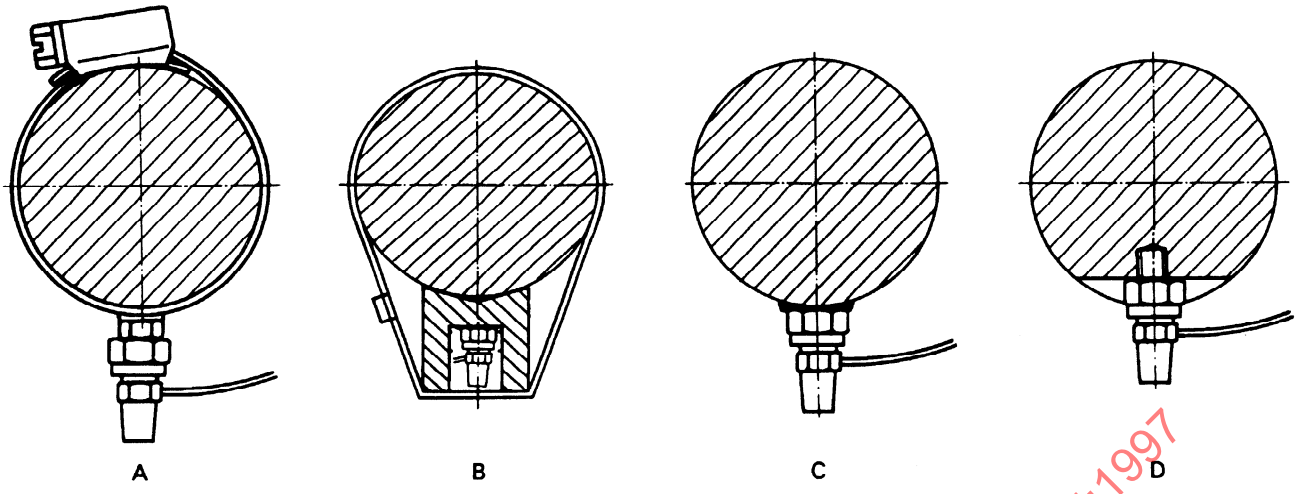
4.4 Fastening of the transducer

Fastening of the transducer and mechanical filter on the power tool control handle shall be in accordance with ISO 8662-1:1988, 4.2 (see figure 1).

Dimension in millimetres



a) Adaptor fastening to be used for straight control-handle. The adaptor may be clamped with hose clips or glued to the surface.



b) For pistol control-handle, bow control-handle or straight support-handle, the transducer may be mounted in one of four ways:

A: Using a hose clip to which a block is brazed or welded;
B: Using an adaptor to which the transducer is screwed; the adaptor is mounted with the use of plastic straps;
C: Using a suitable adhesive wax on a flat surface;
D: Grinding a flat surface and drilling and tapping a hole.

Figure 1 — Options for the fastening of transducers

4.5 Auxiliary equipment

The supply air pressure shall be measured using a precision class pressure gauge in accordance with ISO 2787. The hydraulic pressure shall be measured with the same accuracy as the air pressure.

A scale having an accuracy of at least ± 1 N shall be used when measuring the feed force.

The blow frequency of the power tool during the test can be determined by an electronic filter, using the signal from the vibration transducer or other suitable means.

4.6 Calibration

Calibration shall be carried out in accordance with ISO 8662-1:1988, 4.8.

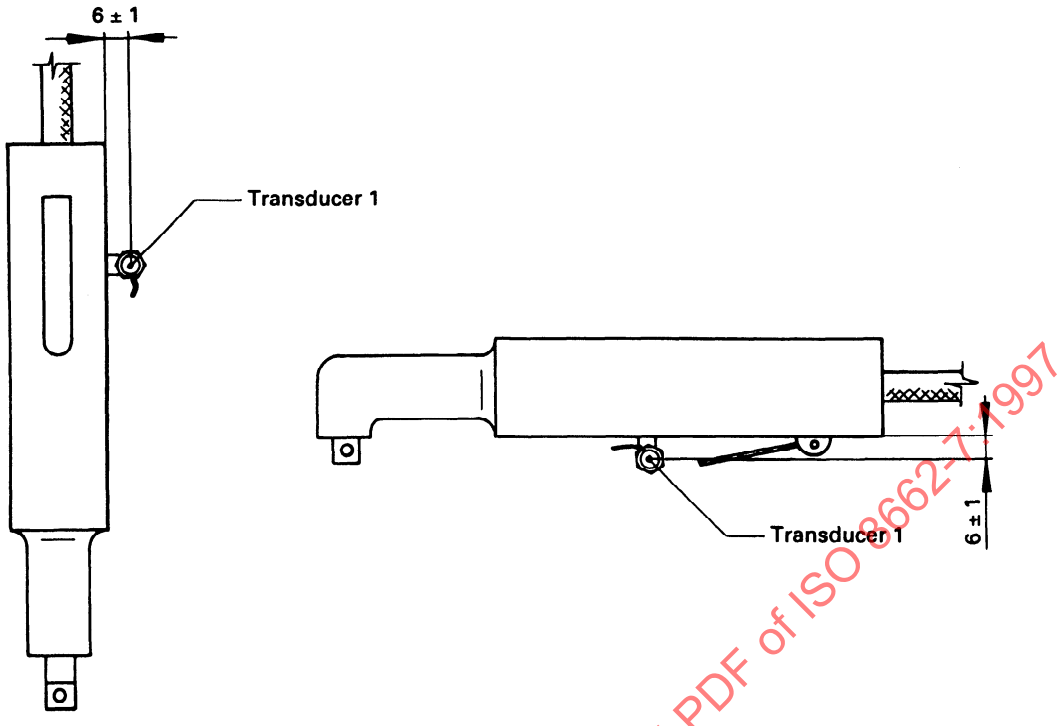
5 Measurement direction and measurement location

For different types of power tools, measurements shall be made in the directions and locations illustrated in figure 2.

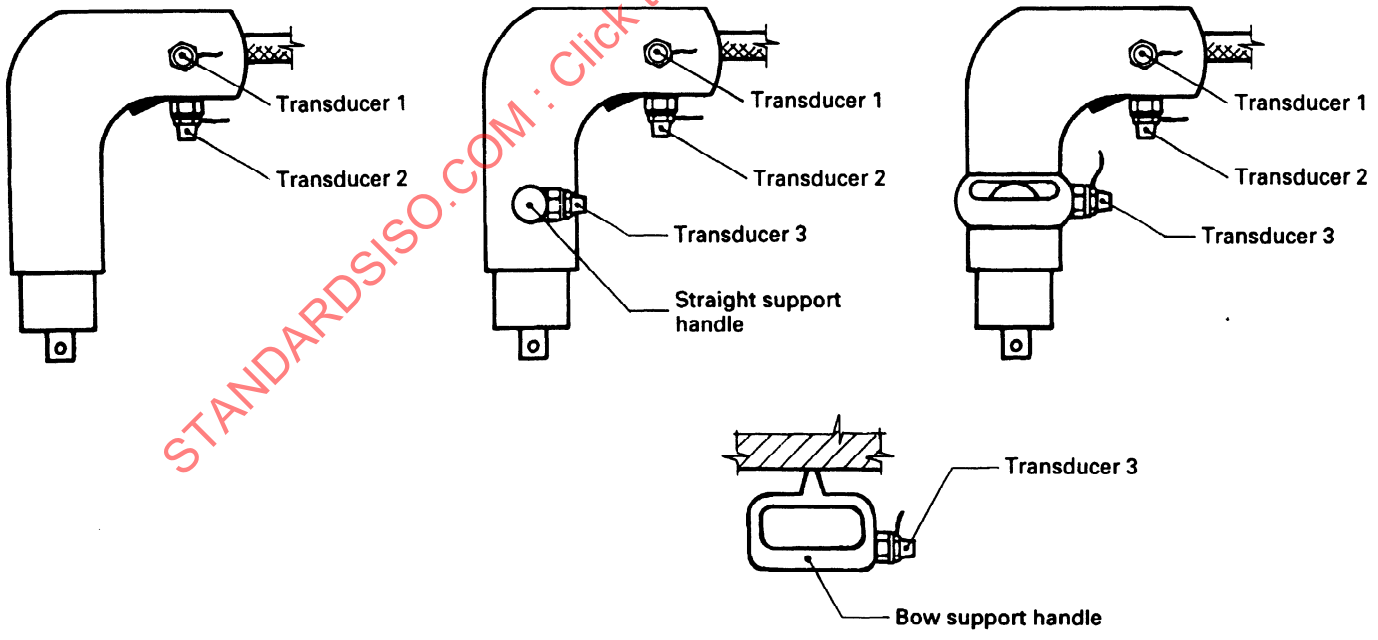
Measurements shall be made on the handle/handles, where the operator normally holds the power tool. The normal position of the transducer shall be halfway along the length of the handle. If the placing of the trigger makes this impossible, then the transducer shall be placed as close as possible to this position.

For straight control-handle power tools, the transducer shall be located so as to measure the acceleration on the power tool surface in a tangential direction relative to the motor shaft. The transducer shall therefore be located in accordance with figures 1 a) and 2 a) at a distance of (6 ± 1) mm from the surface of the power tool.

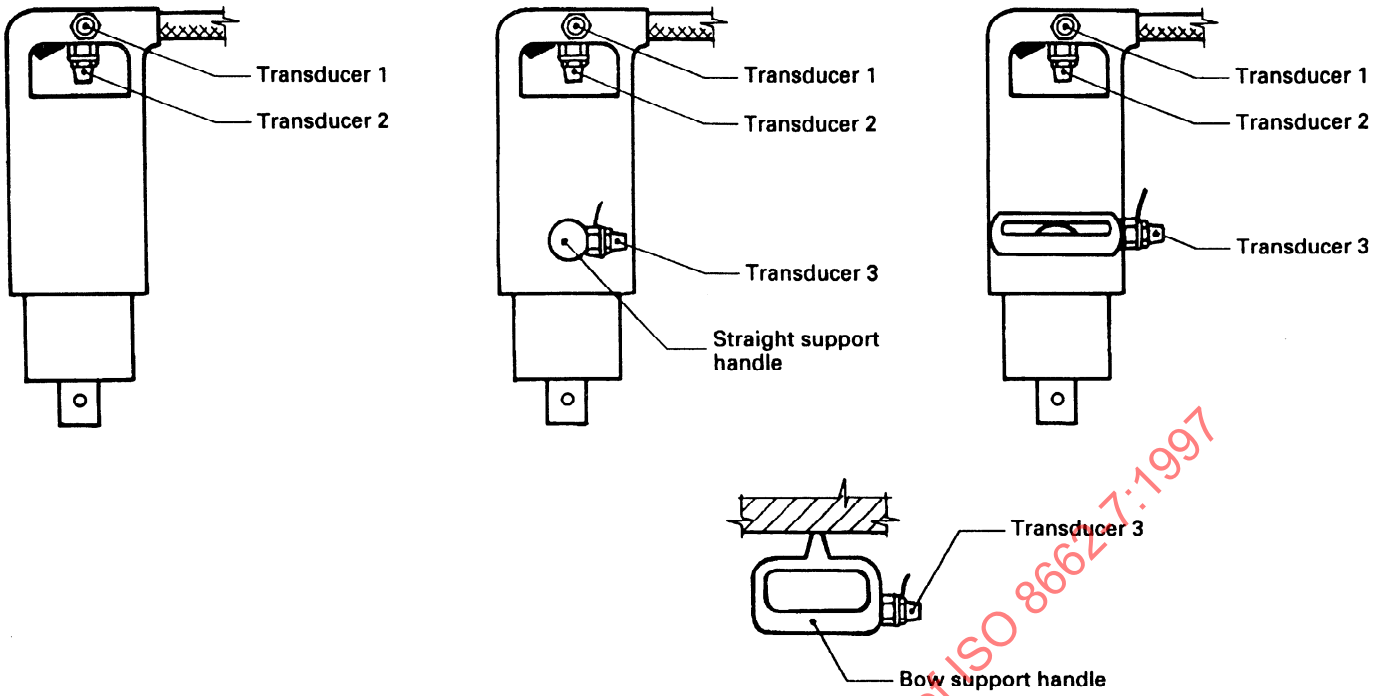
Dimensions in millimetres



a) Straight control-handle power tools, i.e. the control handle is parallel with the motor shaft. The output shaft may be coaxial with or at an angle to the motor shaft.



b) Pistol control-handle power tools, with or without support handle. The output shaft may be coaxial with or at an angle to the motor shaft.



c) Bow control-handle power tools, with or without support handle. The output shaft may be coaxial with or at an angle to the motor shaft.

Figure 2 — Measurement direction and examples of position of transducers

6 Determination of working procedure

6.1 General

Measurements shall be carried out on a new, properly serviced and lubricated power tool.

For hydraulic power tools, a warmup time of about 10 min should be allowed before starting the measurements. For pneumatic power tools, no such warmup period is necessary. All clutches shall be warmed up for about 20 s by operating the tool against the loading device described in 6.2.

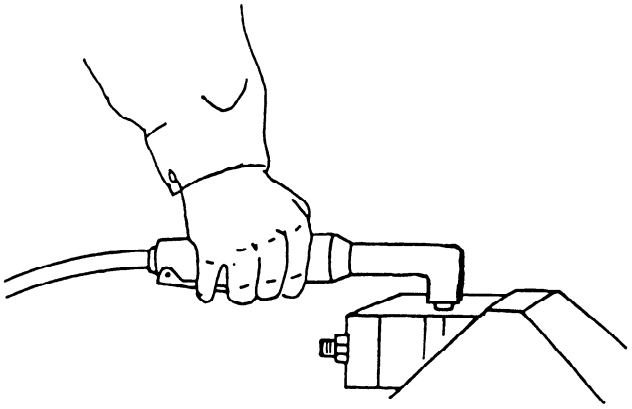
During testing, the power tool shall operate at the rated power supply and shall be used in accordance with the manufacturer's specifications. For pneumatic power tools, the air shall be supplied to the power tool by a hose having a length of at least 2 m, which is attached to the power tool via a threaded hose connector and secured with a hose clip. Quick couplings shall not be used. The operation of the power tool shall be stable and smooth (see 6.3).

During the test, the loading device shall be arranged so that the operator can have an upright or almost an upright posture and work the power tool with its output shaft pointing vertically downwards. He shall be able to hold the power tool comfortably during the test. Arm and wrist angles as illustrated in figure 3 shall be used for the different power tool types.

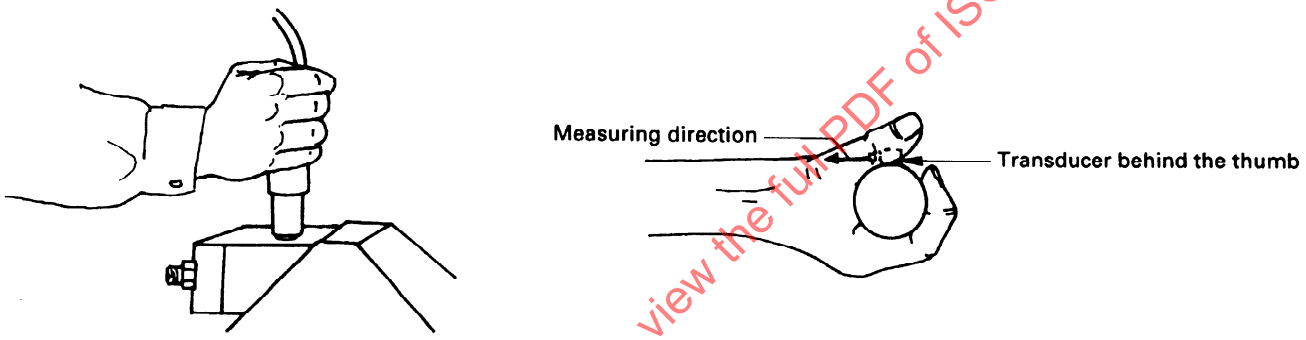
6.2 Loading device

6.2.1 General

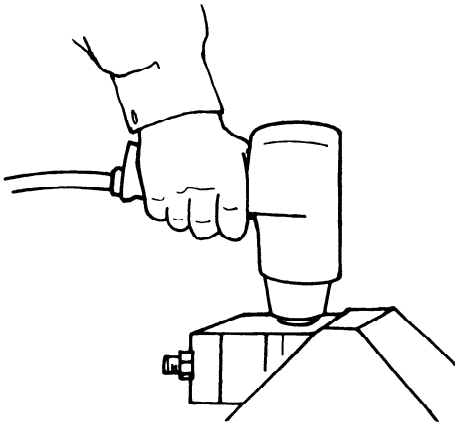
During the measurement, the power tool shall be operated against a loading device (a brake device) in order to obtain a stable rotational frequency of the output shaft of $(0{,}15 \pm 0{,}05)\ s^{-1}$. Examples of the design of two suitable brake devices are given in annex B.



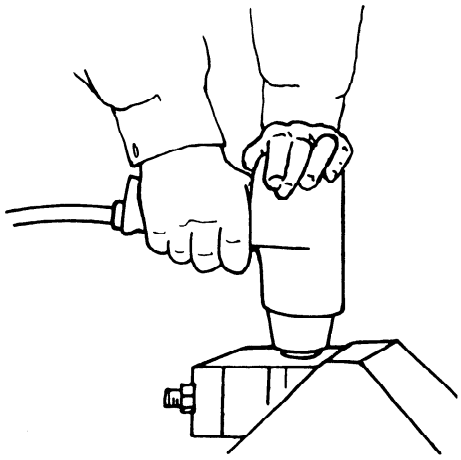
a) On straight control-handle power tools with angle head [see figure 2 a), right], the operator's arm shall be perpendicular to the control handle, and in the plane of the motor and output shaft.



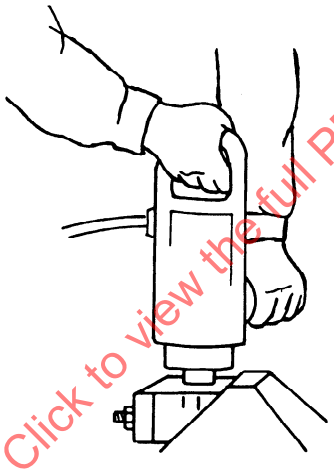
b) On straight control-handle power tools with straight head [see figure 2 a), left], the operator's arm shall be horizontal, and perpendicular to the handle. Note the indication that the transducer shall be mounted parallel with the operator's forearm.



c) On pistol control-handle power tools without support handle [see figure 2 b), left], with square-drive (or corresponding) sizes up to and including 10 mm, one-handed operation shall be used.



d) On pistol or bow control-handle power tools without support handle [see figures 2 b) left and c) left] with square-drive sizes larger than 10 mm, two-handed operation shall be used.



e) On two-handle power tools [see figures 2 b) middle and right, figure 2 c), middle and right], the operator's support-handle arm shall be as parallel as possible to the motor shaft.

Figure 3 — Working position of operator

6.2.2 Brake

The brake device consists of:

— a steel base, which is the mounting base for the brake and supports the inner brake block;

— a pair of brake blocks made of laminated phenolic which brake the socket;

— a steel plate which supports the outer brake block;

— two coverplates made of steel;

— a socket which is rotated by the power tool;

— bolts, nuts and cup springs to apply the contact pressure between the socket and the brake block;

— mounting screws to stop the axial movements of the socket.

Examples of parts forming the brake device are given in annex B.

The cup springs shall be mounted in suitable directions to give a stable contact pressure, i.e. they shall be about half-compressed when the specified rotational frequency is reached.

The socket and block contact surfaces shall be lubricated, e.g. with thin layer of copper grease. If a higher friction coefficient is needed, a lubricant consisting of high-pressure gear oil with gear-oil additive may be used for the braking surfaces.

Intense use of the brake may necessitate the introduction of air cooling by the addition of a small hole in the lower coverplate.

The mounted test rig shall not have any significant resonances in the frequency range at which it could influence the test result. This can be assured by bolting the base frame to a concrete block having a mass of at least 400 kg.

6.2.3 Selection of size of brake block and socket

The brake device shall, as well as applying a frictional torque to the power tool, provide a realistic inertial loading on the output shaft by the use of realistic sizes of sockets for different sizes of power tools.

However, only brake block and socket combinations for the most common square-drive sizes are specified in annex B:

a) "Brake device, small" is used for power tools with 6,3 mm, 10 mm, 12,5 mm and 16 mm (1/4 in, 3/8 in, 1/2 in and 5/8 in) square output shaft drives;

b) "Brake device, large" is used for 20 mm, 25 mm and 40 mm (3/4 in, 1 in and 1 1/2 in) drives.

For other output shaft drives, other block and socket combinations may be used. Adaptors between the power tool output shaft and the socket of a standard combination may be selected. In these cases the socket size (inertia) selected shall be realistic for the power tool, and adaptors, if used, shall be as short as possible. The female square-drive sockets shall be within the tolerances specified in ISO 691.

6.3 Operating conditions

The power tool shall be operated at its maximum power in right-hand rotation. It is permissible to operate the power tool in left-hand rotation, if shut-off mechanisms, etc. make continuous operation in right-hand rotation impossible. The brake shall be adjusted to a socket rotational frequency of $(0{,}15 \pm 0{,}05)\ s^{-1}$.

For power tools with clutches which are designed to be adjusted to obtain a range of torque outputs, as specified by the manufacturer, measurements shall be made at the clutch setting corresponding to the upper limit of the torque adjustment range.

Some power tools shall be warmed up before every test series (see 6.1). To maintain stable operating temperature and torque performance of hydraulic impulse clutch power tools, the time between test runs of a series and the time between the warmup procedure and the first run in a test series should not exceed 60 s and not be less than 5 s.

The power tool output shaft and the socket shall be well aligned, which may need some practice, before the measuring series is started. Inclining the power tool towards the socket increases the magnitude of the vibration.

6.4 Feed force

During testing, the operator shall apply a feed force (expressed in newtons) equal to the weight of the power tool (± 50%). The feed force can be monitored by having the operator stand on a scale. The applied feed force shall ensure stable tool operation during the test.

For push-start type power tools, the feed force shall be sufficient to cause the power tool to operate according to the manufacturer's recommendations.

7 Measurement procedure and validity of measurements

7.1 Power supply

The air pressure of pneumatically powered tools shall be measured in accordance with ISO 2787 and maintained at the value specified by the manufacturer.

Hydraulic pressure shall be measured and maintained as specified by the manufacturer.

Requirements equivalent to the above should be met for tools powered by other means.

7.2 Test procedure

Three skilled operators shall each carry out one test series with the power tool to be tested. During the test, the power tool shall be held and operated in a manner typical of normal use.

A test series shall consist of five test runs on the loading device. The time for each test run shall not be less than 4 s.

7.3 Validity of test

Measurements shall be continued until a valid test series has been obtained, i.e. when the variation coefficient (see 7.4) of five consecutive weighted values, for the same operator, is less than 0,15 or the standard deviation is less than 0,30 m/s^2.

7.4 Coefficient of variation

The coefficient of variation, C_v, of a test series is defined as the ratio of the standard deviation, s_{n-1}, of a series of measurement values and the mean value of the series, $\bar{x}$.

$$C_v = \frac{s_{n-1}}{\bar{x}}$$

where the standard deviation is

$$s_{n-1} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

and the mean value of the series is

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

where

x_i is the ith value measured;

n is the number of measurement values.

7.5 Evaluation of results

The arithmetic mean of five values for each transducer position and for each operator shall be calculated. For each transducer position, the overall arithmetic mean value shall be calculated using the mean value obtained for each of the three operators. The largest of these overall arithmetic mean values shall be the basis for the declaration.

8 Test report

In addition to the specifications given in ISO 8662-1:1988, clause 7, the following information shall be given in the test report:

a) the specification of socket, (length and outer diameter) and adaptor, if used;

b) the socket rotational frequency;

c) the air or hydraulic pressure or other data relating to the power supply;

d) the blow frequency;

e) the feed force;

f) the result of the vibration measurement (see 7.5);

g) a sketch showing the position of the handles and the position of the transducers on the handles.

A model test report is shown in annex A.

Annex A
(informative)

Model test report for impact, impulse and ratchet wrenches, screwdrivers and nut runners

The test has been carried out in accordance with ISO 8662-1:1988, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General*, and ISO 8662-7:1997, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 7: Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action.*

General

Tested by: ..... Reported by: .....

Date: .....

Power tool tested

Type: ..... Manufacturer: .....

Model No.: ..... Serial No.: .....

Mass, kg: ..... Output shaft drive, geometry and size:

Brake device

Important parts used, with reference to annex B, or description of additional parts: .....

Socket specification: .....

Adaptor specification: .....

Operating conditions

Blow frequency, Hz: ..... Pressure, bar, or voltage, V: .....

Hydraulic flow rate, l/s: ..... Duration of each test run, s: .....

Feed force, N: ..... Socket rotational frequency, s^{-1}: .....

Measuring equipment

Accelerometer — manufacturer, type: .....

Accelerometer — mass, g: .....

Mechanical filter — manufacturer, type: .....

Mechanical filter — mass, g: .....

Amplifier — manufacturer, type: .....

Analyser — manufacturer, type: .....

Tape recorder — manufacturer, type: .....

Fastening of transducer and mechanical filter

Describe the method for fastening of transducer and mechanical filter, if any.

State the measurement direction.

Signal processing

State the type of signal integration in the spectral analyser and the method of determining the weighted acceleration.

Additional specifications

Report for the tape recorder, if used, the correction factors per octave band or third octave band centre frequencies.

Report any other details, if applicable, concerning the measurement.

Results

The results shall be expressed as weighted values according to the following tables:

Individual weighted r.m.s. values — Operator A

Values in metres per second squared

Test run	Weighted value		
	Position of transducer		
	1	2	3
1 2 3 4 5			
Arithmetic mean value			
Coefficient of variation			

Individual weighted r.m.s. values — Operator B

Values in metres per second squared

Test run	Weighted value		
	Position of transducer		
	1	2	3
1 2 3 4 5			
Arithmetic mean value			
Coefficient of variation			

Individual weighted r.m.s values — Operator C

Values in metres per second squared

Test run	Weighted value		
	Position of transducer		
	1	2	3
1 2 3 4 5			
Arithmetic mean value			
Coefficient of variation			

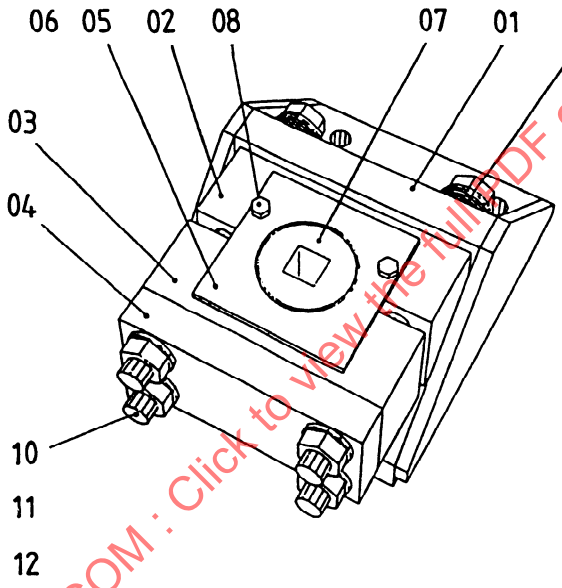
Values in metres per second squared

Result	Weighted value		
	Position of transducer		
	1	2	3
Overall arithmetic mean value for three operators			

Annex B
(informative)

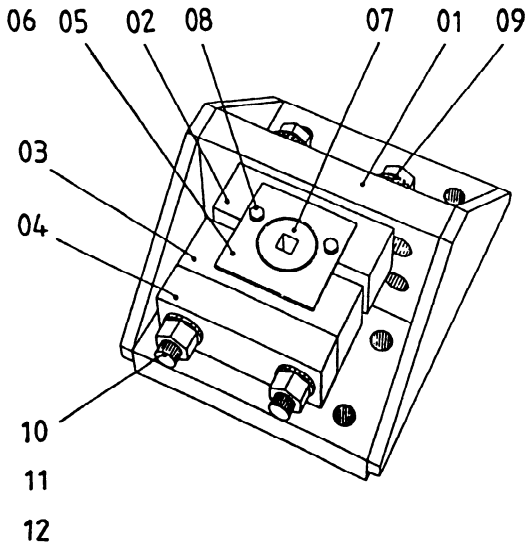
Brake devices — Assembly drawings and specification of parts

B.1 Brake device, large, intended for power tools with shaft sizes 20 mm, 25 mm and 40 mm.

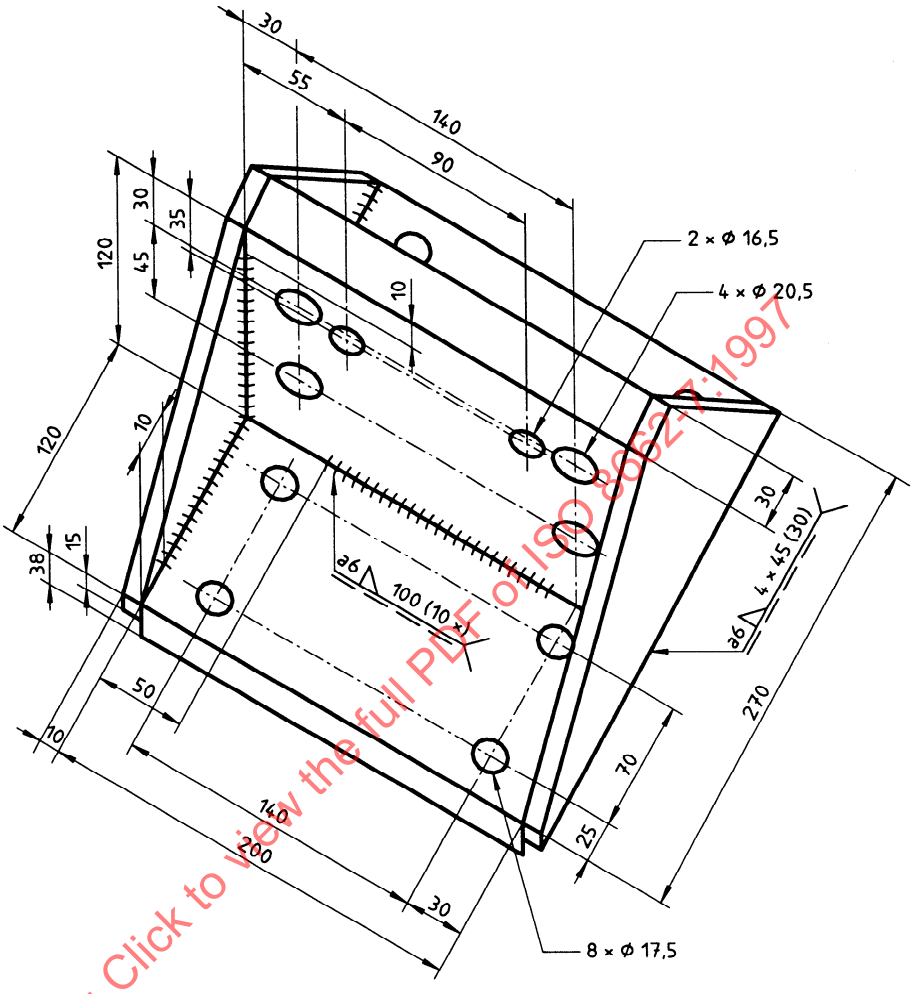


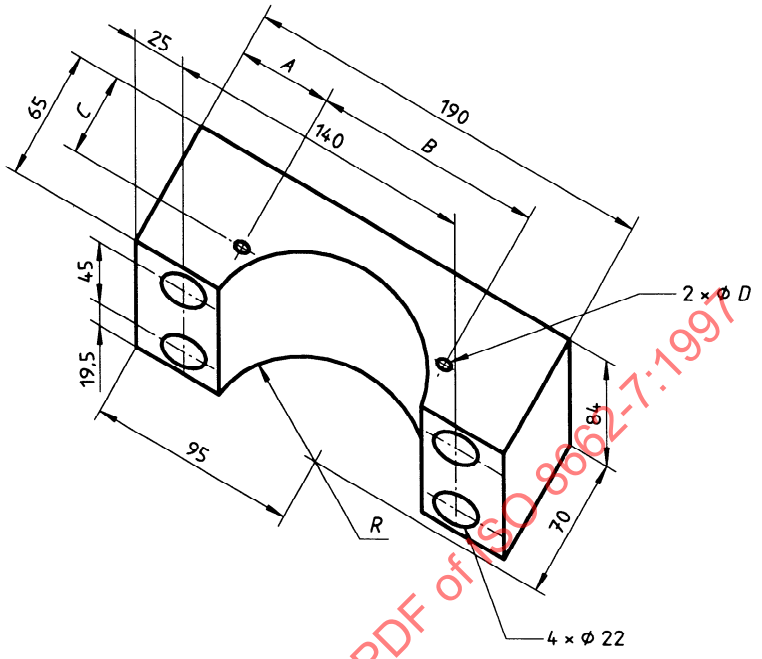
Brake device, large				Square drive size		
				20 mm (3/4 in)	25 mm (1 in)	40 mm (1 1/2 in)
Pos.	**Name of part**	**No.**	**Material**	**Quantity**		
01	Base	1001	Structural steel	1	1	1
02	Block, large	1002-01	Phenolic-cotton laminate Fine grade	1	—	—
02	Block, large	1002-02	Phenolic-cotton laminate Fine grade	—	1	1
03	Block, large	1002-03	Phenolic-cotton laminate Fine grade	1	—	—
03	Block, large	1002-04	Phenolic-cotton laminate Fine grade	—	1	1
04	Plate, large	1004	Tool steel	1	1	1
05	Coverplate, large upper	1006-01	General engineering steel	1	—	—
05	Coverplate, large upper	1006-02	General engineering steel	—	1	1
06	Coverplate, large lower	1007	General engineering steel	1	1	1
07	Socket, e.g. Apex 7360	1011-01		1	—	—
07	Socket, e.g. Apex 8386	1011-02		—	1	—
07	Socket, e.g. Apex 9184	1012		—	—	1
08	Screw M8 × 100		ISO 8.8	2	2	2
09	Cup spring 40/20,4/2,25 (approx.)		DIN 2093 — A 40 GR 2	40	40	40
10	Screw M20 × 250		ISO 8.8	4	4	4
11	Nut M20		ISO 8.8	4	4	4
12	Plain washer 37 × 21,3 × 3,3 (approx.)		General engineering steel	8	8	8

B.2 Brake device, small, intended for power tools with shaft sizes 6,3 mm, 10 mm, 12,5 mm and 16 mm.

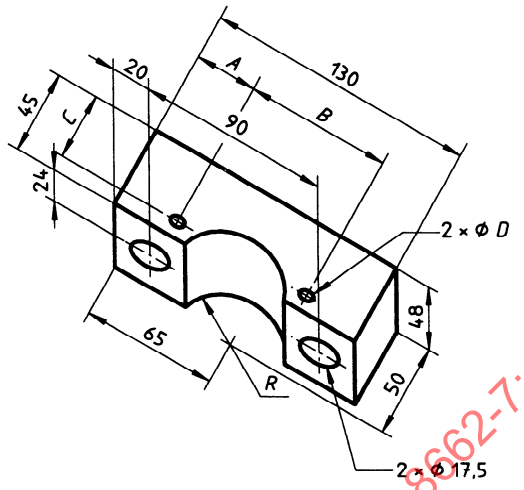


Brake device, small				Square drive size			
				6,3 mm (1/4 in)	10 mm (3/8 in)	12,5 mm (1/2 in)	16 mm (5/8 in)
Pos.	**Name of part**	**No.**	**Material**	**Quantity**			
01	Base	1001	Structural steel	1	1	1	1
02	Block, small	1003-01	Phenolic-cotton laminate Fine grade	1	—	—	—
02	Block, small	1003-02	Phenolic-cotton laminate Fine grade	—	1	—	—
02	Block, small	1003-03	Phenolic-cotton laminate Fine grade	—	—	1	1
03	Block, small	1003-04	Phenolic-cotton laminate Fine grade	1	—	—	—
03	Block, small	1003-05	Phenolic-cotton laminate Fine grade	—	1	—	—
03	Block, small	1003-06	Phenolic-cotton laminate Fine grade	—	—	1	1
04	Plate, small	1005	Tool steel	1	1	1	1
05	Coverplate, small upper	1008-01	General engineering steel	1	1	—	—
05	Coverplate, small upper	1008-02	General engineering steel	—	—	1	1
06	Coverplate, small lower	1009	General engineering steel	1	1	1	1
07	Socket, e.g. Apex 1220	1010-01		1	—	—	—
07	Socket, e.g. Apex 3228	1010-02		—	1	—	—
07	Socket, e.g. Apex 5146	1010-03		—	—	1	—
07	Socket, e.g. Apex 6142	1010-03		—	—	—	1
08	Screw M6 × 60		ISO 8.8	2	2	2	2
09	Cut spring 31,5/16,3/1,75 (approx.)		DIN 2093 — A 31,5 GR 2	20	20	20	20
10	Screw M16 × 200		ISO 8.8	2	2	2	2
11	Nut M16		ISO 8.8	2	2	2	2
12	Plain washer 30 × 17,3 × 3,3 (approx.)		General engineering steel	4	4	4	4

Name of part	Material	Dimensions mm
Base 1001	Structural steel	

Name of part	Material	Dimensions mm
Block, large 1002	Phenolic-cotton laminate Fine grade	

Brake block, large, 1002					
No.	*A*	*B*	*C*	*D*	*R*
1002-01	43	104	45	9	35
1002-02	43	104	45	9	51
1002-03	—	—	—	—	35
1002-04	—	—	—	—	51

Name of part	Material	Dimensions mm
Block, small 1003	Phenolic-cotton laminate Fine grade	

Brake block, small, 1003

Item No.	*A*	*B*	*C*	*D*	*R*
1003-01	34	62	38	7	11,25
1003-02	34	62	38	7	16
1003-03	34	62	38	7	25,5
1003-04	—	—	—	—	11,25
1003-05	—	—	—	—	16
1003-06	—	—	—	—	25,5