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Cartridge operated hand-held tools — Safety requirements — Fixing and hard marking tools

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee MTE/21, Cartridge-operated fixing tools.

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

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Cartridge operated hand-held tools - Safety requirements - Fixing and hard marking tools

Outils portatifs à charge propulsive - Exigences de sécurité - Outils de scellement et de marquage

Kartuschenbetriebene handgehaltene Werkzeuge - Sicherheit - Befestigungs- und Markierwerkzeuge

This European Standard was approved by CEN on 14 April 2011.

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

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Contents

Foreword

This document (EN 15895:2011) has been prepared by Technical Committee CEN/TC 213 “Cartridge operated hand-held tools - Safety”, the secretariat of which is held by SNV.

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of an identical text or by endorsement, at the latest by November 2011, and conflicting national standards shall be withdrawn at the latest by November 2011.

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 relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European standard has been drawn up in co-operation with representatives of manufacturers of cartridge-operated hand-held tools and health and safety authorities (Deutsche Gesetzliche Unfallversicherung (DGUV), Swedish Work Environment Authority).

The “Permanent International Commission for the Proof of Small-Arms, C.I.P.” has given substantial contributions to this standard. The C.I.P. regulations pertinent to cartridge operated hand-held tools have been largely integrated in the present standard.

Normative and informative annexes to this standard are indicated in the contents list.

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, 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.

Introduction

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

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document. When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This European standard covers safety requirements for cartridge operated fixing and hard marking tools which operate with an intermediate member (piston).

This European standard deals with all significant hazards, hazardous situations and events relevant to cartridge operated fixing and hard marking tools, when they are used as intended and under conditions of misuse which are reasonably foreseeable (see Clause 4). It deals with the significant hazards in the different operating modes and intervention procedures as referred to in EN ISO 12100-1:2003, 5.3.

Although the safe use of cartridge operated tools depends to an important extent on the use of appropriate cartridges and fasteners, this standard is not formulating requirements for the cartridges and fasteners to be used with the tools (see Clause 7).

This European Standard applies to tools designed for use with cartridges with casings made of metal or plastic and with solid propellant and containing a minor quantity of primer with a composition different from that of the main propellant.

The fixing tools in the scope are those intended for use with fasteners made from metal.

NOTE Information about cartridges can be found in the publication of the Permanent International Commission for the Proof of Small Arms (C.I.P.).

This European standard is not applicable to cartridge operated fixing and hard marking tools which are manufactured before the date of its publication as EN.

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.

EN 614-1+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 61310-1:2008*, Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

ISO 2768-1:1989, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 and the following apply.

3.1
fixing tool
tool to drive fasteners into a base material

3.1.1
tool for single cartridges
tool designed for the use of single (loose) cartridges

3.1.2
tool for collated cartridges
tool designed for the use of multiple (collated) cartridges

3.1.3
universal cartridge operated tool
cartridge operated tool which is intended for use in any possible operating direction and which can be held with one or two hands

3.1.4
cartridge operated stand-up tool
cartridge operated tool which is intended for the operating direction vertically downward and which is operated with both hands and with the operator in a standing position

NOTE A universal cartridge operated tool which is operated in the vertically downward operating direction with a long auxiliary handle or in a fixture is not considered a stand-up tool.

3.1.5
cartridge operated pole tool
cartridge operated tool which is affixed to the end of a pole and which is intended exclusively for the operating direction vertically upward and which is operated with both hands and with the operator in a standing position

NOTE A universal cartridge operated tool affixed to a pole which is an accessory is not considered a pole tool.

3.2
hard marking tool
tool to mark materials by imprinting

EXAMPLE Imprinting of letters and numerals.

3.3
cartridge
device which contains propellant used to drive the piston

3.3.1
single cartridge (loose cartridge)
cartridge intended to be inserted by hand in the cartridge chamber one by one

3.3.2
collated cartridge
cartridge that is contained with a number of others in a means of collation, e.g. a plastic collation strip or a metal disc

3.3.3
proof cartridge
cartridge used exclusively for strength testing of tools and loaded with a stronger than usual propellant charge

NOTE See 6.3.2 and Annex A.

3.4
calibre
designation of a cartridge, derived from the main dimensions and normally expressed in the form “body diameter/length” (see Annex A)

3.5
fastener
fixing device intended for use in a fixing tool

NOTE The fixing device may be a nail, a threaded stud, an eyelet or a similar object intended to be driven into a base material.

3.6
base material
material into which the fastener is driven

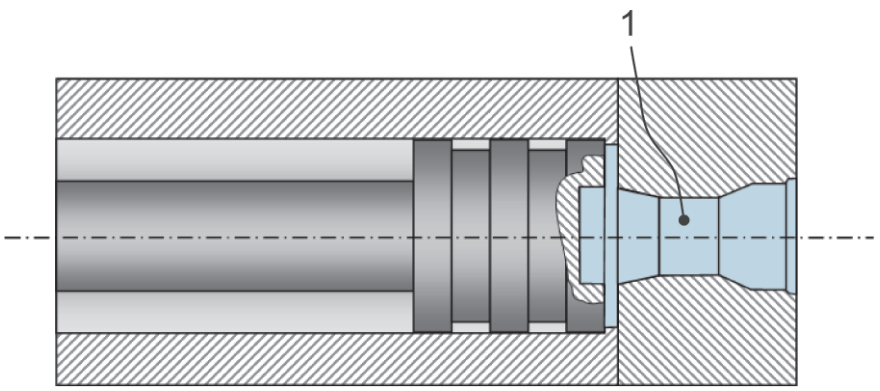
3.7
average muzzle velocity (fixing tools)
$\bar{v}_{10}$
mean arithmetic value of test element/piston velocity evaluated out of 10 single test values

3.8
maximum muzzle velocity (fixing tools)
v_e
maximum test element/piston velocity to be expected calculated on the basis of the average muzzle velocity and the standard deviation for the 10 tests

3.9
reference combustion volume
V_{ref}
volume defined for testing of cartridge strength; one single reference value of 0,16 cm^3

3.10
total volume
V_{tot}
sum of the volumes of the combustion chamber and the empty cartridge chamber as determined from the design drawings or CAD models

NOTE V_{tot} is a design-specific value.

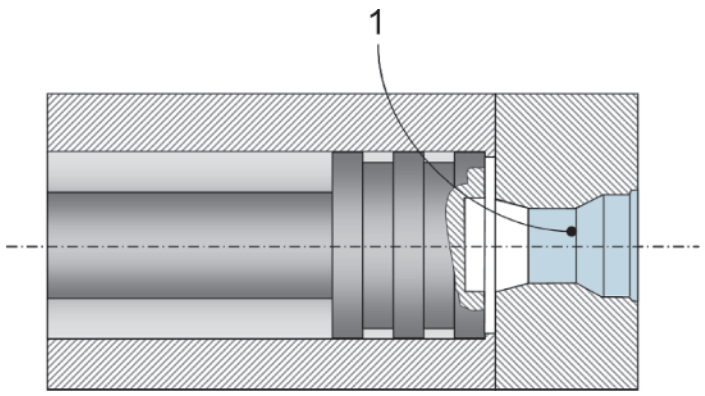


Key

1 Total volume V_{tot} (tool for single cartridges)

3.11
minimum volume of the cartridge chamber
V_{ET}
smallest technically possible cartridge chamber for a given calibre

NOTE V_{ET} is a constant value for each calibre laid down in Table A.1 of Annex A.



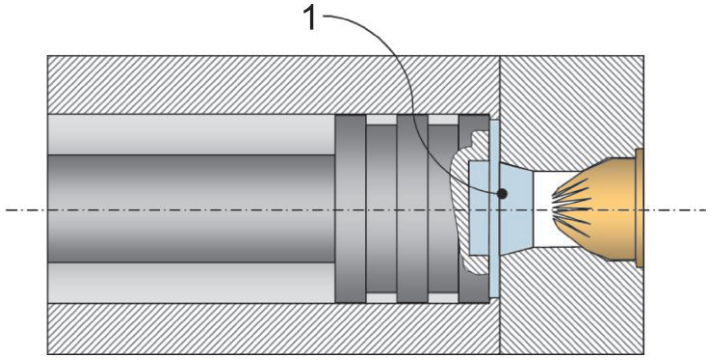
Key

1 Minimum volume of the cartridge chamber V_{ET} (tool for single cartridges)

3.12
minimum operational volume of the combustion chamber
V_a
volume consisting of the volume of the combustion chamber with the piston in its extreme top position and the open volume in the piston head

NOTE V_a is a design-specific value and is calculated as the difference between the design-specific volume V_{tot} and the calibre-specific volume V_{ET}:

$$V_a = V_{tot} - V_{ET}$$

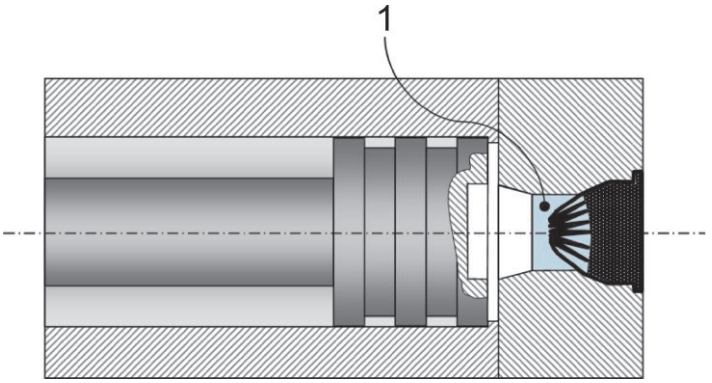


Key

1 Minimum operational volume of the combustion chamber V_a (tool for single cartridges)

3.13
reduced volume of the cartridge chamber
V_h^*
volume of the minimum size cartridge chamber V_{ET} minus the volumes of the cartridge casing and the propellant

NOTE V_h^* is a constant value for a given calibre laid down in Table A.1 of Annex A.

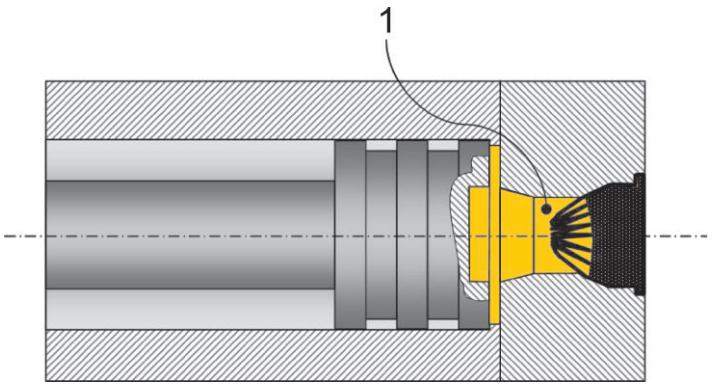


Key

1 Reduced volume of the cartridge chamber V_h^* (tool for single cartridges)

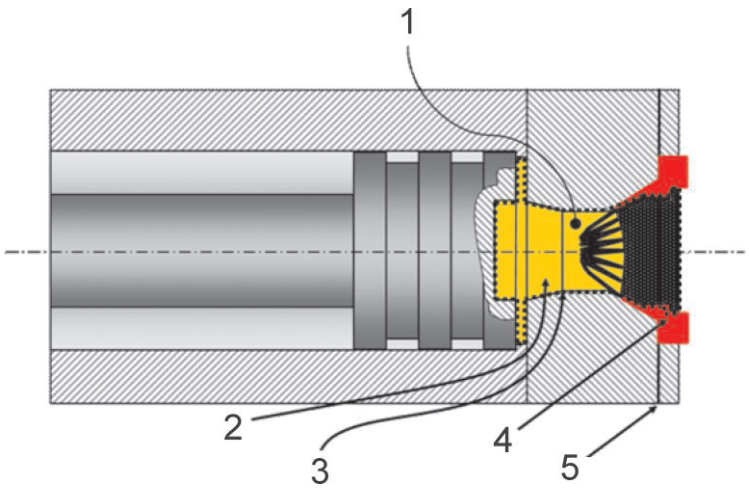
3.14
effective combustion volume
V_{eff}
effective (total) volume of all connecting voids between the cartridge and the piston before the firing of the cartridge; calculated by

$$V_{eff} = V_h^* + V_a = V_h^* + V_{tot} - V_{ET}$$



Key

1 Effective combustion volume V_{eff} (tool for single cartridges)



Key

1 Effective combustion volume V_{eff} (tool for collated cartridges)
2 V_a collated cartridges
3 Boundary line of V_{ET}
4 Collation strip
5 Separation line between cartridge chamber and collation strip

NOTE 1 V_{eff} is the volume which in combination with the selected cartridge strength effectively determines the gas pressure generated in a tool.

NOTE 2 V_{eff} is a design-specific value.

3.15
maximum gas pressure

p_{max}

maximum value of combustion pressure in the cartridge chamber depending on the calibre and the effective volume of the combustion chamber, calculated according to the combustion equation

$$p_{max} = a \cdot V_{eff}^{b}$$

or, with $V_{eff} = V_h^* + V_a$ as the effective combustion volume

$$p_{max} = a \cdot \left(V_h^* + V_a\right)^b,$$

where a, b are coefficients determined experimentally

NOTE 1 Table A.1 of Annex A contains all the necessary values of a, b, V_h^* etc. per calibre.

NOTE 2 The maximum gas pressure p_{max} is a constant value per tool with its individual minimum operational volume of the combustion chamber V_a and thus its individual effective combustion volume V_{eff}. It refers to the strongest possible cartridge of the respective calibre.

3.16
real gas pressure
$p_{max, real}$
combustion pressure produced by a factually available cartridge (used for an overpressure test)

NOTE The real gas pressure $p_{max, real}$ is generally lower than p_{max}.

3.17
relative cartridge strength
X
ratio of the combustion pressure of a factually available cartridge and the tabulated maximum combustion pressure

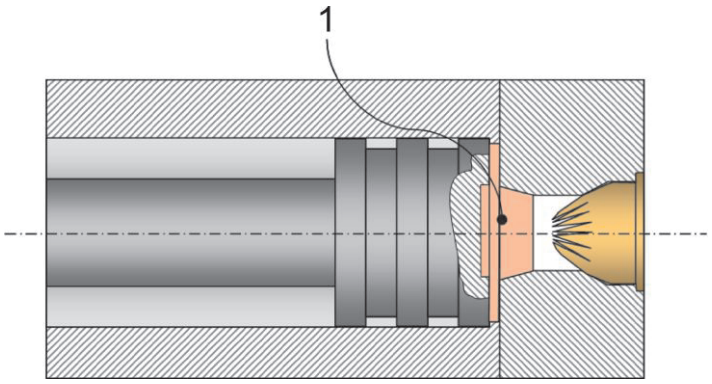
$$X = \frac{p_{max, real}}{p_{max}}$$

NOTE X would be 1,0 for cartridges producing exactly the p_{max} tabulated in Annex A.

3.18
reduced proof volume of the combustion chamber
V_E
reduced proof volume of the combustion chamber for resistance testing with an overpressure of 1,3 times of the maximum gas pressure p_{max}, calculated using the equation

$$V_E = 1{,}3^{\frac{1}{b}} \cdot V_a + \left(1{,}3^{\frac{1}{b}} - 1\right) \cdot V_h^*$$

This equation is valid for cartridges with a relative strength of X between 1,0 and 0,85.



Key

1 Reduced proof volume of the combustion chamber V_E

3.19
adapted reduced proof volume of the combustion chamber
$V_{E,\ adapted}$
volume of the combustion chamber reduced to an even lower value than the theoretical value V_E to account for a factually available cartridge weaker than $X = 0{,}85$ in overpressure testing.

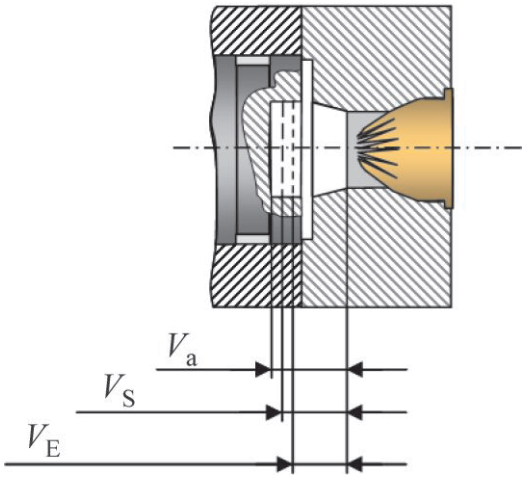
$V_{E,\ adapted}$ is dependent on the relative cartridge strength X and is calculated using the equation

$$V_{E,\ adapted} = \left(\frac{1{,}3 \cdot 0{,}85}{X}\right)^{\frac{1}{b}} \cdot V_a + \left(\left(\frac{1{,}3 \cdot 0{,}85}{X}\right)^{\frac{1}{b}} - 1\right) \cdot V_h^*$$

This equation is valid for cartridges with a relative strength of X below 0,85 as long as $V_{E,\ adapted}$ does not drop below 50 % of V_E calculated according to 3.18.

3.20
reduced system testing volume of the combustion chamber
V_S
reduced volume of the combustion chamber for system testing with an overpressure of 1,15 times of the maximum gas pressure p_{max} of each tested cartridge strength calculated using the equation

$$V_S = 1{,}15^{\frac{1}{b}} \cdot V_a + \left(1{,}15^{\frac{1}{b}} - 1\right) \cdot V_h^*$$



Key

V_a Minimum operational volume
V_S Reduced system testing volume
V_E Reduced proof volume

3.21
A-weighted emission sound pressure level
L_{pA}
ten times the logarithm to the base 10 of the ratio of the square of the emission sound pressure, p, to the square of a reference value, p_0, expressed in decibels

$$L_{pA} = 10 \lg \frac{p^2}{p_0^2} \text{ dB}$$

where the reference value, p_0, is 20 µPa

3.22
A-weighted single event emission sound pressure level in dB
L_{EA}
A-weighted and time-integrated emission sound pressure level of an isolated single sound event of specified duration T (or specified measurement time interval $T = t_2 - t_1$ covering the single event), normalized to reference time interval $T_0 = 1$ s; given by the following equation:

$$L_{EA} = 10 \lg \left[\frac{1}{T_0} \int_0^T \frac{p^2(t)}{p_0^2} \mathrm{d}t \right] \text{ dB}$$

NOTE The reference sound pressure is $p_0 = 20$ µPa.

3.23
A-weighted sound power level
L_{WA}
ten times the logarithm to the base 10 of the ratio of the sound power of a source, P, to a reference value, P_0, expressed in decibels

$$L_{WA} = 10 \lg \frac{P}{P_0} \text{ dB}$$

where the reference value, P_0, is 1 pW

3.24
sound energy level in dB
L_J
ten times the logarithm to the base 10 of the ratio of the sound energy, J, radiated by the sound source under test, to the reference sound energy, J_0 ($J_0 = 1$ pJ $= 10^{-12}$ J)

$$L_J = 10 \lg \frac{J}{J_0} \text{ dB}$$

NOTE The A-weighted sound energy level is denoted by L_{JA}.

3.25
peak emission sound pressure
p_{peak}
greatest absolute emission sound pressure during a stated time interval

NOTE Peak sound pressure is expressed in pascals.

3.26
C-weighted peak emission sound pressure level in dB
$L_{pC,\,peak}$
ten times the logarithm to the base 10 of the ratio of the square of the peak emission sound pressure, p_{peak}, to the square of a reference value, p_0, expressed in decibels

$$L_{pC,\,peak} = 10 \lg \frac{p_{peak}^2}{p_0^2} \text{ dB}$$

where the reference value, p_0, is 20 µPa

3.27
piston stopping device
dedicated component used in some tool designs for preventing the piston from being ejected from the tool

NOTE The piston stopping device is often an exchangeable wear part.

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

Table 1 — List of significant hazards

No.	Hazard	Hazardous situation/event	Clause of this European Standard
1.1	Stabbing or puncture due to free flying fasteners at high velocity (direct or from ricochets) or from fragments of broken fasteners	Incorrect use or maintenance because of lack of knowledge or use of inappropriate tools for maintenance and cleaning	5.2, 7.3.1, 7.3.2, 7.3.3
1.2		Use of improper items for substitution of original items with the tool	5.3.2, 7.3.2, 7.3.3
1.3		Unintentional firing due to lack of attention during use, shocks or falls of the tool, inadequate trigger actuation force or trigger location	5.7
1.4		Muzzle velocity too high	5.5
1.5		Use of fasteners (inappropriate for the tool or the application) breaking when entering the base material	5.3.3, 7.3.1, 7.3.2
2.1	Stabbing, puncture, crushing or severing due to ejection of fragments from the tool, cartridge casings or the collation system	Insufficient strength of the tool for the intended cartridges and types of use	5.4
2.2		Use with cartridges with too high charge	7.3.1, 7.3.2, 7.4
2.3		Cartridge exploding outside the closed chamber	5.4, 5.7, 7.3.1, 7.3.2
2.4		Tool not adapted to the cartridges or collation systems or to the fasteners for which it is intended	5.4, 7.3.1
2.5		Ejection of the piston (or other components) because of poor design of the retention provisions	5.6.1
2.6		Ejection of parts of the piston after breakage of the piston	5.6.2
3	Stabbing or puncture due to ejection of fragments of base material	Fragments or spalling from base material created by the penetration of a fastener	5.3.2, 5.3.3, 7.3.1, 7.3.2
4.1	Burns due to escaping combustion gases	Poor design of tool allowing for the emission of hot combustion gases toward the user	5.11
4.2		Cartridge exploding outside the closed chamber	5.4, 5.7, 7.3.1, 7.3.2
5.1	Permanent hearing loss, tinnitus, reduced perception of warning signals, reduced speech communication abilities due to noise during firing	Single burst noise emission when firing	5.8, 7.2, 7.3
5.2		Cartridge exploding outside the closed chamber	5.4, 5.7, 7.3.1, 7.3.2

Table 1 *(continued)*

No.	Hazard	Hazardous situation/event	Clause of this European Standard
6	Musculoskeletal disorder due to mechanical shocks	(Repetitive) recoil when firing	5.9, 7.3.5
7.1	Burns due to contact with surfaces at high temperature	Contact with tool surfaces at high temperature during normal use: — parts normally touched when holding the tool — parts of control devices (short duration contact) — parts not intended to be touched	5.10, 7.2, 7.3.2
7.2		Contact with tool surfaces at high temperature during transport, servicing or maintenance	5.10, 7.2, 7.3.2
8.1	Hazards due to neglecting ergonomic principles	Poor ergonomic design of the tool in general	5.12.1
8.2		Poor design of the handle not ensuring a firm grip on the tool with the possibility of loosing control, in particular concerning: — control of the tool in case of heavy tools — use by both left-handed and right-handed operators — use with protective gloves if necessary inadequate location of the trigger	5.12.2, 5.12.3
8.3		Poor design of the trigger with too high actuation force causing repetitive strain injury	5.12.3
9	Possible injuries when using the tool after incorrect (re)-assembling	Design allowing for errors of fitting of parts of the tool	5.3.2

5 Safety requirements and/or protective measures

5.1 General

Cartridge operated hand-held tools shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100-1:2003 and EN ISO 12100-2:2003 for relevant but not significant hazards, which are not dealt with by this document.

5.2 Carrying box and tools to be supplied

Cartridge operated fixing and hard marking tools shall be supplied with the following equipment:

a) specific tools required for maintenance and cleaning of the cartridge operated tool in compliance with the instruction handbook,

b) solid box which can be protected/secured against unauthorised opening and having space for the cartridge operated tool, instructions for use, essential tools for daily maintenance and cleaning (e.g. brushes), and safety-related accessories (e.g. safety goggles). To protect the box against unauthorised opening, the box shall have a lock or allow the user to affix a lock of his own choice, e.g. a padlock.

For verification see 6.1.

5.3 General design of the tool

5.3.1 General

Cartridge operated fixing and marking tools shall be designed for correct and safe functioning with the cartridges, collation systems and the fasteners or marking accessories for which they are intended.

5.3.2 The design of the tool shall prevent errors that could be made when assembling and reassembling parts of them if such errors can be a hazard.

Relevant errors in assembly are e.g.

— assembling a tool with a wrong piston stopping device or without inserting a piston stopping device,

— assembling a tool without sufficiently tightening the thread joining the fastener guide and the main tool body,

— fitting a splinter guard with too much distance from the work surface.

The manufacturer shall identify all the parts which can be disassembled and reassembled by the user which could create a hazard if they were mounted incorrectly. These parts shall be designed such that they cannot be assembled in a way that they create a hazard.

In particular, parts that shall be considered are:

— piston;

— piston stopping device;

— fastener guide;

— magazine (tools for collated fasteners);

— splinter guard.

For verification see 6.3.1.

5.3.3 Tools that are intended to be used in applications where splinters might occur shall have fixtures where splinter guards can be attached. Matching splinter guards shall be made available by the manufacturer.

For verification see 6.3.2.

5.4 Resistance at overpressure and temperature/operating safety and reliability

5.4.1 General

The design of the tool shall ensure that the combustion pressure and the temperature do not cause damage to the tool itself or to the system components which are directly affected by this pressure and this temperature and are relevant for user safety.

5.4.2 The tool shall be able to withstand the highest pressures that can be expected without any deformation, cracks or other defects.

For verification see 6.4.2.

5.4.3 The tool shall be able to withstand the highest temperatures that can be expected under the conditions of intended use without any defects.

For verification see 6.4.3.

5.4.4 The tool shall not cause unintended damage to the cartridges used in the tool.

For verification see 6.4.4.

5.4.5 Tools for collated cartridges shall not cause safety-critical damage on the intended collation system for the cartridges.

For verification see 6.4.5.

5.5 Velocity limit of the piston and of the fasteners (fixing tools)

The design of the tools shall ensure that:

— the average velocity $\bar{v}_{10}$ of piston and fasteners does not exceed 100 m/s, and

— the maximum velocity v_e of piston and fasteners does not exceed 110 m/s.

For verification see 6.5.

5.6 Safe retention of the piston of a cartridge operated tool

5.6.1 The cartridge operated tool shall ensure a reliable stopping of the piston under those conditions where the highest piston velocity is obtained and if the piston is stopped inside the tool with no energy being dissipated in the base material.

For verification see 6.6.1.

5.6.2 The design of the cartridge operated tool shall prevent that the piston breaks in such a way that major parts of it are ejected from the tool.

NOTE This does not address the normal wear of the piston tip.

For verification see 6.6.2.

5.7 Prevention of unintentional firing

5.7.1 Operating safety

Firing shall be prevented during loading and unloading and with open cartridge chamber.

For verification see 6.7.1.

5.7.2 The tool shall not fire in the case of impacts or blows.

For verification see 6.7.2.

5.7.3 The tool shall not fire if it is dropped from heights as specified in 6.6.3.

For verification see 6.7.3.

5.7.4 Free firing safety

The tool shall not fire if the trigger is actuated unless the muzzle is first pressed against the fastening surface (or surface to be marked) with a force of at least 1,5 times the tool weight (tool weight ready for operating) and with a minimum of 50 N.

For verification see 6.7.4.

5.8 Reduction of noise emission

The cartridge operated fixing or hard marking tool shall generate noise levels as low as possible and practicable. Therefore noise reduction shall be an integral part of the design process taking into account measures at source as very generally described in EN ISO 11688-1:2009.

NOTE 1 The main noise source is the single burst noise emission at the exhaust system for the combustion gases.

NOTE 2 An example of noise reduction measures are silencers.

To reduce as much as possible the remaining risk to the user, the manufacturer shall recommend the use of personal protective equipment, i.e. appropriate hearing protection in the operating instructions (comp. 7.3.2 f).

For verification see 6.8.

5.9 Reduction of recoil

The design of fixing and hard marking tools shall ensure that the mechanical impact transmitted by the tool to the hand-arm system of the operator during firing is kept as low as practically possible.

Essential elements to be considered for reaching this objective are:

— the ergonomic design of the handle and the required hand gripping force (see also 5.12),

— the required pressing effort that shall be as low as compatible with the free firing safety measures and as functionally possible (see 5.7.4),

— the possibility of using charge and power setting appropriate for the types of work for which the tool is intended (see also 7.3.2 a),

— the ratio of the mass of the piston and the mass of the tool shall be as low as practically possible.

For verification see 6.9.

5.10 Maximum permissible surface temperatures

Cartridge operated tools shall be designed and constructed in such a way that the surface temperatures do not exceed the limit values laid down in EN ISO 13732-1:2008.

The temperature of handles or other surfaces of the tool which are intended to be touched for holding the tool shall not exceed 48 °C.

For other intentional contacts the contact times to be considered for defining the maximum surface temperatures shall be

— 4 seconds for the activation of the trigger or switches,

— 10 seconds for the activation of power adjustment devices.

The contact time to be considered for surfaces not intended to be touched shall be 0,5 seconds.

If any of these limits cannot be respected, appropriate warnings shall be given as indicated in 7.1 and 7.2.

For verification see 6.10.

5.11 Exhaust of combustion gases

The tool shall be designed such that no exhaust vents are directed against the user's face, hands or body.

For verification see 6.11.

5.12 Ergonomics

5.12.1 General

Cartridge operated fixing and hard marking tools shall be designed and constructed in accordance with the ergonomic principles of EN 614-1+A1:2009 and of 4.8 of EN ISO 12100-2:2003, taking also account of the following.

5.12.2 Handle

The design of the handles and other parts intended for holding the cartridge operated tools shall enable the operator to have a firm grip on the tool. The holding provisions shall be appropriate for right-handed as well as for left-handed operators.

Handles shall be adapted to the functional anatomy and the dimensions of the operator's hand, including when wearing protective gloves.

NOTE Guidance on the dimensions of the handle can be found in Annex F and in EN ISO 7250:1997 and in EN 792-13+A1:2008, Annex C.

Tools with a mass of 6 kg or more shall be capable to be held with both hands. The provision for the second hand can be either:

— a second handle which may be removable or

— an appropriate grip zone on the tool body.

For verification see 6.12.2.

5.12.3 Trigger and actuation

The trigger shall be adapted to the (main) handle so that it can be used easily as well by right-handed as by left-handed operators.

NOTE Guidance on the trigger can be found in Annex F.

The actuation force of the trigger shall be as low as functionally possible and compatible with the measures for prevention of unintended actuation.

NOTE Guidance can be found in EN 894-3+A1:2008, 8.2.

Similarly, the required force for pressing the tool against the surface before firing shall be as low as compatible with the measures for prevention of unintended firing (see also 5.7.4) and as functionally possible.

For verification see 6.12.3.

6 Verification of the safety requirements and/or protective measures

6.1 General

The conformity with the requirements of Clause 5 shall be verified as specified in this clause. The criteria for acceptance are contained in Clause 5 or are specified in this clause.

The verification methods are presented in the same order as the corresponding requirements of Clause 5.

All tests shall be carried out at ambient temperature of (20 ± 5) °C.

6.2 Verification of equipment and packaging

Verification of carrying box and specific tools shall be done by visual inspection.

6.3 Verification of safe design

6.3.1 The result of the analysis of potentially hazardous exchangeable components shall be documented and retained. The identified parts shall be listed. For all parts listed, assembly tests shall be carried out to verify that they cannot be mounted in a way which could create a hazard.

6.3.2 Design verification and assembly test

6.4 Verification of resistance at overpressure and of operating safety

6.4.1 General

Testing is carried out on the basis of the following criteria:

— the tool with dimensions within the manufacturing tolerances,

— the largest and heaviest piston,

— the piston and barrel shall be selected for ensuring the minimum clearance between both within the manufacturing tolerances,

— the heaviest fasteners or marking head and letters, and,

— if applicable, the matching collation systems.

6.4.2 Overpressure test

The power setting of the tool shall be set to maximum power.

Ten fasteners are fired into a material suitable for their application.

Compliance with 5.4.2 is verified at an overpressure of $1{,}3 \cdot p_{max}$ as defined in 3.15.

Two methods exist to reach the targeted overpressure:

a) using proof cartridges developing at least $1{,}3 \cdot p_{max}$

or

b) using the strongest charge which technically can be used in the tool while reducing the minimum operational volume of the combustion chamber V_a to a reduced proof volume V_E in order to obtain $1{,}3 \cdot p_{max}$ (see 3.15). This procedure is carried out using

   — cartridges which in standardised pressure testing with $V_a = V_{ref} = 0{,}16$ cm^3 shall develop a mean pressure p_{10} at least equal to 85 % of p_{max} (0,16) specified for the calibre in question

   — in combination with a test piston with reduced additional volume V_E in order to achieve at least $1{,}3 \cdot p_{max}$.

If the strongest cartridges which are available do not develop a mean pressure p_{10} of at least 85 % of p_{max} (0,16), the procedure of indent b) may also be used but with an adapted reduced proof volume $V_{E,\ adapted}$ (see 3.19) reduced below the value of V_E to account for the weaker cartridge. This method is acceptable as long as the resulting adapted reduced proof volume $V_{E,\ adapted}$ is greater or equal to 50 % of V_E.

The tool will pass the overpressure test if no plastic deformation or cracks are observed in those parts of the tool which bear the gas pressure load (chamber, barrel, locking parts).

If in case of tools for collated cartridges defects occur during the test in the standard collation system, a special collation system made of metal shall be used for a repeat test.

6.4.3 Temperature test

The cartridge operated tool is operated for a period of 10 minutes with the maximum operation rate as specified in the instruction manual and the temperatures thus produced are measured. The tool is used with the strongest available cartridge and, if adjustable, is set at the power setting which produces the highest temperatures of the tool.

NOTE Depending on design, this setting need not be the maximum setting.

The test is passed if upon visual inspection the tool does not show damage to any of its parts.

6.4.4 Verification of correct chambering

Verification is done using the test described in 6.4.2 using the reduced system testing volume V_S instead of V_E (see 3.20).

The tool will pass if after the test the walls and bottoms of the cartridges are not cracked.

6.4.5 Verification of the specific design elements for tools for collated cartridges

Design of the elements of the tool relevant for the correct functioning of the collated cartridge system for which it is intended shall be verified.

Additionally a compatibility test shall be carried out for every type of collated cartridges intended to be used with the tool. A description of an adequate testing procedure is given in Annex E.

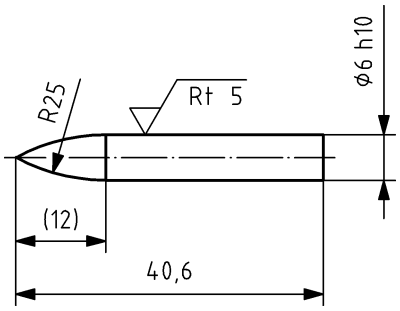
6.5 Verification of the permissible muzzle velocity (fixing tools)

Compliance with 5.5 shall be verified by measuring the “muzzle velocity” by measuring the velocity of a free flying test element or of the piston.

For this purpose, the tool shall be loaded with a special test element made of steel as shown in Figure 1 and the strongest charge which technically can be used in the tool. Tools with adjustable power are tested at their maximum power setting. If a tool is intended to be fitted with different pistons and barrels, all tests shall be carried out with all of these pistons and barrels considering only the highest velocities.

For the test, a piston shall be used which leads to the highest muzzle velocity.

NOTE Normally the lightest piston will lead to the highest muzzle velocity.



Tolerances: ISO 2768 –m

R_z Surface roughness

Figure 1 — Test element

If the test element needs additional guidance in the barrel, this shall be ensured by slipping two washers made of plastic (or of AlMg alloy material of 0,3 mm thickness) onto the front and rear end of the test element. The washers shall have a bore diameter of 5,5 mm and an outside diameter adapted to the barrel bore diameter. The mass of the test element shall be (8 ± 0,3) g.

By means of a suitable rod the test element shall be pushed into the fastener guide towards the rear of the cartridge operated fixing tool so as to intimately contact the face of the piston. By this, it is ensured that the test element is accelerated at the same rate as the piston and reaches the same velocity as the piston at the muzzle.

The cartridge operated fixing tool loaded with the test element shall then be pressed against a plate of thin sheet metal and fired such as to enforce the exiting of the test element from the muzzle and the penetration of the sheet metal by the test element. By this, the test element is simulating the free flight of a fastener which might occur unintentionally in a similar situation.

To determine the muzzle velocity of the cartridge operated fixing tool, one of the following shall be measured:

— the velocity of the piston attained close to the muzzle, i.e. immediately before the piston impacts the piston stopping device,

— the velocity of the test element immediately after leaving the muzzle in its forced free flight.

For the determination of either velocity, the tool manufacturer shall use a suitable measuring method and measuring equipment.

Measuring equipment shall be used which allows the measurement of the average muzzle velocity with a maximum measuring error of ± 3 %.

By definition, the average muzzle velocity $\bar{v}_{10}$ is the mean value of 10 measurements, whereby the unilateral upper tolerance limit at 95 % confidence level, related to 95 % of the populations, shall not exceed the maximum permissible value by more than 10 %.

The maximum velocity v_e is computed according to the laws of statistics using the coefficient $k_{2,10}$ and the value s for the standard deviation of each series:

$$v_e = \bar{v}_{10} + k_{2,10} \cdot s_{10}$$

$$k_{2,10} = 2{,}91$$

s_{10} = value of the standard deviation of each series

During the 10 successive velocity firings it is permissible to replace a jammed or blocked piston. However, the piston shall not break.

The test is passed if the average muzzle velocity $\bar{v}_{10}$ does not exceed 100 m/s and the maximum velocity v_e does not exceed 110 m/s.

NOTE An example of testing procedures for the determination of muzzle velocity is given in Annex B.

6.6 Verification of measures for safe retention of the piston

6.6.1 Verification of piston stopping provision

For testing the stopping provision of the fixing or hard marking tool, the tool shall be fitted with a piston with a reduced system testing volume of the combustion chamber V_S such as to produce an overpressure of 115 % of the maximum gas pressure p_{max}.

The fixing or hard marking tool shall be applied to a thin metal plate and fired.

NOTE See Annex B for a detailed example of test setup which can be used for the testing of piston stopping device.

The test shall be repeated three times. If necessary in accordance with the instruction manual, the stopping device and/or the piston shall be replaced.

The test is passed if the tool does not break and the piston is not ejected from the tool.

6.6.2 Verification of measures against breakage of the piston

Verification is done using the same test as described in 6.6.1. The test is passed if no parts of the piston are ejected from the tool.

6.7 Prevention of unintentional firing or improper use

6.7.1 Verification of safe operation

Verification of the design and functional testing.

Functional testing shall be done according to the following procedure:

The empty tool (i.e. without cartridges) shall be loaded with a metal feeler gauge of 5,0 mm thickness and with square or rectangular cross section by inserting the feeler gauge between the cartridge chamber and the firing unit. If necessary to allow triggering, tools designed for collated fasteners shall be loaded with a strip of matching fasteners.

The cartridge operated tool is pressed onto a surface until reaching the end of its stroke. In this position the trigger is depressed.

The test is passed if the trigger does not operate, i.e. the firing pin is not released (see Annex C for illustrations of the measurement procedure).

6.7.2 Verification of firing safety in the case of impacts and blows

Verification shall be done according to the following procedure:

A tool shall be used with a cartridge inserted but without a piston or fastener if relevant. The tool shall be dropped, muzzle downwards, from a height of 0,3 m onto a piece of hard wood three times with the trigger fixed in the firing position.

The test is passed if no firing occurs in any one of the three tests.

6.7.3 Verification of free fall safety

This test shall be repeated with three tools.

For verification, the drop test of the tool shall be carried out as follows:

A tool shall be used with a cartridge inserted but without a piston or fastener if relevant. The tool shall be dropped twelve times from a height of 1,5 m and three times from a height of 3 m onto a square steel plate having a thickness of 30 mm and an edge length of at least 500 mm.

The tool shall be dropped such that, upon impact of the tool on the plate, its muzzle is pointed

— vertically downwards: four drops from a height of 1,5 m and one drop from a height of 3 m (the tool shall fall on the muzzle),

— horizontally: four drops from a height of 1,5 m and one drop from a height of 3 m,

— vertically upwards: four drops from a height of 1,5 m and one drop from a height of 3 m.

In a case where a different angle of impact is obviously the most critical, the angle of impact shall be modified according to the design so that the most unfavourable case is assumed.

— After each drop the function shall be verified visually and manually.

— If necessary, any damaged components shall be exchanged before the next drop in order to ensure the function of the tool.

After each drop it shall be verified whether a striking pin mark can be seen on the cartridge base with the naked eye even if the tool has not fired.

The test is passed if in none of all drops any striking marks are found on the base of the cartridge and no unintentional firing has occurred.

— If a striking pin mark is detected after a 3 m drop, then ten additional drops shall be carried out from a height of 3 m.

The test is passed if no firing has occurred in these additional 3 m drops.

6.7.4 Verification of free firing safety

For testing the free firing safety device, the following tests shall be carried out:

a) The unloaded tool, i.e. without a cartridge shall be pressed with the muzzle against a base in horizontal direction until the firing position is reached. Then the trigger is actuated.

   The test is passed if the contact force required for the tool to allow firing is superior to 1,5 times the tool weight and above 50 N.

b) The trigger shall be depressed as far as possible and then the tool shall be pressed against a base in horizontal direction with a force greater than 1,5 times the weight of the tool and greater than 50 N.

   The test is passed if the tool does not fire.

6.8 Verification of the single burst noise emission

The noise emission values shall be measured and declared according to Annex D and declared as dual number noise emission values according to EN ISO 4871:2009.

6.9 Verification of the recoil (shock) levels

Design verification.

NOTE To evaluate the effect of alternative designs, guidance can be found in CEN ISO/TS 15694:2004, in particular in 4.11 (Root-mean-square value of W_h-weighted acceleration) and 6 (Measurement procedure).

6.10 Verification of maximum surface temperatures

An examination is to be carried out to confirm that the surface temperature of the handles of the cartridge operated fixing or hard marking tool or other surfaces of the tool do not exceed the limit values set out in 5.10.

For this purpose, the cartridge operated tool is operated for a period of 10 min with the maximum operation rate as specified in the instruction manual and the surface temperatures thus produced are measured. The tool is used with the strongest available cartridge and, if adjustable, is set at maximum power.

6.11 Verification of exhaust direction

Verify by design check.

6.12 Verification of ergonomic design

6.12.1 Design verification taking into account the ergonomic principles of EN 614-1+A1:2009 and of 4.8 of EN ISO 12100-2:2003.

6.12.2 Verify with practical test if the handles of the tool are designed such that the tool can be easily and safely used by a right-handed as well as by a left-handed operator.

Verify visually if tools with a weight above 6 kg are equipped with

— a second handle or

— an appropriate grip zone on the tool body.

6.12.3 Verify with practical test if the trigger can be easily and safely actuated as well by right-handed as by left-handed operators even when wearing protective gloves.

7 Information for use

7.1 General

Information for use of the tool shall be provided in accordance with Clause 6 of EN ISO 12100-2:2003 and include where relevant the specific information described below.

7.2 Signals and warning device

To reduce as much as possible the residual risks associated with the use of cartridge operated hand-held tools, the use of personal protective equipment, i.e.

— appropriate safety goggles,

— appropriate ear protection,

and, if the requirements of 5.10 cannot be met,

— safety gloves

shall be indicated by prominent warnings affixed to the tool or the box.

Signals shall inform clearly and without ambiguity, preferably with use of pictograms. Pictograms shall comply with the principles of EN 61310-1:2008.

The warning sign to be used for hot surfaces shall be in accordance with EN ISO 13732-1:2008, Figure H.1.

7.3 Accompanying documents

7.3.1 General

The cartridge operated fixing or hard marking tool shall be accompanied by an instruction handbook in accordance with 6.5 of EN ISO 12100-2:2003 including the other elements of the present clause.

The instruction handbook shall include all safety data required for correct use; it shall contain at least the following information:

— exact designation of the tool in accordance with the marking of the tool given in 7.4;

— information on technical data;

— illustration of the tool showing the function and the tool components important for the user;

— instructions — if necessary with illustration — for the use of the tool;

— instructions — if necessary with illustration — for the maintenance of the tool;

— instructions of behaviour in the case of cartridge misfire;

— behaviour in the case of malfunctions and

— information on the method of assembly when installing the piston stopping device.

The instructions shall include the necessary information concerning:

— the specifications for cartridges that can be used with the tool;

NOTE 1 The CIP rules may be an important element for determining the suitability of cartridges.

— additionally for tools for collated cartridges, the procedure which shall be used to assess the compatibility of his collated cartridges for the given tool, preferably with a reference to the test described in Annex E, which enables the user to ask the supplier of cartridges for the appropriate information.

— the specifications of suitable fasteners to be used for the fixing tool and

NOTE 2 Fasteners are considered to be suitable if they are compatible with the specific tool and do not fracture under the application conditions they are specified for.

— the specifications of marking accessories for hard marking tools.

The instruction handbook shall give information about residual risks.

Important safety information shall be indicated with a general warning sign.

7.3.2 Information for the safe use

The operating instructions shall draw attention to the following:

a) Only cartridges shall be used for which the grading of the charge level has been chosen according to the respective application.

   If there is no empirical value for the charge level required, it is recommended to start at the weakest charge level. In the case of fixing and hard marking tools with adjustable power and cartridges of only one charge level the starting point shall be the adjustment with the lowest power.

b) Fasteners shall only be driven into suitable materials.

NOTE In general, suitable materials are:

- normal strength concrete;
- structural steel;
- cast steel;
- ductile cast iron;
- light metal.

In general, unsuitable are:

- materials with excessive brittleness (e.g. glass or ceramics) and
- materials with excessive hardness (e.g. hardened steel).

c) Maximum recommended operation rate.

d) Fixing and hard marking tools and cartridges shall be protected from moisture and heat when stored.

e) Fixing and hard marking tools shall be transported and stored in a box which can be protected/secured against unauthorised opening.

f) While working with fixing and hard marking tools,

- appropriate safety goggles shall be used,
- appropriate ear protection shall be used,
- gloves shall be used if the surface temperatures exceed those defined in 5.10,
- splinter guards shall always be used in applications where splinters can occur.

g) If the cartridge does not fire immediately after actuating the trigger, the user shall continue pressing the tool to the surface for at least 30 s.

h) Measures for noise reduction such as the use of sound-damping supports where possible (see EN ISO 11690-2:1996).

i) No assembly of spare parts or other interchangeable equipment which are not envisaged at the origin by the manufacturer (see 7.3.3 b).

7.3.3 Information for maintenance and servicing

The operating instructions shall draw attention to the following:

a) Cartridge operated fixing and hard marking tools shall be cleaned regularly at intervals prescribed by the manufacturer.

b) The information shall include the specifications of the spare parts to be used for fixing and hard marking tools. Spare parts which can be replaced as part of maintenance operations (e.g. by the operator) shall be listed separately in the instruction handbook.

c) If a defect is detected which no longer guarantees the safe use, the tool shall be rendered inoperative immediately. The tool shall not be used until the defect has been repaired.

d) Repair work shall be carried out by persons who have the necessary skills and the knowledge of the design and construction of the tool in order to carry out repairs.

7.3.4 Noise information

The instruction handbook and the sales literature describing the performance characteristics of the tool shall contain the following information on noise emission defined in accordance with Annex D:

— A-weighted emission sound pressure level at work stations, $L_{p\mathrm{A}}$, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact shall be mentioned.

— C-weighted peak emission sound pressure level, $L_{p\mathrm{C,\ peak}}$, at work stations, where this exceeds 63 Pa (130 dB in relation to 20 µPa).

— A-weighted sound power level, $L_{W\mathrm{A}}$, emitted by the machinery, where the A-weighted emission sound pressure level at work stations, $L_{p\mathrm{A}}$, exceeds 80 dB(A).

— The maximum possible number of driving processes within one second, $N_{\mathrm{max,1s}}$.

— The fact that $L_{p\mathrm{A}}$ and $L_{W\mathrm{A}}$ have been calculated for and are valid at the maximum possible number of driving processes within one second, $N_{\mathrm{max,1s}}$.

Whenever sound emission values are indicated, the uncertainties surrounding these values shall be specified. The operating conditions of the machinery during measurement and the measuring methods shall be described.

7.3.5 Information on vibration

The instruction handbook and the sales literature describing the performance characteristics of the tools shall include information about the vibration total value to which the hand-arm system is subjected, if it exceeds 2,5 m/s^2. For the tools in the scope of this document it can be stated that “the vibration total value to which the hand-arm system is subjected does not exceed 2,5 m/s^2”.

NOTE Cartridge operated fixing and hard marking tools generate mechanical recoil that is transmitted into the hand and arm of the operator, but these shocks are not considered to be vibration.

7.4 Marking

Cartridge operated fixing and hard marking tools shall be marked in a clearly visible and durable way with the following information:

— business name and full address of the manufacturer and, where applicable, his authorised representative,

— mandatory marking[1)],

— designation of the tool,

— designation of series or type,

— serial number,

— the year of construction, that is the year in which the manufacturing process is completed,

— calibre of cartridge to be used.

1) For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European Directive(s), e.g. Machinery.

Annex A
(normative)

Values of combustion equation for the calculation of maximum gas pressure in the cartridge chamber p_{max} according to 3.15

Table A.1

Calibre	V_h^*	a	b	V_{ET}	**Maximum allowable gas pressure** $p_{max}(0,16)$ **measured at** $V_a = V_{ref} = 0,16$ cm^3
	cm^3	bar	–	cm^3	bar
5,5/16	0,10	1 220	–0,619	0,45	2 800
5,6/16	0,14	1 920	–0,670	0,44	4 300
5,6/25	0,319	2 720	–0,744	0,70	4 700
5,7/14	0,14	1 720	–0,720	0,39	4 100
5,7/16	0,16	1 460	–0,690	0,47	3 200
5,7/25	0,22	1 250	–0,780	0,71	2 650
6,3/10	0,14	1 540	–0,607	0,37	3 200
6,3/12	0,18	1 480	–0,655	0,43	3 000
6,3/14	0,21	1 360	–0,671	0,49	2 650
6,3/16	0,20	2 400	–0,615	0,56	4 500
6,8/11	0,20	1 550	–0,646	0,48	3 000
6,8/18	0,31	2 690	–0,684	0,74	4 500

Maximum gas pressure p_{max} as a function of V_a

$$p_{max} = a \cdot \left(V_a + V_h^*\right)^b$$

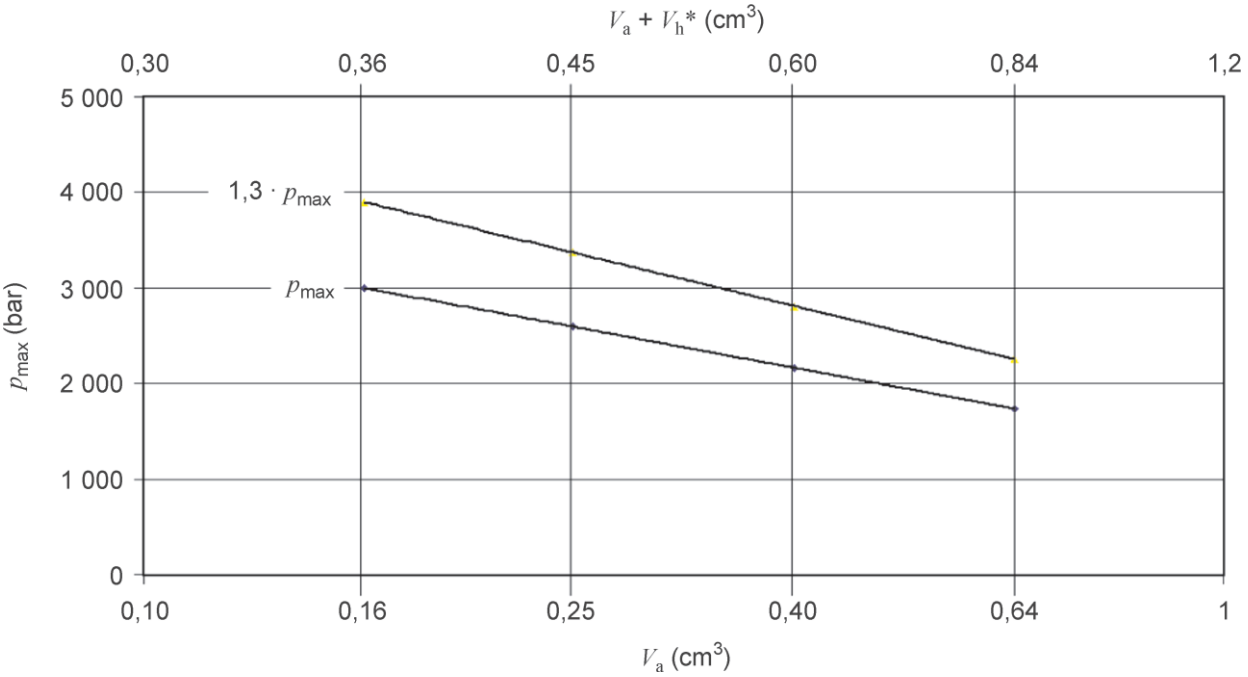


Figure A.1 — Maximum gas pressure p_{max} as a function of V_a
(example: calibre 6,8/11)

Testing volumes V_E, $V_{E,\ adapted}$, V_S

The (adapted) reduced proof and system testing volumes can be calculated directly as functions of the minimum operational volume of the combustion chamber V_a using the equations given in 3.18, 3.19, and 3.20:

$$V_E = 1{,}3^{\frac{1}{b}} \cdot V_a - \left(1 - 1{,}3^{\frac{1}{b}}\right) \cdot V_h^* \qquad \text{resp.} \qquad V_{E,\ adapted} = \left(\frac{1{,}3 \cdot 0{,}85}{X}\right)^{\frac{1}{b}} \cdot V_a + \left(\left(\frac{1{,}3 \cdot 0{,}85}{X}\right)^{\frac{1}{b}} - 1\right) \cdot V_h^*$$

and

$$V_S = 1{,}15^{\frac{1}{b}} \cdot V_a - \left(1 - 1{,}15^{\frac{1}{b}}\right) \cdot V_h^*$$

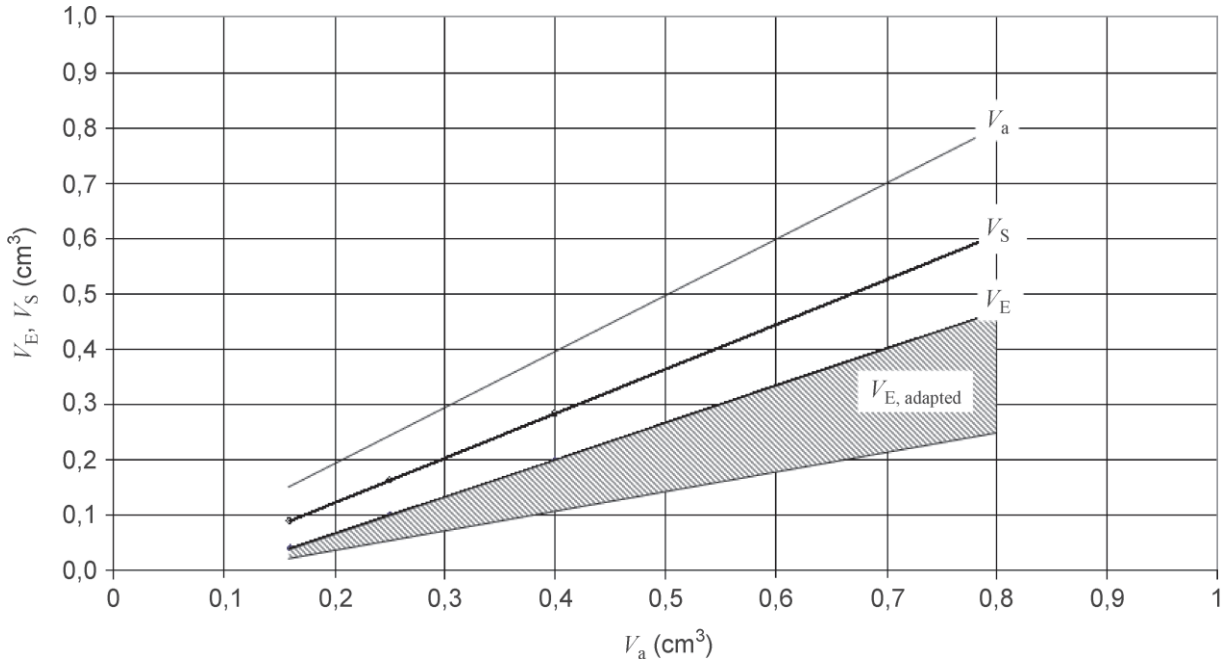


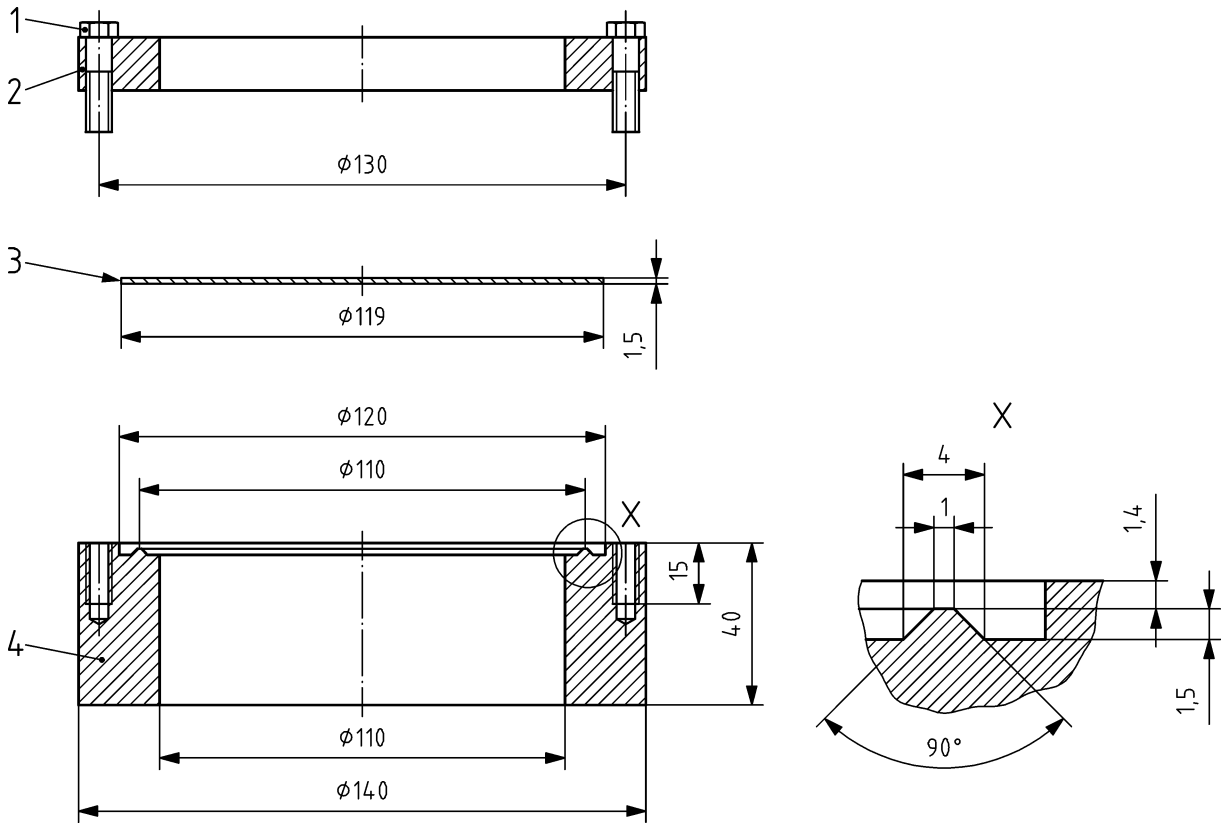
Figure A.2 — System test volume V_S, reduced proof volume V_E, adapted reduced proof volume $V_{E,\ adapted}$
(example: calibre 6,8/11)

Annex B
(informative)

Example of testing procedures for determination of muzzle velocity

The fixing tool is applied to the centre of a test plate having a thickness of 1,5 mm and a diameter of 119 mm made of aluminium alloy with a tensile strength of 230 MPa or a material with corresponding characteristic values which is clamped in a support as shown in Figure B.1. Then the tool is fired.

The velocity of the test element is determined on a gauge length of 1 m limited by two photoelectric barriers at a distance of 0,5 m and 1,5 m respectively from the muzzle of the fixing tool.



Tolerances: ISO 2768 –f

Key

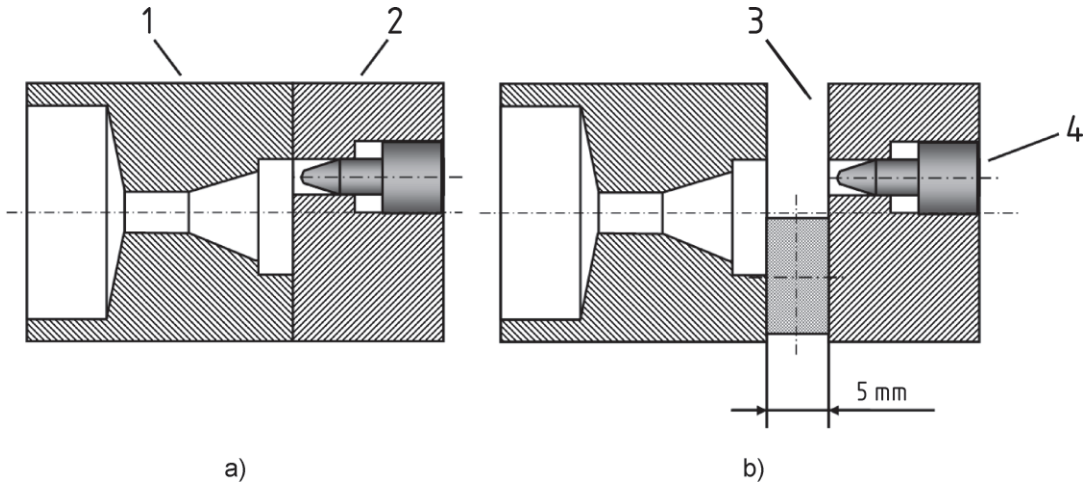
1 six bolts on periphery
2 upper clamping ring
3 test plate
4 lower clamping ring

Figure B.1 — Fixing device with test plate

Annex C
(normative)

Testing for the verification of safe operation

Verify that the tool does not contain any cartridges. The breech is opened and a feeler gauge of 5,0 mm thickness is inserted between the rear of the cartridge chamber and the front of the firing unit (see Figure C.1).



Key

1 cartridge chamber
2 firing unit
3 feeler gauge
4 firing pin

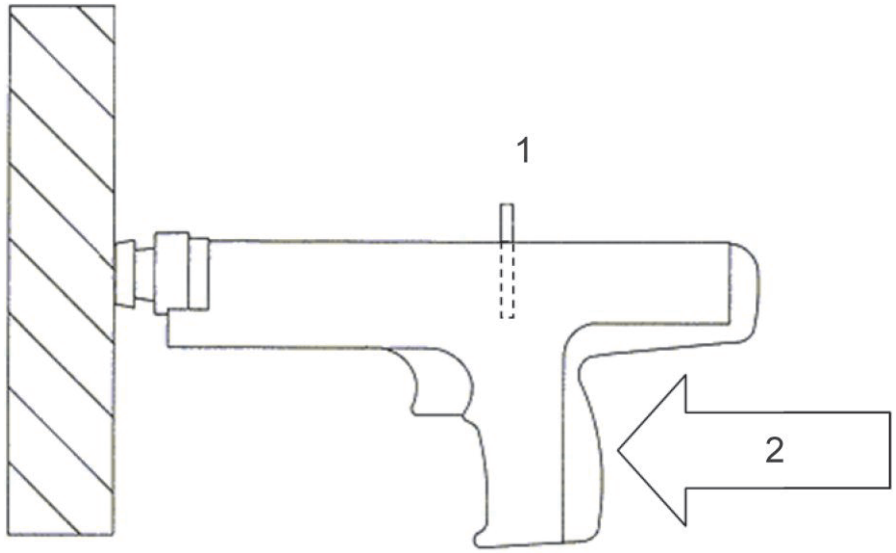
a) breech closed
b) feeler gauge inserted in breech

Figure C.1 — Test setup

If necessary to allow triggering, tools designed for collated fasteners shall be loaded with a strip of matching fasteners.

The cartridge operated tool is pressed onto a surface until reaching the end of its stroke, i.e. as far as possible. In this position the trigger is depressed.

The test is passed if the trigger does not operate, i.e. the firing pin is not released.



Key

1 feeler gauge
2 compress

Figure C.2 — Tool prepared for testing (illustrative)

Annex D
(normative)

Noise test code

D.1 Measurement setup

D.1.1 Object of measurement and condition

The cartridge operated tool is operated according to the operating instructions. It is loaded with the most frequently used cartridge and a matching fastener (to be specified in the operating instructions).

D.1.2 Preparations for measurement

D.1.2.1 Universal cartridge operated tools and stand-up tools

The cartridge operated tool is tested on a concrete cube of 600 mm × 600 mm × 200 mm having a compressive strength between 25 MPa and 40 MPa. For the purpose of the measurement, the concrete block can be put on a table with wooden slats or rubber feet interposed or bedded in sand.

The cartridge operated tool is fired vertically downwards. The operator shall not stand between the tool and the microphone.

D.1.2.2 Cartridge operated pole tools

The cartridge operated tool is tested on the underside of a concrete slab of 2 000 mm × 1 000 mm × 200 mm having a compressive strength between 25 MPa and 40 MPa. For the purpose of the measurement, the concrete block is mounted horizontally overhead (e.g. on a rack) with its underside at a height of 3 m. The concrete block can be seated on wooden slats or rubber feet.

The cartridge operated tool is fired vertically upwards. The operator shall not stand between the tool and the microphone.

D.2 Emission sound pressure level determination

D.2.1 Basic International Standards to be used

EN ISO 11201:2010 shall be used.

D.2.2 Selection of relevant work station

For universal cartridge operated tools, the measurement positions O and O' for the determination of the A-weighted single event emission sound pressure level at work station shall be at $h = 0{,}5$ m above the muzzle of the cartridge operated tool and at $a = 0{,}2$ m on the left and the right side of the tool (see Figure D.1 and D.3.2.1a).

The values measured at positions O and O' are not to be taken into account for calculating the A-weighted single event sound pressure level on the surface.

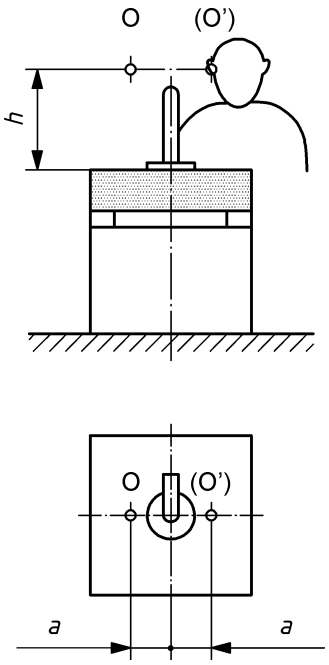


Figure D.1 — Measurement positions O and O' at work station (universal tools)

To adequately represent the position of the operator's ears, for cartridge operated stand-up tools, the positions O and O' shall be at the distance $h = 1{,}6$ m above the muzzle and at $a = 0{,}2$ m on the left and the right side of the tool (see Figure D.2 and D.3.2.1a).

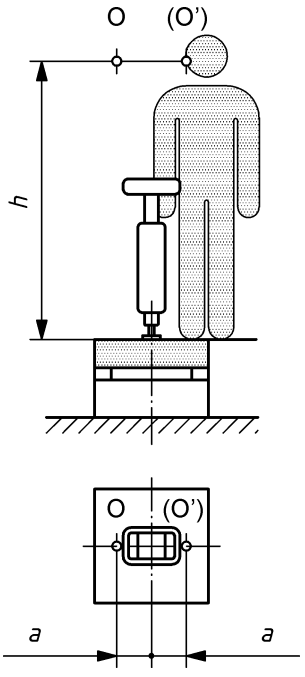


Figure D.2 — Measurement positions O and O' at work station (stand-up tools)

To adequately represent the position of the operator's ears, for cartridge operated pole tools for overhead operation, the positions O and O' shall be at the distance $h = 1{,}4$ m below the muzzle and at $a = 0{,}2$ m on the left and the right side of the tool see Figure D.3 and D.3.2.1b).

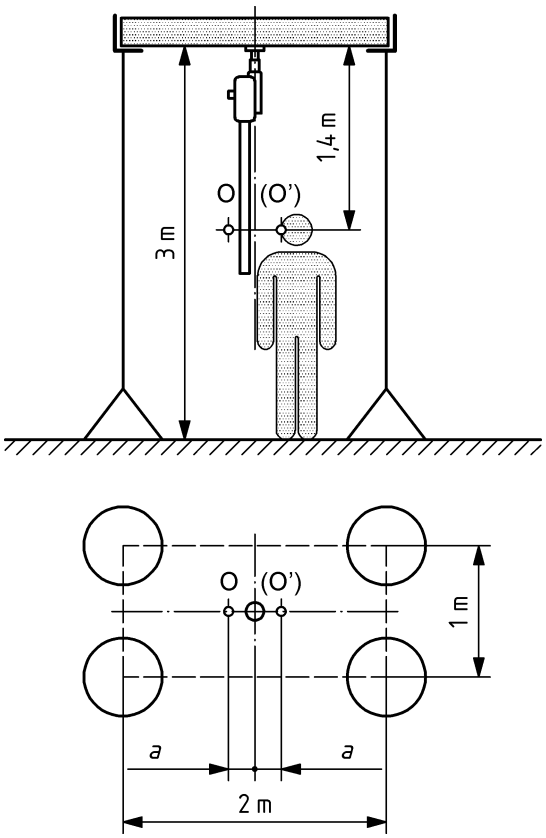


Figure D.3 — Measurement positions O and O' at work station (pole tools)

D.2.3 Measurement procedure

At position O (operator's position) five corresponding measurements of an A-weighted single event emission sound pressure level of one driving process are to be taken and the arithmetic mean is to be calculated. The resulting sound pressure level is taken to be the A-weighted single event emission sound pressure level at the work station L_{EA}.

The A-weighted emission sound pressure level at the work station, L_{pA}, shall be calculated from L_{EA} by taking into consideration the maximum possible number of driving processes within one second, $N_{max,1s}$, according to the following equation:

$$L_{pAeq} = L_{EA} + 10 \lg N_{max,1s} \text{ dB}$$

where $N_{max,1s}$ is the maximum possible number of driving processes within one second.

In the case that the C-weighted peak emission sound pressure level at the work station exceeds 130 dB, in addition, ten corresponding measurements of driving processes shall be taken and the arithmetic mean shall be calculated. The resulting C-weighted peak emission sound pressure level at the work station is denoted $L_{pC,\,peak}$.

D.2.4 Measurement uncertainty

The accuracy shall be of grade 2. The measurement uncertainty shall be stated in accordance with EN ISO 11201:2010.

D.3 Sound power level determination

D.3.1 Basic International Standards to be used

If it is required to determine the sound power level, basic sound power measurement standards shall be used, such as EN ISO 3744:2010. The sound power level shall be given as A-weighted sound power level in dB. The reference sound power is 1 pW (1 pW $= 10^{-12}$ W).

D.3.2 Measurement procedure

D.3.2.1 Measurement surface

The measurement surface is a hypothetical cube on which the measurement positions are located and which envelops the cartridge operated tool (see Figures D.4 and D.5).

NOTE Positions O and O' for measuring the A-weighted single event emission sound pressure level at work station are not located on this measurement surface.

a) Universal cartridge operated tools and stand-up tools

The measurement surface ends at floor level, which is to be regarded as a sound reflecting periphery. The height of the centre point of the cartridge operated tool above the ground shall be (1,00 $\pm$ 0,10) m. The centre point is located on the driving axis at half of the height of the cartridge operated tool.

NOTE 1 Because the cartridge operated tool is of small size the centre point of the cartridge operated tool is used instead of the surface.

b) Cartridge operated pole tools

The measurement surface ends at the bottom level of the concrete slab. The height of the centre point of the cartridge operated tool above the ground shall be 4 m minus half the length of the cartridge operated tool.

NOTE 2 The length of the cartridge operated tool refers to the tool itself, not to the handling pole to which the tool is affixed.

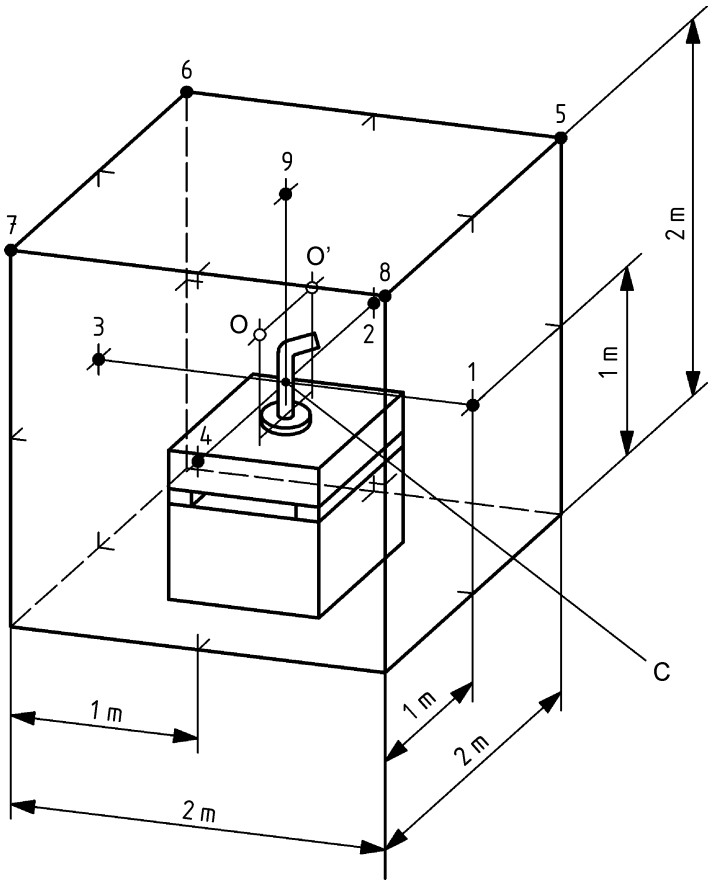
The centre point is located on the driving axis at half of the height of the cartridge operated tool.

D.3.2.2 Measurement distance

The measurement distance shall be 1,00 m from the centre point of the cartridge operated tool (see Figures D.4 and D.5).

D.3.2.3 Measurement positions

For universal tools and stand-up tools, the location of the nine measurement positions $i = 1, 2 \ldots 9$ shall be those of Figure D.4.

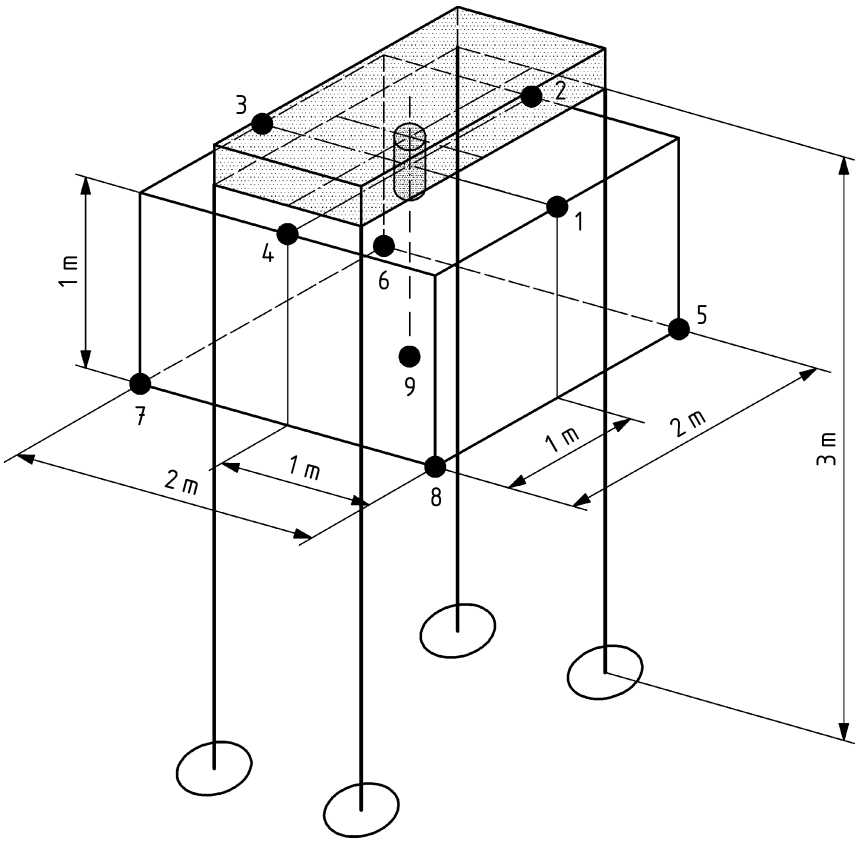


Key

C geometric centre of cartridge operated tool above floor level
● measurement positions 1, 2 ... 9

Figure D.4 — Location of the measurement positions for universal cartridge operated tools and stand-up tools

For pole tools, the measurement positions shall be those of Figure D.5.



Key

- measurement positions 1, 2 ... 9

Figure D.5 — Location of the measurement positions for cartridge operated pole tools

D.3.2.4 Measurement of the A-weighted single event sound pressure level

The A-weighted single event sound pressure level of one driving process $L'_{EA,1m}$ shall be measured five times at each measurement position i. The arithmetic mean of the five values shall be determined for each measurement position i and is denoted $L'_{EA,1m,i}$ (with $i = 1, 2, ..., 9$).

D.3.3 Calculation

D.3.3.1 Calculation of the area S and the superficial measure L_S of the enveloping measurement surface

The area of the enveloping measurement surface S is determined according to the dimensions as given in Figures D.4 and D.5. Consequently the value of the superficial measure L_S is

$$L_S = 10 \lg \frac{S}{S_0} \text{ dB}$$

where $S_0 = 1 \text{ m}^2$.

NOTE For universal cartridge operated tools and stand-up tools (see Figure D.4) the area of the enveloping measurement surface S is 20 m^2, and thus the respective value for the superficial measure L_S is 13 dB.

D.3.3.2 Calculation of the A-weighted single event sound pressure level on the measurement surface

The A-weighted single event sound pressure level on the measurement surface is calculated from the sound pressure levels measured at the nine measuring positions on the enveloping measurement surface in accordance with D.3.2.1:

$$\overline{L_{E\,\mathrm{A,1m}}} = 10\ \mathrm{lg}\left[\frac{1}{9}\cdot\sum_{i=1}^{9}10^{0{,}1\cdot L'_{E\,\mathrm{A,1m},i}}\right]\mathrm{dB} - K_{1\mathrm{A}} - K_{2\mathrm{A}}$$

It is recommended to carry out measurements in an anechoic test room over a reflecting plane. In this situation the background noise correction $K_{1\mathrm{A}}$ and the environmental correction $K_{2\mathrm{A}}$ are negligible.

D.3.3.3 Calculation of the sound energy level

The A-weighted sound energy level $L_{J\mathrm{A}}$ is calculated from the A-weighted single event sound pressure level on the measurement surface as stated in D.3.3.2, and the superficial measure L_S of the measurement surface as stated in D.3.3.1:

$$L_{J\,\mathrm{A}} = \overline{L_{E\,\mathrm{A,1m}}} + L_S$$

D.3.3.4 Calculation of the A-weighted sound power level

The A-weighted sound power level, $L_{W\mathrm{A}}$, shall be calculated from $L_{J\mathrm{A}}$ by taking into consideration the maximum possible number of driving processes within one second, $N_{\mathrm{max,1s}}$, according to the following equation:

$$L_{W\,A} = L_{J\,A} + 10\ \mathrm{lg}\ N_{max,1\,s}\ \mathrm{dB}$$

where $N_{\mathrm{max,1s}}$ is the maximum possible number of driving processes within one second.

D.3.4 Measurement uncertainty

The accuracy shall be of grade 2. The measurement uncertainty shall be stated in accordance with EN ISO 3744:2010.

D.4 Declaration of noise emission values

Noise emission values for cartridge operated tools shall be declared as dual number noise emission values according to EN ISO 4871:2009.

Example of a declaration:

Machine: Cartridge operated fixing tool Type: ABC Model: XYZ, calibre 6,8/11	
DECLARED DUAL-NUMBER NOISE EMISSION VALUES In accordance with ISO 4871:2009	
A-weighted sound power level, L_{WA} (ref. 1 pW) in decibels*)	101
Uncertainty, K_{WA}, in decibels	3
A-weighted emission sound pressure level at work stations, L_{pA} (ref. 20 µPa), in decibels*)	84
Uncertainty, K_{pA}, in decibels	3
Values determined according to noise test code given in EN 15895-1, using the basic standards EN ISO 3744:2010 and EN ISO 11201:2010	
NOTE The sum of the measured noise emission value and its associated uncertainty represents an upper boundary of the range of values which is likely to occur in measurements.	
*) number of driving processes within one second $N_{max,1s}$ = X (exemplary values)	

Verification shall be done in accordance with ISO 4871:2009, by using the same mounting, installation and operating conditions as used for the determination of the declared noise emission values of this machine.

Annex E
(informative)

Testing for the verification of safe operation

Recommended procedure for testing the suitability of collated cartridges with a tool. The test shall be conducted by a trained person who is familiar with the precautions necessary for an overpressure test (e.g. wearing of suitable personal protective equipment). The test is not intended to be carried out by a regular user of the tool.

The suitability test for a particular type of collated cartridges should be carried out for each of the respective cartridge strengths within the limits of the intended, in accordance with the following:

— The test should be carried out with four standard collation systems, each loaded with three standard cartridges of identical strength, the cartridges being inserted one next to the other,

— For the test a piston should be used with a reduced system testing volume of the combustion chamber V_S such as to produce an overpressure of 115 % of the maximum gas pressure of the respective cartridge strength.

The reduced system testing volume V_S is calculated by

$$V_S = 1{,}15^{\frac{1}{b}} \cdot V_a + \left(1{,}15^{\frac{1}{b}} - 1 \right) \cdot V_h^*$$

V_S reduced system testing volume (see 3.20 and Annex A, Table A.1)

b coefficient determined experimentally (see Annex A, Table A.1)

— The test should be carried out with a fastener suitable for the system and the base material used, or a suitable marking head.

— The power setting of the tool should be set at maximum.

The test is passed if after test firing

— the walls and the bottoms of all cartridge casings are free from cracks, holes and fractures,

— the collation system is intact and not broken or fractured and is free from lengthwise cracks affecting the three spent cartridges.

Annex F
(informative)

Information on the ergonomic design of the handle

F.1 In the area of finger d_3 the circumference of the handle should lie between 105 mm and 120 mm. In the area of fingers d_4 and d_5 the circumference of the handle should not be greater.

F.2 The space between the fingers and a magazine area should amount to at least $d/2$ of the respective finger diameter, based on the trigger in the non-operational position.

F.3 The space of 3 mm between the fingers should also allow for the wearing of work gloves.

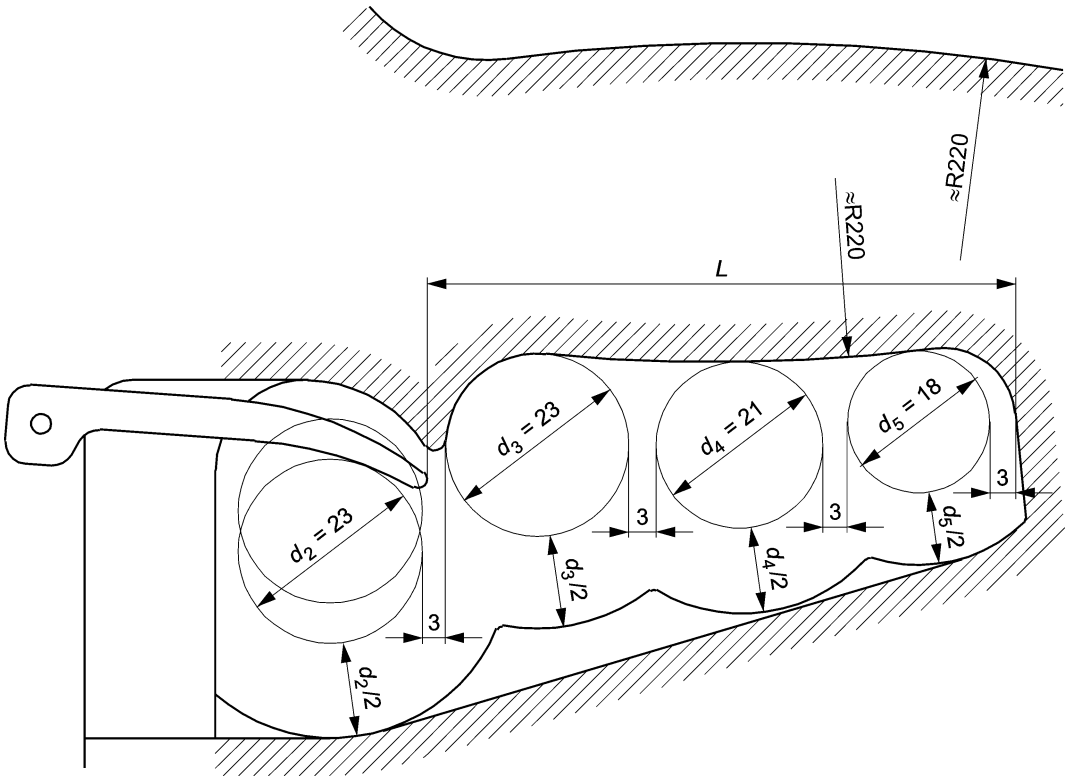


Figure F.1 — Example of handle dimensions on a cartridge operated tool

Annex ZA
(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 a 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 relevant Essential Requirements of that Directive 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.

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