BS EN 16264:2014

Incorporating corrigendum November 2014

BSI Standards Publication

Pyrotechnic articles — Other pyrotechnic articles — Cartridges for powder actuated tools

National foreword

This British Standard is the UK implementation of EN 16264:2014.

The UK participation in its preparation was entrusted to Technical Committee CII/47, Pyrotechnic articles.

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

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

Published by BSI Standards Limited 2014

ISBN 978 0 580 88687 4

ICS 71.100.30

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2014.

Amendments/corrigenda issued since publication

Date	Text affected
30 November 2014	Implementation of CEN Correction Notice 15 October 2014: Contents page added

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16264

September 2014

ICS 71.100.30

English Version

Pyrotechnic articles - Other pyrotechnic articles - Cartridges for powder actuated tools

Articles pyrotechniques - Autres articles pyrotechniques - Cartouches d'outils actionnés par poudre

Pyrotechnische Gegenstände - Sonstige pyrotechnische Gegenstände - Kartuschen für kartuschenbetriebene handgehaltene Werkzeuge

This European Standard was approved by CEN on 8 February 2014.

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Ref. No. EN 16264:2014 E

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Foreword

This document (EN 16264:2014) has been prepared by Technical Committee CEN/TC 212 “Pyrotechnic articles”, the secretariat of which is held by NEN.

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of an identical text or by endorsement, at the latest by March 2015 and conflicting national standards shall be withdrawn at the latest by March 2015.

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 2007/23/EC on the placing on the market of pyrotechnical articles.

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

The "Permanent International Commission for the Proof of Small-Arms, C.I.P.” has contributed substantially to this standard. The C.I.P. regulations pertinent to cartridges for powder actuated tools have been largely integrated in the present standard and the current states of technology are matched.

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

1 Scope

This European Standard defines the procedures for classifying, testing and labelling of cartridges for powder actuated tools (PAT cartridges), as defined in Clause 3 of this standard.

This European Standard does not apply to pyrotechnic articles containing blasting agents and military explosives except black powder and flash composition.

PAT cartridges contain pyrotechnic composition(s) delivering mainly gases, intended to propel a piston. The piston propels fasteners (e.g. nails) or drives hard marking characters into appropriate materials.

This standard also applies to PAT cartridges sold to persons younger than 18 years, if this is permitted by the member state due to the low hazard of the PAT cartridges.

NOTE PAT cartridges can also be used for hard marking tools. Information on cartridge operated fixing and hard marking tools can be found in EN 15895:2011.

This European Standard applies to the cartridges listed in Table 1.

Table 1 — Lists of the established calibres for PAT cartridges

	Calibre
Rimfire type	22 NC (5,5/16)
	22 (5,6/16)
	22 EX (5,6/25)
	5,7/16
	5,7/25
	6,3/10
	6,3/12
	6,3/14
	6,3/16
	6,8/11
	6,8/18
Centre fire type	9 × 17
	9 × 20
	9 × 27
	38 SP (9 × 29)

2 Normative references

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

EN ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics (ISO 3611)*

EN ISO 9237, *Textiles — Determination of the permeability of fabrics to air (ISO 9237)*

EN ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics (ISO 13385-1)*

ISO 2137, *Petroleum products and lubricants — Determination of cone penetration of lubricating greases and petrolatum*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
acceptance quality limit
AQL
quality level that is the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling

3.2
base material
material into which the fastener or marking punch is driven

3.3
calibre
designation of a cartridge, normally expressed in the form “body diameter / length”

Note 1 to entry: See Scope for applicable cartridge calibres.

3.4
cartridge for powder actuated tools (PAT)
device which contains a minor quantity of primer mix together with a larger quantity of solid propellant used to drive the piston of a fixing or hard marking tool

3.5
single cartridge
loose cartridge
cartridge that is not mechanically attached to other cartridges and is inserted individually in the cartridge chamber (by hand)

3.6
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

3.7
cartridge chamber
essentially cylindrical or slightly conical bore which accommodates the cartridge before ignition; located in the rear end of the piston guide of a cartridge operated tool; the dimensions of the cartridge chamber correspond to cartridge calibre

3.8
powder actuated tool
PAT
tool to drive fasteners into a base material by means of a piston powered by the hot combustion gases from a cartridge

3.9
cartridge case
closed container of essentially cylindrical shape made of metal or plastic forming the outer shell of a cartridge and containing a primer or primer mix and propellant

3.10
cartridge type
set of cartridges defined by specific calibre and design, including pyrotechnic compositions and tolerances

3.11
centre fire cartridge
cartridge in which the primer is located in a primer cup (see 3.26)

3.12
coefficients of tolerance
coefficients of tolerance for n measurements with a statistical certainty of 95 % in $K_{3,n}$ 90 % of cases, where $K_{3,10}$ = 2,36 for n=10

3.13
collation
means for attaching several cartridges to each other at regular distances; plastic strips and metal discs are commonly used for collation

3.14
combustion chamber
cavity adjoining to the cartridge chamber in which the combustion of the propellant takes place and consisting of a bore connecting the cartridge chamber with the main cavity of piston guide, the free volume of the piston guide itself behind the piston in its rearmost position, and sometimes a free volume in the concave piston head

3.15
crimp
closed front end of a (metal) cartridge generated by radial deformation of the cylindrical body into tight folds with an essentially star-shaped cross section

3.16
fastener
object intended for use in a cartridge operated fixing tool

Note 1 to entry: The object may be a nail, a threaded stud or similar object that is driven into the base material.

3.17
ignition pin
steel pin guided in a bore in the breech face igniting the primer mix of the cartridge by impacting on the rim of the cartridge bottom or centre primer cup

3.18
lot
consists of a batch of cartridges of the same type, having homogeneous components, manufactured in series production

3.19
piston
essentially cylindrical or shouldered element made of annealed steel, freely movable longitudinally in the cylindrical piston guide (“barrel”) of a cartridge operated tool which is accelerated by the high pressure in the combustion chamber at its rear and impacts on the fastener with its tip

3.20
piston guide
"barrel" of a cartridge operated tool which is essentially the cylindrical bore of a tool and containing the piston

3.21
plunger
slug
brass or semi hardened steel cylinder used in pressure barrel, having different face dimensions to reproduce the additional volume V_a

Note 1 to entry "Slug" is used as a synonym of "plunger" in the context of pressure measurement with a test barrel.

3.22
propellant
mostly nitrocellulose-based powder which fills the cartridge partly or totally, depending on cartridge strength, the hot combustion gases of which accelerate the piston of a cartridge operated tool

3.23
primary pack
package of cartridges of the same calibre and strength (colour), offered for retail sale as a single unit

3.24
primer mix
pyrotechnic composition located in the rim of the cartridge or in the centre primer which ignites the propellant when the ignition pin deforms the rim of the cartridge or the centre primer cup and locally compresses and ignites the primer mix

3.25
pyrotechnic composition
mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these, as a result of a self-sustained exothermic reactions

3.26
primer
device used in centre fire cartridges consisting of a metal cup containing primer mix and an anvil located in the centre

3.27
rim
circumferential outward bulge at the rear end of a cartridge generated by axial deformation of the hemispherical end of the punch-drawn metal blank

3.28
rimfire cartridge
cartridge in which the primer mix is located in the rim of the cartridge case

3.29
test barrel
test equipment used to measure the gas pressure and energy of PAT cartridges

3.30
volume of minimum chamber
V_{ET}
volume of minimum chamber according to Table 3 for measuring appliances (test barrel) is a constant value per calibre as presented in Figure 1

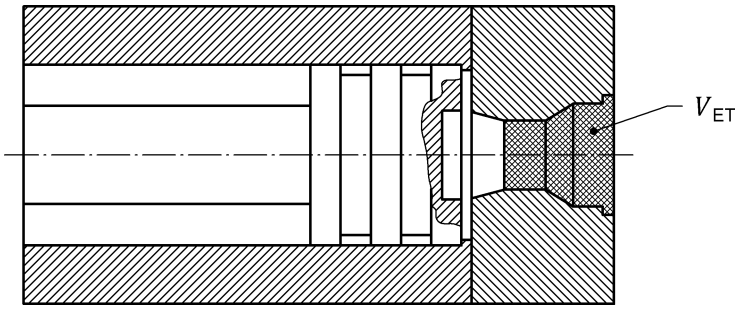


Figure 1 — V_{ET}

3.31
total volume of maximum cartridge
V_C
total volume of maximum cartridge as presented in Figure 2 according to Table 2

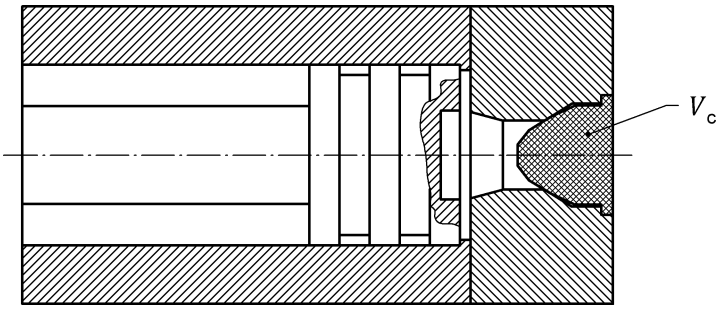


Figure 2 — V_C

3.32
volume of the material of the case
V_m
volume of the material of the case (without primer mix where rimfire cartridges are concerned, with primer where centre fire cartridges are concerned) as presented in Figure 3

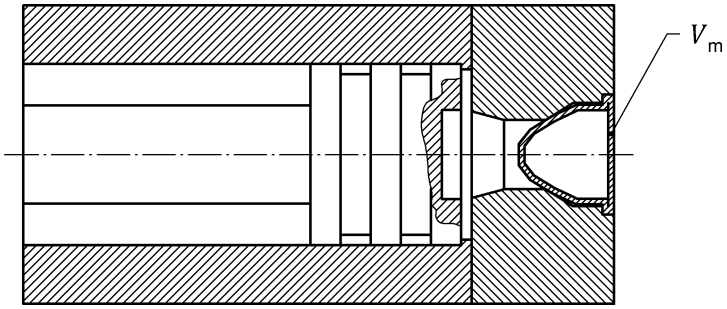


Figure 3 — V_m

3.33
additional volume
V_a
volume between the chamber and the plunger in its extreme position as presented in Figure 4

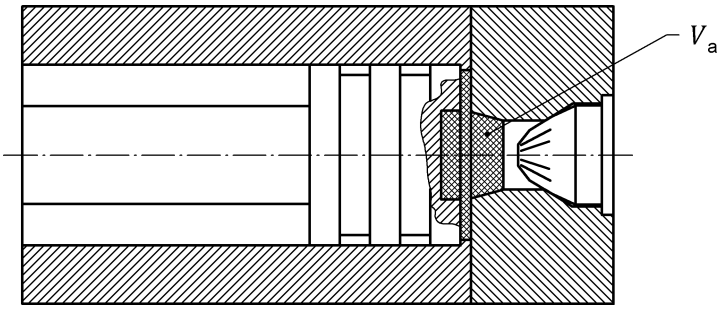


Figure 4 — V_a

3.34
total volume
V_{tot}
total volume of PAT tool $V_{tot} = V_{ET} + V_a$ as presented in Figure 5

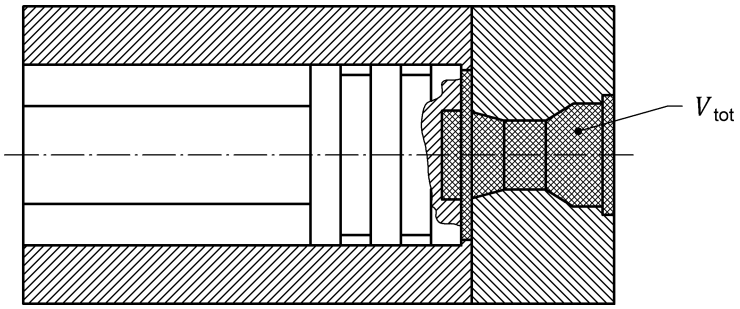


Figure 5 — V_{tot}

3.35
free volume
V_i
volume of free space between the cartridge and the chamber $V_i = V_{ET} - V_C$ as presented in Figure 6

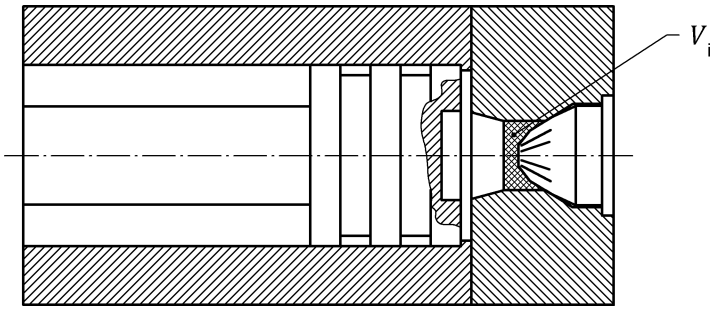


Figure 6 — V_i

3.36
free combustion volume
V_h
free volume in the chamber given by the equation $V_h = V_{ET} - V_m$ as presented in Figure 7

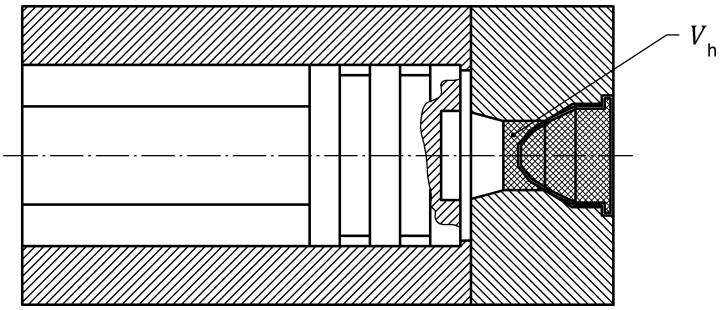


Figure 7 — V_h

3.37
total additional volume
V_A
additional volume given by the equation $V_A = V_i + V_a = (V_{ET} - V_C) + V_a$ as presented in Figure 8

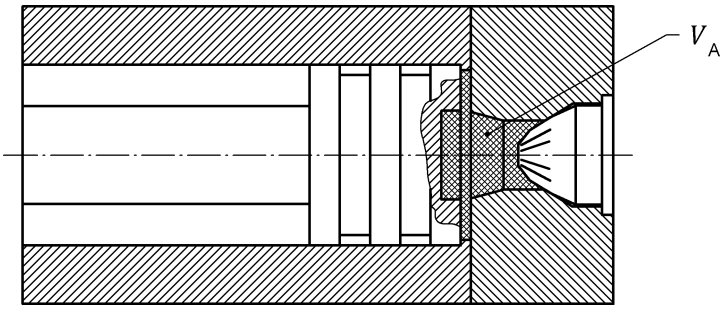


Figure 8 — V_A

3.38
total combustion volume
V_T
volume given by the equation $V_T = V_h + V_a = (V_{ET} - V_m) + V_a$ as presented in Figure 9

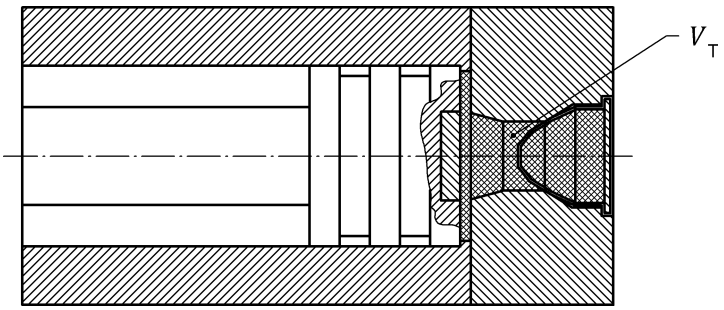


Figure 9 — V_T

4 Standard equipment

The standard equipment described in the following points shall be used during the test; any equivalent equipment with the same or better accuracy may be used alternatively.

4.1 Timing device:

— Type 1: Timing device capable of being read to the nearest 0,01 s.

— Type 2: Timing device capable of being read to the nearest 1 min.

4.2 Calliper:

— Type 1: Flat faced Vernier calliper reading to 0,05 mm (conforming to EN ISO 13385-1).

— Type 2: Micrometer calliper reading to 0,01 mm (conforming to EN ISO 3611).

4.3 Scale:

— Type 1: Minimum capacity 200 g.

— Type 2: Resolution 5,0 mg or better (linearity *e* = 5,0 mg or better).

4.4 Climatic chamber:

— Temperature from – 10 °C up to + (52 ± 1) °C.

— Relative Humidity from 60 % up to (75 ± 5) %.

Several climatic chambers may be used for different tests if these tests require different temperatures and / or humidity.

5 Requirements

5.1 Design documentation

5.1.1 General

The manufacturer or importer shall supply a document which describes the PAT cartridges. This document facilitates the analysis to be done by the notified body to ensure that the article fulfils the Essential Safety Requirements of Directive 2007/23/EC.

5.1.2 Minimum content of documentation

The documentation shall contain the following minimum information:

— Identification and description of the cartridges (name and calibre).

— Identification of the fixing or hard marking tool(s) for which the conformity certificate of the cartridges is applied.

— Net weight of propellant.

— Net weight of primer mix.

— Chemical composition and percentage of substances used in the propellant and the primer mix.

— Pressure level developed by the cartridges, measured as defined in 5.4.

— Energy level developed by the cartridges, measured as defined in 5.5.

— Name and address of the manufacturer or importer.

5.2 Design

5.2.1 General

These tests shall be done to verify that the tested cartridges are in accordance with the Essential Safety Requirements of Directive 2007/23/EC.

5.2.2 Conformity to documentation

The tested cartridges shall be in accordance with the relevant manufacturing documentation. The requirement is considered fulfilled if the manufacturer's documentation contains the minimum content (see 5.1.2) and the article has been successfully tested according to 5.3 and 5.5.

Neither quantitative nor qualitative analyses of the chemical composition shall be required.

5.3 Dimensions

5.3.1 General

The verification of dimensions shall be done to check the important cartridge dimensions from the safety point of view (see Figure 10 a), Figure 10 b), Figure 10 c), Figure 11 and Table 2).

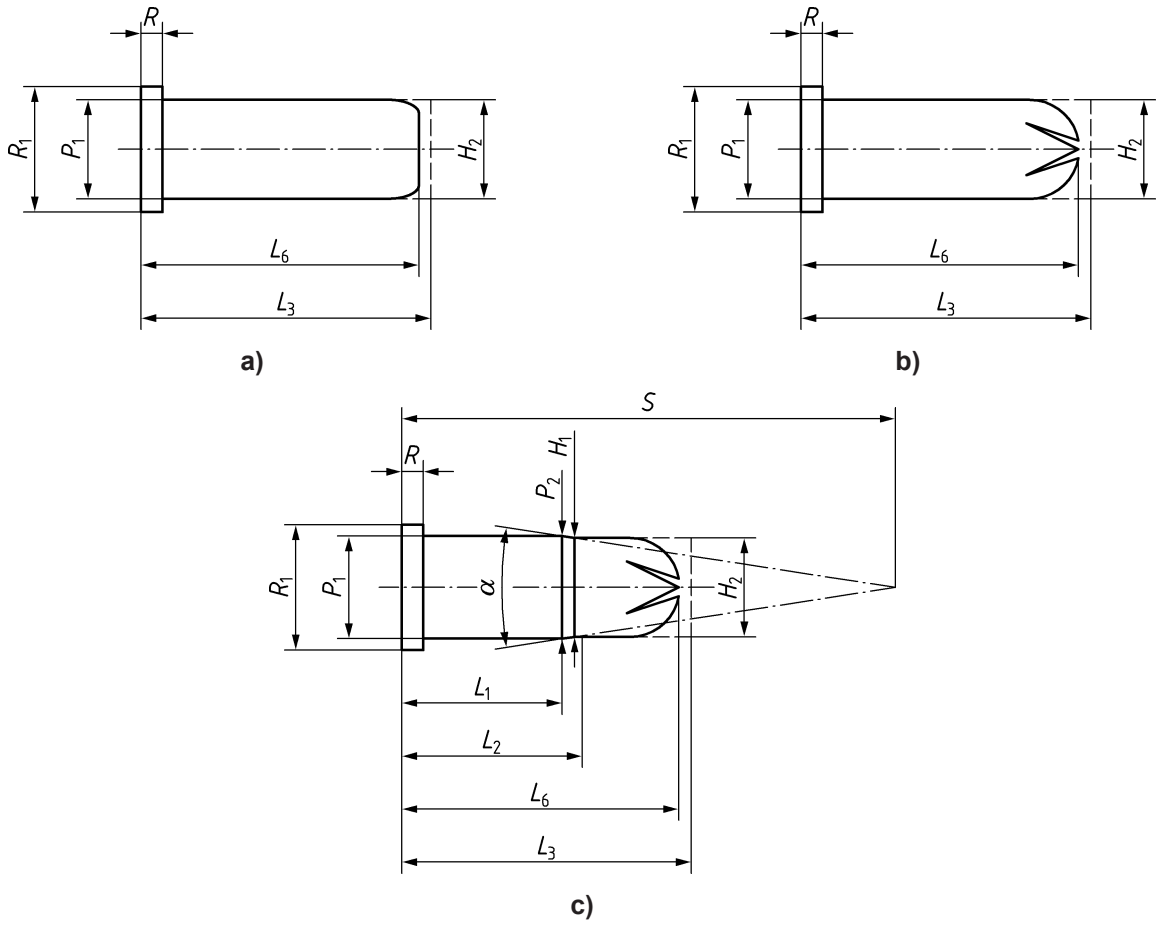


Figure 10 — Dimensions of rim-fire type cartridges

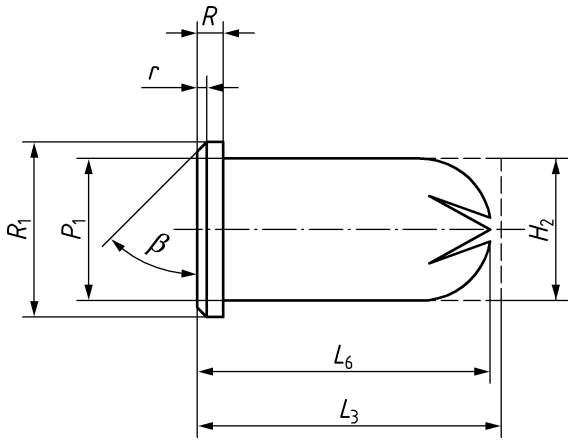


Figure 11 — Dimensions of centre-fire type cartridges

Table 2 — Maximum cartridges dimensions

	CARTRIDGE	L_3	L_6	R	R_1	f	Beta	P_1	P_2	α	S	H_1	H_2	V_C
Rimfire type	22 NC (5,5/16)	15,6	15,3	1,12	7,06			5,74	5,74	17°32'44"	27,64	5,49	5,49	0,39
	22 (5,6/16)	16,2	15,5	1,12	7,06			5,74					5,74	0,35
	22 EX (5,6/25)	25,3	25,1	1,12	7,06			5,74					5,74	0,68
	5,7/16	16,3	16	1,36	7,3			5,74					5,74	0,43
	5,7/25	25,5	25	1,4	7,15			5,74					5,74	0,69
	6,3/10	10,8	10,3	1,25	7,6			6,32					6,32	0,26
	6,3/12	12,8	12,5	1,3	7,6			6,32					6,32	0,33
	6,3/14	14,5	14	1,3	7,6			6,32					6,32	0,38
	6,3/16	16,6	16,3	1,3	7,6			6,32					6,32	0,5
	6,8/11	11,8	11	1,45	8,5			6,86					6,86	0,34
	6,8/18	18,7	18	1,45	8,5			6,86					6,86	0,61
Centre fire type	9 × 17	18,3	18,15	1,35	11,1	0,3	45°	9,58					9,58	1,08
	9 × 20	20,00	19,50	1,35	11	0,50	45°	6,63					9,63	1,48
	9 × 27	27,00	26,00	1,35	11	0,50	45°	9,63					9,63	1,99
	38 SP (9 × 29)	29,2	29	1,47	11,18	0,3	45°	9,63					9,63	2,18

Definition of symbols:

L_3: total length of the cartridge after firing (mm)

L_6: total length of the cartridge before firing (mm)

R: thickness of case rim (mm)

R_1: diameter of case rim (mm)

P_1: diameter at the end of rill or rim (mm)

H_2: diameter of the case at the end of the cylindrical part (mm)

α = Angle of junction cone

V_C: Total volume of maximum cartridge (cm^3)

5.3.2 Equipment

The shape gauge used in this test is a block of steel with a shaped bore as illustrated in Figure 12 with dimensions given in Table 3.

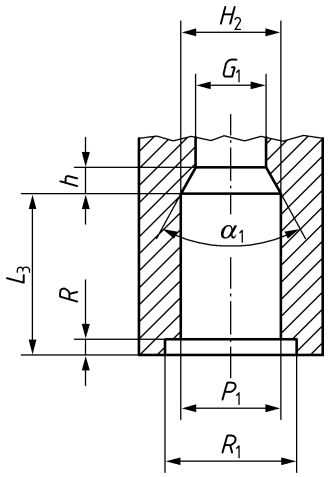


Figure 12 — Chamber dimensions

Table 3 — Minimum chamber dimension

	CARTRIDGE	L_3	R	R_1	P_1	H_2	G_1	α_1	V_{ET}
Rimfire type	22 NC (5,5/16)	16	1,1	7,1	5,8	5,76	6	180°	0,45
	22 (5,6/16)	16,33	1,1	7,3	5,76	5,76	6	180°	0,44
	22 EX (5,6/25)	26	1,1	7,3	5,8	5,76	6	180°	0,7
	5,7/16	17	1,36	7,3	5,8	5,76	6	180°	0,47
	5,7/25	26	1,45	7,3	5,8	5,76	6	180°	0,71
	6,3/10	11	1,25	7,7	6,35	6,35	6	180°	0,37
	6,3/12	13	1,25	7,7	6,35	6,35	6	180°	0,43
	6,3/14	15	1,25	7,7	6,35	6,35	6	180°	0,49
	6,3/16	17	1,25	7,7	6,35	6,35	6	180°	0,56
	6,8/11	12	1,45	8,55	6,9	6,9	6	180°	0,48
	6,8/18	19	1,45	8,55	6,9	6,9	6	180°	0,74
Centre fire type	9 × 17	18,5	1,3	11,2	9,6	9,6	6	180°	1,37
	9 × 20	20,50	1,38	11,08	9,64	9,64	10,20	180°	1,53
	9 × 27	27,00	1,50	11,20	9,65	9,65	10,02	180°	2,01
	38 SP (9 × 29)	30	1,5	11,25	9,67	9,65	6	180°	2,24

Definition of symbols:

L_3 = Length of chamber at diameter H_2 (mm)

R = Distance between breech face and the backward edge of barrel (mm)

R_1 = Breech diameter (mm)

P_1 = Diameter of chamber at distance R (mm)

H_2 = Diameter at distance L_3 (mm)

G_1 = Diameter at commencement of rifling (mm)

V_{ET} = Volume of minimum chamber (cm^3)

5.3.3 Procedure

The dimensions of the cartridge shall be checked. Fixed dimension limits are checked by means of a general shape gauge, taking into account minimum dimensions of chambers as referred in Figure 12 and Table 3.

The cartridges shall be fitted in the general shape gauge and the dimensions L_6, H_2 verified with micrometer calliper (4.2).

5.3.4 Acceptance criteria

The maximum dimensions, verified with micrometer calliper (4.2), shall be in conformity with the fixed dimension limits reported in Figures 10 a), 10 b), 10 c) and 11 and in Table 2.

All cartridges tested shall enter smoothly into the gauge with a maximum force of 10 N.

5.4 Pressure measurement

5.4.1 General

The purpose of this test is to verify the maximum gas pressure developed by the tested cartridges.

5.4.2 Equipment

5.4.2.1 General

The equipment shown in Figure 13 to Figure 18 shall be used for pressure testing. The dimensions reported on the drawings are allowed to have the tolerances shown in Table 4.

Table 4 — Equipment tolerance

Dimension	Tolerance
P_1	+ 0,03 mm
H_2	
R_1	+ 0,05 mm
R	
L_3	+ 0,10 mm

5.4.2.2 Test barrel

The test barrel assembly shall meet the following requirements:

— The test barrel shall be made from steel with a minimum tensile strength of R = 1 000 MPa as presented in Figure 13.

NOTE Suitable material is, e.g. no. 1.7225 (42CrMo4):

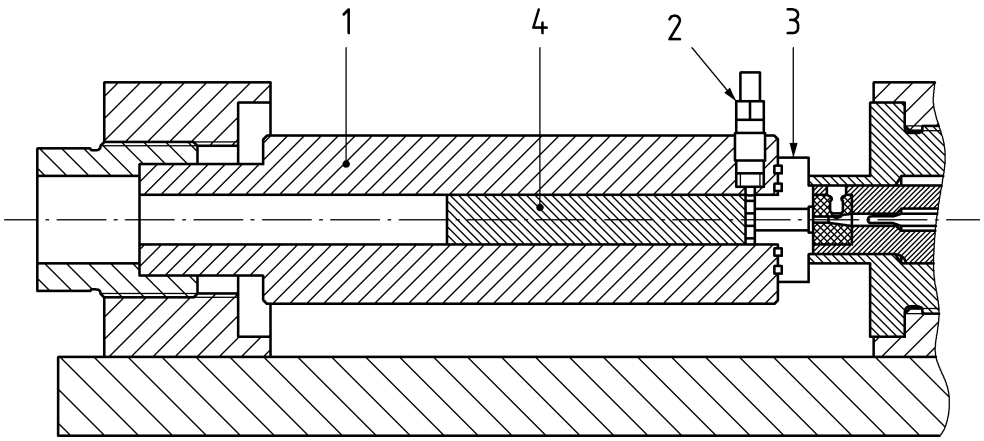
— Calibre: Ø 16 mm (F7);

— Length: (200 ± 1) mm (from the end of the chamber);

— Position of pressure transducer: 1,5 mm measured from the end of the chamber;

— Transducer hole: Ø 3 mm;

— Depth: 3 mm.



Key

1 barrel and transducer mounting
2 piezoelectric pressure transducer
3 cartridge holder
4 plunger

Figure 13 — Test barrel assembly

5.4.2.3 Cartridge holder

The cartridge holder shall meet the following requirements:

— The insert shall be made from steel with a minimum tensile yield strength of R = 1 300 MPa as presented in Figure 14.

NOTE 1 Suitable materials are no. 1.7707 (30CrMoV9) or no. 1.6580 (30CrNiMo8).

NOTE 2 Diameter to be adapted to the fitting in the barrel.

Dimensions in millimetres

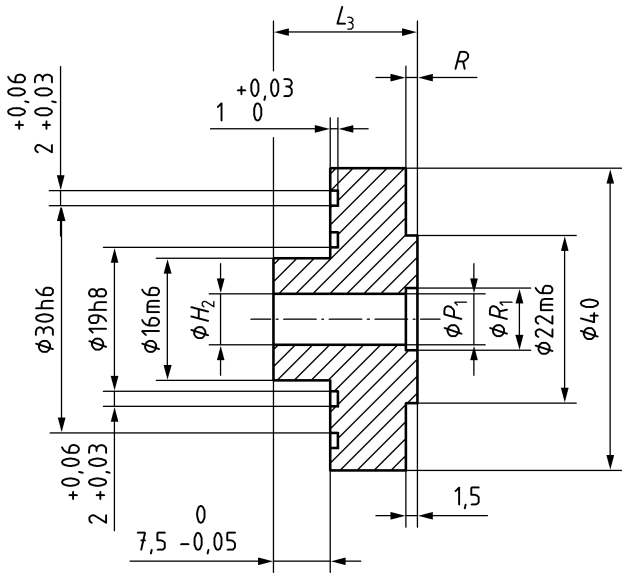


Figure 14 — Cartridge holder

Dimensions in millimetres

Table 5 — Cartridge holder

CARTRIDGE	L_3	R	R_1	P_1	H_2
22 NC (5,5/16)	16	1,1	Ø 7,10	Ø 5,8	Ø 5,76
22 (5,6/16)	16,33	1,1	Ø 7,30	Ø 5,76	Ø 5,76
22 EX (5,6/25)	26	1,1	Ø 7,30	Ø 5,80	Ø 5,76
5,7/16	17	1,36	Ø 7,30	Ø 5,80	Ø 5,76
5,7/25	26	1,45	Ø 7,30	Ø 5,80	Ø 5,76
6,3/10	11	1,25	Ø 7,70	Ø 6,35	Ø 6,35
6,3/12	13	1,25	Ø 7,70	Ø 6,35	Ø 6,35
6,3/14	15	1,25	Ø 7,70	Ø 6,35	Ø 6,35
6,3/16	17	1,25	Ø 7,70	Ø 6,35	Ø 6,35
6,8/11	12	1,45	Ø 8,55	Ø 6,90	Ø 6,90
6,8/18	19	1,45	Ø 8,55	Ø 6,90	Ø 6,90
9 × 17	18,5	1,3	Ø 11,2	Ø 9,60	Ø 9,6
9 × 20	20,5	1,38	Ø 11,08	Ø 9,64	Ø 9,64
9 × 27	27	1,5	Ø 11,20	Ø 9,65	Ø 9,65
38 SP (9 × 29)	30	1,5	Ø11,25	Ø 9,67	Ø 9,65

5.4.2.4 Plunger

The plunger shall meet the following requirements:

— The plunger shall be made material with a minimum tensile strength of R = 550 – 560 MPa as presented in Figure 15.

NOTE Suitable materials are brass (58 - 70 % Cu) or semi hardened steel:

— Diameter: 16 mm (h7);

— Mass: M_p = (80 ± 1) g;

— Additional volume: V_a = 0,16 cm^3 to 0,80 cm^3;

— Length: proportional to mass.

Dimensions in millimetres

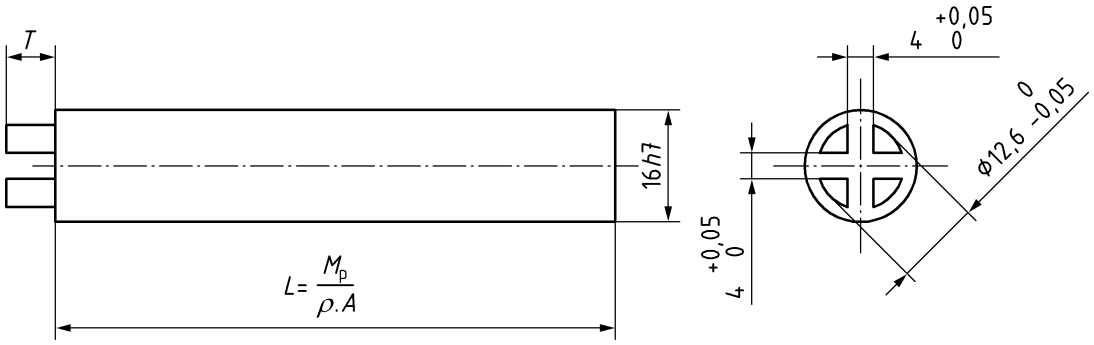


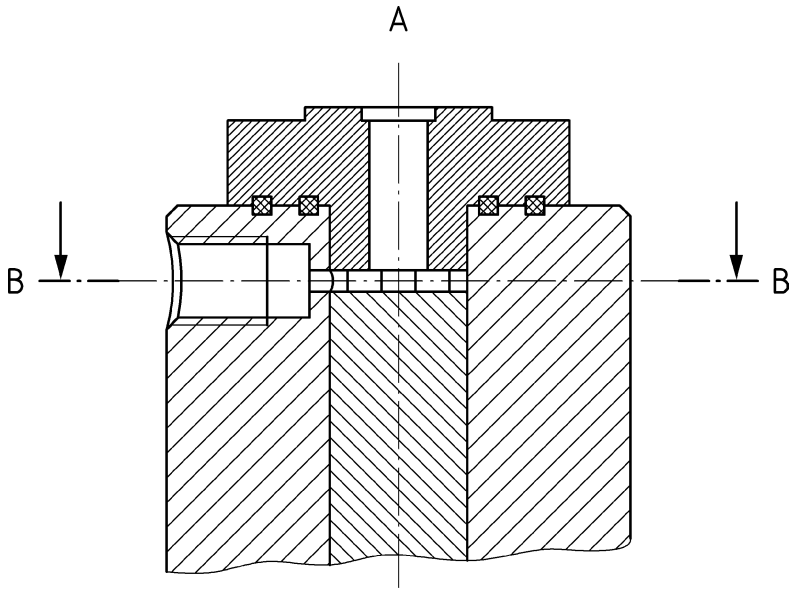
Figure 15 — Plunger (slug)

Table 6 — Plunger (slug)

Test	V_a cm^3	T mm
Rimfire	0,16	1,00 + 0,02
Centre fire	0,40	2,50 + 0,05
Rimfire	0,80	5,00 + 0,05

5.4.2.5 Crossed slots

The crossed slots of the piston shall lie in the axis of the groove of the transducer.



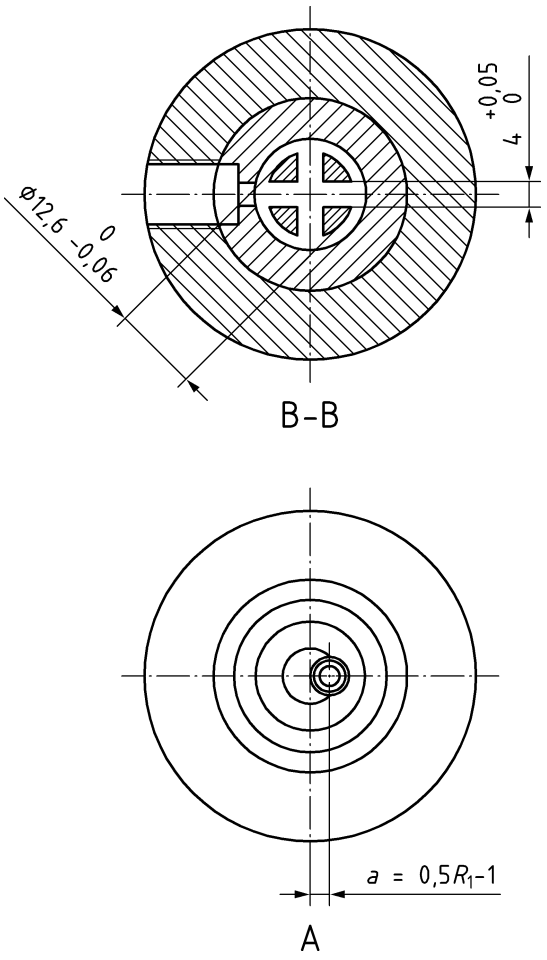
Key

A top view

B-B cross section

a) Position of the crossed slots

Dimensions in millimetres



Key

A top view

B-B cross section

b) Position of the crossed slots (Section B - B) and position of the firing pin (from below) (View A)

Figure 16

5.4.2.6 Plunger operated test barrel

The test barrel shall be made from steel with a minimum tensile strength of R = 1 000 MPa as presented in Figure 17.

NOTE Suitable material is no. 1.7225 (42CrMo4). The dimensions in brackets are given for information.

Dimensions in millimetres

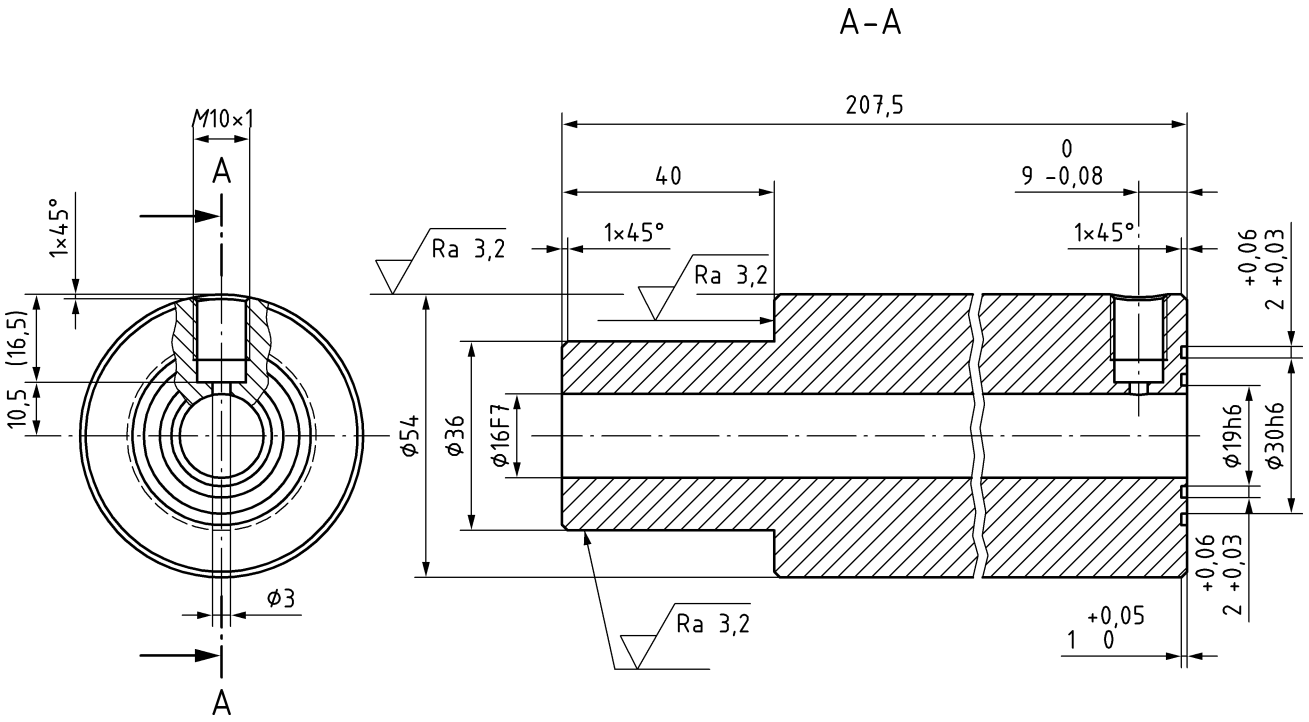


Figure 17 — Plunger operated test barrel

5.4.2.7 Seals

The seals shall meet following requirements as shown in Figure 18.

NOTE Suitable material is CuZn40Pb2.

Dimensions in millimetres

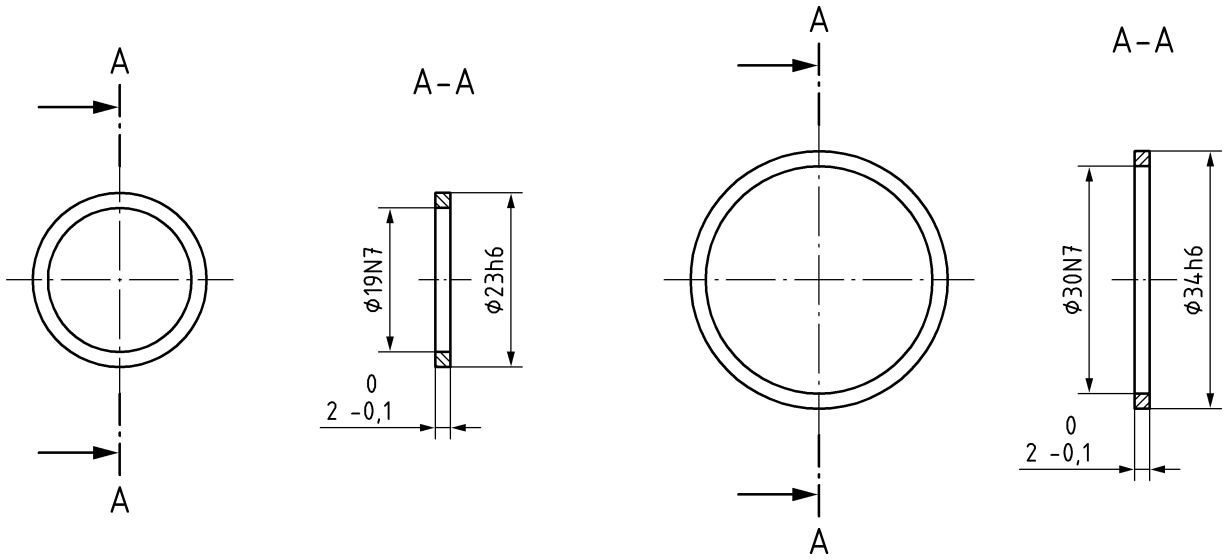


Figure 18 — Seals

5.4.2.8 Equipment for pressure measurement

The equipment for pressure measurement shall meet the following requirements:

a) Electromechanical transducer:

   1) Range of measurement: up to 7 000 bar;

   2) Pressure transmission surface: Ø ≤ 6 mm;

   3) Fundamental frequency: ≥ 100 kHz;

   4) Deviation from linearity: ≤ 1 %;

b) Electronic filter:

   1) Approximately 20 kHz (−3 db);

   2) Bessel characteristic n = 2 (12 dB/octave);

c) Climatic chamber see 4.4;

d) Timing device see 4.1 (type 2).

5.4.3 Procedure

5.4.3.1 General

The test shall be carried out on cartridges acclimatized at least 24 h, in a climatic chamber, at the following conditions:

— temperature: (+21 ± 1) °C;

— relative humidity: (60 ± 5) %.

5.4.3.2 Rimfire

In case of rimfire cartridges, the pressure shall be measured using at least 12 cartridges for each additional volume:

V_a = 0,16 cm^3 and 0,8 cm^3

5.4.3.3 Center fire

In case of centre fire cartridges, the pressure shall be measured using at least 12 cartridges for an additional volume:

V_a = 0,4 cm^3

5.4.3.4 Evaluation of the results

Twelve firings shall be carried out for each additional volume in order to obtain 10 usable figures.

If any failure to conduct the procedure correctly is observed, the respective results shall be disregarded and the test shall be repeated.

For other aberrant extreme values, the following criterion shall be applied:

— on completing a series of 12 measurements with the same additional volume, the recorded values shall be numbered in ascending order $(P_1,...P_{12})$;

— then the extreme values P_1 and P_{12} shall be examined;

— having examined P_1 and P_{12}, the following formula can then be written:

$$ZB_1 = \frac{P_3 - P_1}{P_{11} - P_1}$$

$$ZB_2 = \frac{P_{12} - P_{10}}{P_{12} - P_2}$$

where ZB_1 and ZB_2 are the ratios of differences of pressure values.

If ZB_1 or ZB_2 > 0,490, P_1 or P_{12} respectively shall be eliminated. If neither value is eliminated, the last two recorded values shall be disregarded. If only one value is eliminated, the last recorded values shall be disregarded.

5.4.3.5 Sequence of testing steps

The test shall be conducted as indicated in the followings points:

a) The testing cartridges shall be acclimatized for at least 24 h at an ambient temperature of (+21 ± 1) °C and at relative air humidity of (60 ± 5) %.

b) The cartridge holder and the appropriate plunger for the additional volume shall be selected according to the calibre of the cartridge to be fired.

c) The bore of the barrel shall be cleaned and lightly lubricated such that the plunger slides in easily.

d) A special lubricant as described in f) of this paragraph shall be applied to the diaphragm of the electromechanical transducer.

e) The electromechanical transducer shall be screwed onto the transducer holder, applying the tightening torque specified by the manufacturer.

f) Before each firing, the channel through which the pressure will be transmitted shall be filled with a silicone-based lubricant of the following specifications: density approximately 1 (g/cm^3), penetration 180 to 210 (1/10 mm) (still medium and agitated medium) in accordance with ISO 2137.

g) The excess lubricant introduced into the barrel while attaching the electromechanical transducer shall be removed.

h) The plunger shall be pushed in as far as it will go, with its flanges positioned opposite to the cartridge so that the cross-shaped opening in the piston is in line with the axis of the electro-mechanical transducer.

i) In subsequent firings, care shall be taken that during handling the plunger is not moved – not even slightly – out of position.

j) After each firing, the cartridge case shall be ejected and recovered to examine the marks from the firings.

k) The plunger shall be recovered and checked to ensure that there are no marks from the firings.

l) Any carbon deposits shall be removed.

If there are signs of excessive gas leaks, the measurement obtained shall not be used. In subsequent tests, the necessary precautions shall be taken to improve gas tightness.

5.4.4 Acceptance criteria

The results shall be interpreted in accordance with the rules of statistics according to Table 7.

Table 7 — Acceptance criteria to be considered

P_{max} (0,16) and P_{max} (0,8)	Maximum admissible pressure for rimfire cartridges with additional volumes V_a = 0,16 cm^3 and 0,8 cm^3 according to Table 8
$P_{max\ colour}$(0,16) and $P_{max\ colour}$ (0,8)	Maximum declared pressures for each colour, for rimfire cartridges calibre, with additional volumes V_a = 0,16 cm^3 and 0,8 cm^3 These values shall be less or equal to P_{max} (0,16) and P_{max} (0,8)
P_{max} (0,4)	Maximum admissible pressure for centre fire cartridges with the additional volume V_a = 0,4 cm^3 according to Table 8
$P_{max\ colour}$ (0,4)	Maximum declared pressure for each colour for centre fire cartridges calibre with the additional volume V_a = 0,4 cm^3 This value shall be less or equal to P_{max} (0,4)

where

$\overline{P_n}(V_a)$ Arithmetic mean of n (10) pressure measurements for the additional volume V_a;

$K_{i.n}$: Coefficient of tolerance for n measurements. Here, the coefficient for 3 sigma and 90 % confidence level is used: 2,36;

S_n: Standard deviation of pressure for n measurements.

In the case of rimfire cartridges, the mean pressure $\overline{P_n}$ for the two additional volumes V_a = 0,16 cm^3 and 0,8 cm^3 shall be less than or equal to the respective maximum admissible values:

P_{max} (0,16) and P_{max} (0,8).

In the case of centre fire cartridges the mean pressure $\overline{P_n}$ for the additional volume V_a = 0,4 cm^3 shall be less than or equal to the maximum declared value P_{max} (0,4):

$$\overline{P_{10}}(V_a) \le P_{max}(V_a)$$

The requirement for a cartridge to produce no individual value for maximum pressure in excess of 1,15 P_{max} (V_a) shall be regarded as fulfilled if:

$$\overline{P_{10}} + K_{3,10} \cdot S_{10} \le 1{,}15 \cdot P_{max}(V_a)$$

$$\overline{P_{10}} + K_{3,10} \cdot S_{10} = \overline{P_{10}} + 2{,}36 \cdot S_{10} \le 1{,}15 \cdot P_{max}(V_a)$$

$$1{,}15 \cdot P_{max}(V_a) = P_K$$

Table 8 — Maximum pressures

CARTRIDGE		VOLUMES [cm³]		PRESSURES V_{a1} [bar]		PRESSURES V_{a2} [bar]	
		V_{a1}	V_{a2}	P_{max}	P_K	P_{max}	P_K
Rimfire type	22 NC (5,5/16)	0,16	0,8	2 800	3 220	1 300	1 495
	22 (5,6/16)	0,16	0,8	4 300	4 945	2 000	2 300
	22 EX (5,6/25)	0,16	0,8	4 700	5 405	2 500	2 875
	5,7/16	0,16	0,8	3 200	3 680	1 500	1 725
	5,7/25	0,16	0,8	2 500	2 875	1 200	1 380
	6,3/10	0,16	0,8	3 200	3 680	1 600	1 840
	6,3/12	0,16	0,8	3 000	3 450	1 500	1 725
	6,3/14	0,16	0,8	2 650	3 048	1 350	1 553
	6,3/16	0,16	0,8	4 500	5 175	2 400	2 760
	6,8/11	0,16	0,8	3 000	3 450	1 550	1 783
	6,8/18	0,16	0,8	4 500	5 175	2 500	2 875
Centre fire type	9 × 17	0,4	/	1 450	1 668	/	/
	9 x20	0,4	/	1 000	1 150	/	/
	9 × 27	0,4	/	3 100	3 565	/	/
	38 SP (9 × 29)	0,4	/	3 600	4 140	/	/

5.5 Energy measurement

5.5.1 Scope

The energy test shall be performed to verify if the energy level developed by the cartridge corresponds to the energy level declared by the manufacturer (see 5.1.2).

The energy level of the cartridges shall be indicated using the scheme of colours and numbers below (Table 9). For each calibre and colour, the manufacturer shall declare an energy value in Joule developed by the cartridge for the additional volume V_a = 0,16 cm³ for rimfire and V_a = 0,4 cm³ for centre fire.

Table 9 — Energy scale table

Energy Scale	Colour of cartridge	Energy level
1	Grey	Minimum energy
2	Brown or white	
3	Green	
4	Yellow	
5	Blue	
6	Red	
7	Black or purple	Maximum Energy

5.5.2 Equipment

For the energy measurement, the equipment of 5.4.2 shall be used.

For the test a plunger with additional volume of V_a = 0,16 cm^3 shall be used.

The plunger velocity shall be measured using light screens and a computing chronograph. The cumulative accuracy, comprehensive of chronograph accuracy and stability error shall be less than 0,25 %.

Another device with the same accuracy or better may be used.

Climatic chamber: see 4.4.

Timing device: see 4.1 (timing device type 1).

5.5.3 Procedure

5.5.3.1 General

The test shall be carried out on cartridges acclimatized for at least 24 h at the following conditions:

— temperature: (+21 ± 1) °C;

— relative humidity: (60 ± 5) %.

5.5.3.2 Test sequence

The test shall be conducted simultaneously to the pressure test (5.4).

5.5.3.3 Test setup

The first light screen shall be located at 1 m from the barrel muzzle and orthogonally to the plunger trajectory.

The second light screen shall be located 0,5 m ± 0,5 mm from the first one, orthogonally to the plunger trajectory.

5.5.3.4 Procedure of velocity measurement

The plunger velocity for the defined additional volume V_a shall be recorded.

5.5.3.5 Evaluation

If any failure to conduct the procedure correctly is observed, the respective results shall be disregarded and the test shall be repeated.

For other aberrant extreme values, the following criterion shall be applied:

— on completing a series of 12 measurements with the same additional volume, the recorded velocity values shall be numbered in ascending order $(v_1,...v_{12})$;

— then the extreme values v_1 and v_{12} shall be examined;

— having examined v_1 and v_{12}, the following formula can then be written:

$$Q_1 = \frac{v_3 - v_1}{v_{11} - v_1}$$

$$Q_2 = \frac{v_{12} - v_{10}}{v_{12} - v_2}$$

where Q_1 and Q_2 are the ratios of differences of velocity values.

If Q_1 and/or Q_2 > 0,490, v_1 and/or v_{12} respectively shall be eliminated. If neither value is eliminated, the last two recorded values shall be disregarded. If only one value is eliminated, the last recorded value shall be disregarded.

The average velocity $\bar{v}$ calculated using the 10 recorded values is used to calculate the energy.

The energy E_{V_a} shall be calculated by the following formula:

$$E_{V_a} = \frac{1}{2} m \bar{v}^2$$

where

E_{V_a} is the energy determined with the minimum additional volume V_a of 0,16 cm^3;

m is the plunger mass [kg];

$\bar{v}$ is the average recorded plunger velocity [m/s].

5.5.4 Acceptance criteria

The test is passed if the average energy E_{V_a} calculated for the defined additional volume V_a differs less than 20 % from the manufacturer's declared energy value.

5.6 Collation test

5.6.1 General

The collation test shall be carried out in order to demonstrate the suitability of collated cartridges for a specific fixing or hard marking tool.

There are four ways to achieve this:

a) using a commercially available tool in combination with test cartridges having an increased pressure as defined in 5.6.2.1;

b) using a commercially available tool with a reduced combustion volume as defined in 5.6.2.2 in combination with the cartridges as submitted for type approval;

c) using a commercially available tool with a reduced combustion volume and a special piston as defined in 5.6.2.3 in combination with the cartridges as submitted for type approval;

d) demonstrating that a valid C.I.P. system approval exists for the relevant combination of cartridges and tool.

System approvals conducted according to the C.I.P. Decisions, 2009, part D-5.2 and issued by a C.I.P. proof house are accepted instead of the collation test.

5.6.2 Equipment for 5.6.1 a) to 5.6.1 c)

Test shall be performed in each tool that the cartridge manufacturer has declared suitable for the use with his cartridges.

5.6.2.1 The test equipment consists of a commercially available tool of the type which the cartridge type approval is applied for. No dimensional changes to either the piston or tool body are carried out. The test cartridges to be used are specially manufactured to produce a combustion pressure of 115 % of the average maximum pressure declared by the manufacturer or importer of the cartridge for each colour during type approval.

5.6.2.2 The test equipment consists of a commercially available tool of the type which the cartridge type approval is applied for. The tool body shall not be modified.

The test tool shall have a piston with a reduced system testing volume V_s as defined below (compare Figure 20).

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

The values of b and V_h^*, etc. per calibre, as given in Table 10, apply.

NOTE The free combustion volume in the reduced chamber V_h^* is calculated as follows:

$$V_h^* = V_h - \alpha \cdot M_c$$

where

M_c is the mass of the propellant and primer mix in g;

$\alpha = 1/\rho = 0,6$ is the average specific volume of the propellant and primer mix in cm^3/g.

5.6.2.3 The test equipment consists of a commercially available tool of the type which the cartridge type approval is applied for.

The diameter of the piston and/or tool shall be modified to produce the smallest clearance between both as defined by the tolerances in the design drawings of the tool manufacturer.

The test tool shall have a piston with a reduced system testing volume V_s as defined below (compare Figure 19).

$$V_S = 1{,}10^{\frac{1}{b}} \cdot V_a + \left(1{,}10^{\frac{1}{b}} - 1 \right) \cdot V_h^*$$

The values of b and V_h^*, etc. per calibre, as given in Table 10, apply.

NOTE The free combustion volume in the reduced chamber V_h^* is calculated as follows:

$$V_h^* = V_h - \alpha \cdot M_c$$

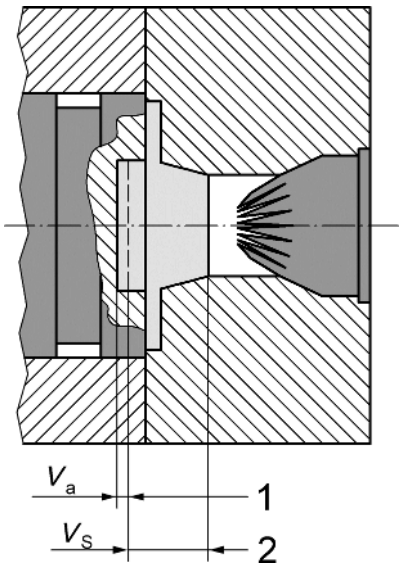
where

M_c is the mass of the propellant and primer mix in g;

$\alpha = 1/\rho = 0,6$ is the average specific volume of the propellant and primer mix in cm^3/g.

Table 10 — Values for the calculation of the test volume V_s for the collation test

Calibre	b	V_h^*
	–	cm^3
6,3/10	- 0,607	0,14
6,3/16	- 0,615	0,20
6,8/11	- 0,646	0,20
6,8/18	- 0,684	0,31



Key

1 minimum operational volume

2 reduced system testing volume

Figure 19 — Volumes of combustion chamber (V_a, V_s)

5.6.3 Procedure for 5.6.1 a) to 5.6.1 c)

The test shall be carried out on four standard collation systems, fully loaded with cartridges of identical strength, acclimatized at least 24 h at the following conditions:

— temperature: (+21 ± 1) °C;

— relative humidity: (60 ± 5) %.

The test shall be performed by firing three consecutive cartridges of each collated system.

The test shall be carried out with a fastener and base material suitable for the combination of tool and cartridge used in the test.

If the tool is equipped with a feature to regulate the energy, the test shall be conducted at maximum energy level.

5.6.4 Acceptance criteria for 5.6.1 a) to 5.6.1 c)

The test is passed if after the firing:

a) the walls and the bottoms of all cartridge cases are free from cracks, holes and fractures;

b) the collation system is intact and not broken or fractured and is free from lengthwise cracks affecting the three spent cartridges;

c) neighbouring cartridges have not been affected.

If case fracture or collated strip rupture are experienced, the test equipment shall be thoroughly checked.

If the test equipment is found to be defective, the test is to be fully repeated, as described in 5.6.3 after repairing or replacing the test equipment.

Lengthwise cracks within the crimp area, being no longer than the crimp itself, are acceptable as long as no metallic or plastic pieces separate from the cartridge case.

5.7 Residue test

5.7.1 General

The residue test shall be done for the safety of the user by verifying the amount of unburned powder produced by cartridges during combustion under conditions representing normal use.

All collated PAT cartridges of all power levels shall pass this test.

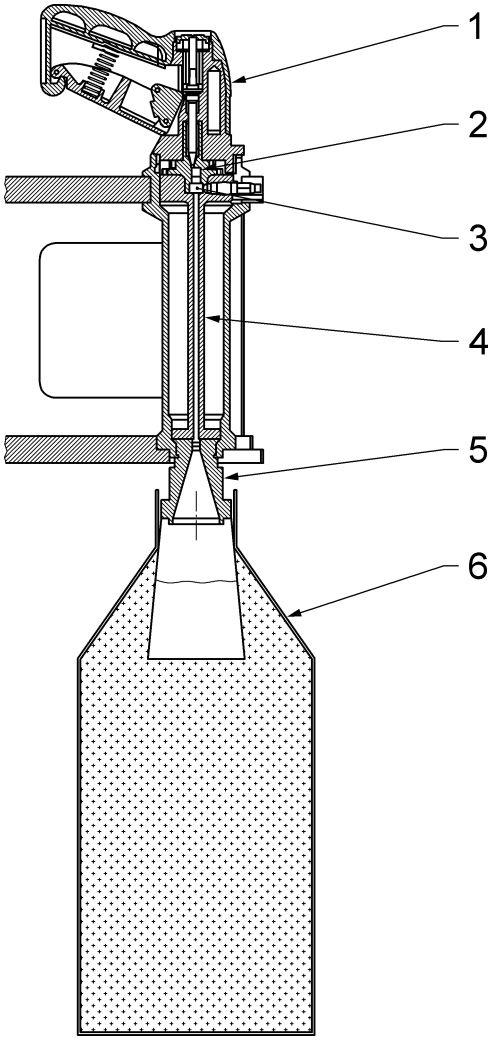
5.7.2 Equipment

5.7.2.1 **Scale** (see 4.3).

5.7.2.2 **Climatic chamber** (see 4.4).

The test is performed as a tool-independent rig test. It simulates the typical combustion characteristics of powder actuated tools operated at minimum power.

The test rig (see Figure 20) consists of six main components or modules:



Key

1 firing unit
2 cartridge chamber insert
3 combustion chamber
4 nozzle
5 muff and flame deflector
6 collector bag

Figure 20 — Schematic drawing of residue test rig

5.7.2.3 **Firing unit** (1)

Any suitable firing unit with adequate ignition pin geometry and ignition energy may be used to fire the cartridges.

5.7.2.4 **Cartridge chamber insert** (2)

The geometry of the cartridge chamber is defined for each calibre in Table 11.

The geometry matches the design of the cartridge chamber of the tool of respective calibre in order to produce the same opening behaviour of the cartridge as in real use.

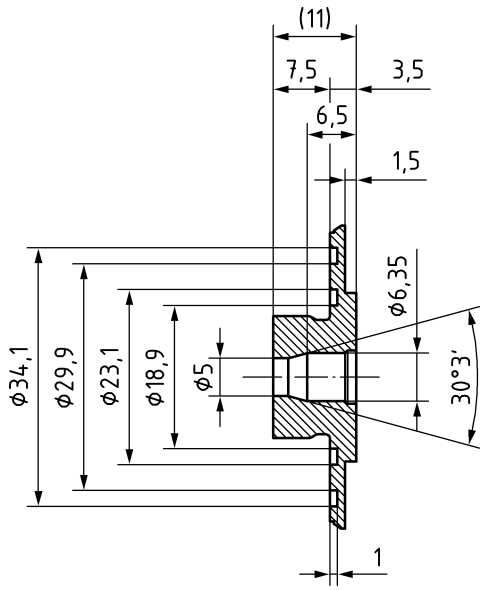
Table 11 — Calibre and shape of cartridge chamber

Calibre	Shape of cartridge chamber
6,3/10	conical (see Figure 21 a))
6,3/16	conical (see Figure 21 b))
6,8/11	conical (see Figures 22 a) and 22 b))
6,8/18	bi-conical (see Figures 23 a) and 23 b))

The inserts presented in Figures 21 a), 21 b), 22 a), 22 b), 23 a) and 23 b), shall be made from steel with a minimum tensile strength of R = 1 300 MPa.

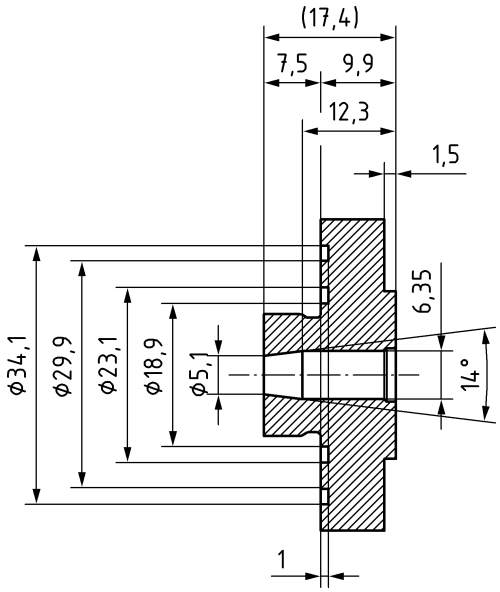
NOTE Suitable materials are No. 1.7707 (30CrMoV9) or No. 1.6580 (30CrNiMo8).

Dimensions in millimetres



a) Cartridge chamber insert for calibre 6,3/10

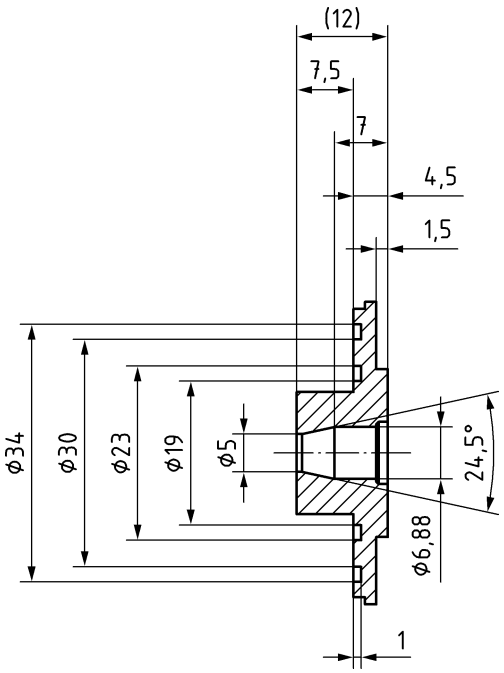
Dimensions in millimetres



b) Cartridge chamber insert for calibre 6,3/16

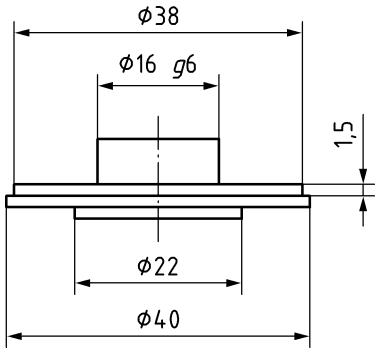
Figure 21

Dimensions in millimetres



a) Cartridge chamber insert for calibre 6,8/11

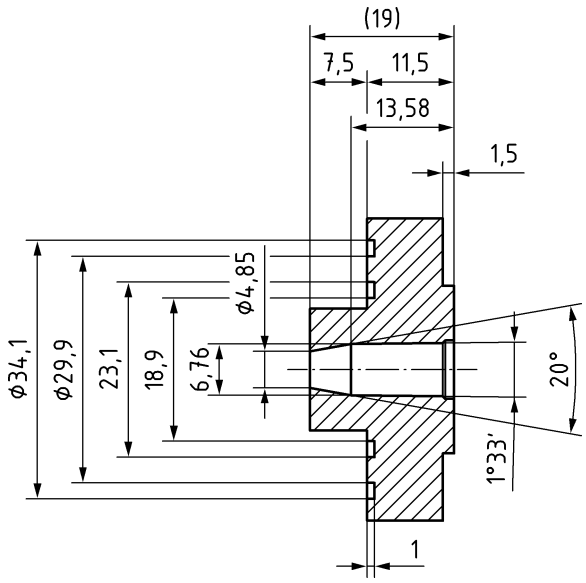
Dimensions in millimetres



b) Cartridge chamber insert for calibre 6,8/11

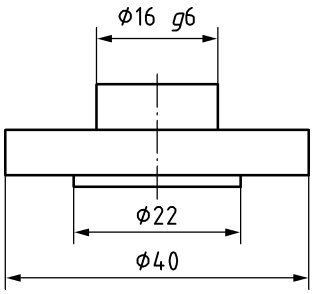
Figure 22

Dimensions in millimetres



Cartridge chamber insert for calibre 6,8/18

Dimensions in millimetres



Cartridge chamber insert for calibre 6,8/18

Figure 23

5.7.2.5 Combustion chamber (3) (volume and dimensions defined per calibre).

The combustion chamber is of cylindrical shape. It is created by a ring-shaped cylindrical insert of varying bore mounted inside a larger bore in the body of the test barrel. Depending on the calibre of the cartridge to be tested, the combustion chamber has the volumes as given in Table 12 and dimensions as given in Figures 26 a) and 26 b).

Table 12 — Calibre and volume of combustion chamber

Calibre	Volume of combustion chamber
6,8/11	0,3 cm^3
6,8/18	0,6 cm^3
6,3/10	0,3 cm^3
6,3/16	0.6 cm^3

5.7.2.6 **Capillary nozzle** (4)

The capillary nozzle simulates typical combustion characteristics of piston tools by producing the same level of combustion pressure and virtually identical dynamics (rise and decline of pressure). It is designed as a bore with Ø3 mm x 193 mm.

5.7.2.7 **Muff and flame detector** (5)

The muff connects the nozzle to the collector bag. The flame deflector focuses the combustion flame away from the sides of the collector bag.

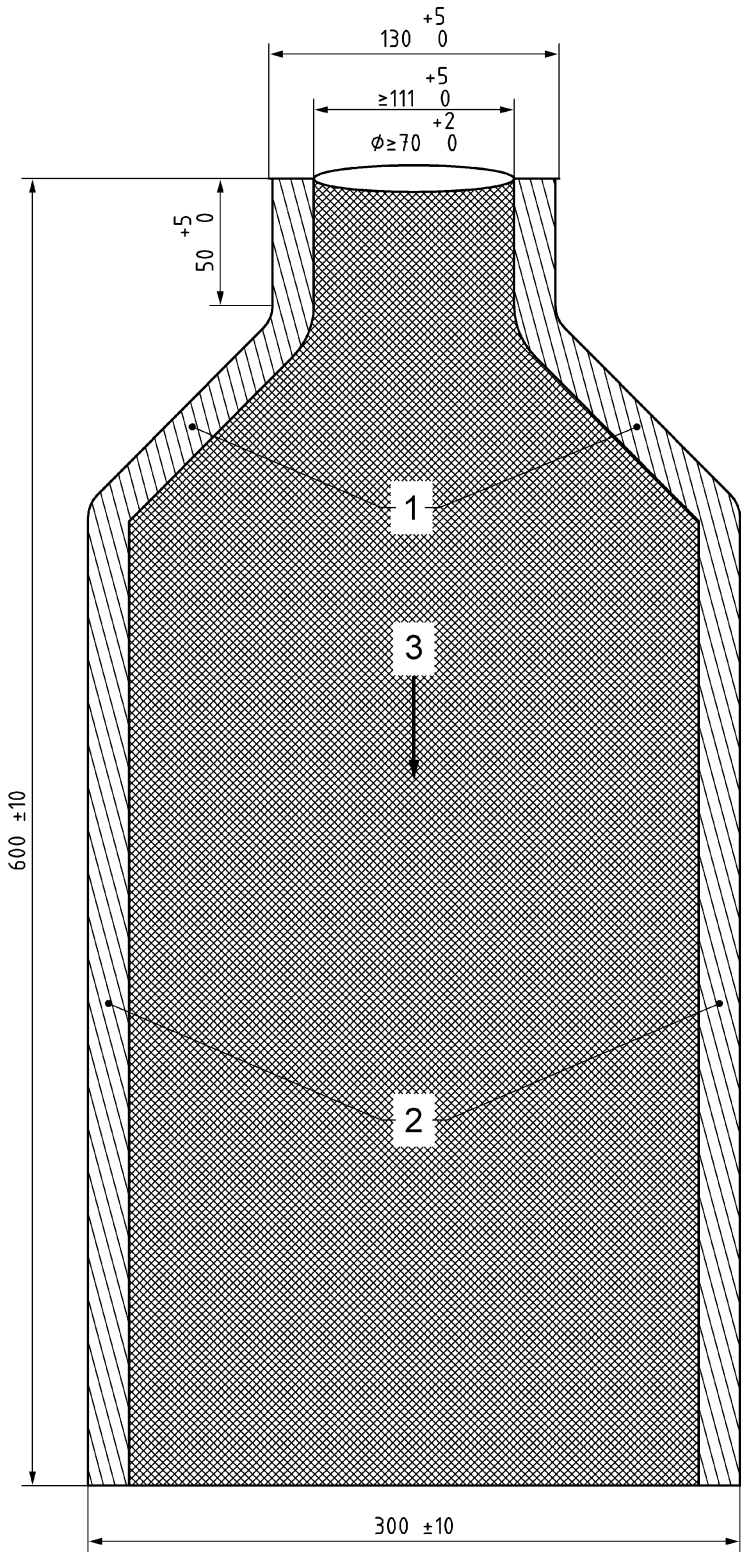
5.7.2.8 **Collector bag for combustion residue** (6)

The collector bag (see Figure 24) is made of very fine-meshed fabric woven from polypropylene multifilament staple fibre which does not absorb humidity. Air permeability shall be in the range of 37 $l/m^2 \cdot s$ with a relative tolerance of ± 5 % at 2 mbar measured according to EN ISO 9237.

NOTE A commercially available fabric satisfying these requirements is SEFAR TETEX MULTI 05–37–420 W manufactured by Sefar AG, Switzerland (http://www.sefar.com).[1)]

1) SEFAR TETEX MULTI 05-37-420 W is the trade name of a product supplied by Sefar AG. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of this product. Equivalent products may be used if they can be shown to lead to the same results.

Dimensions in millimetres



Key

1 bordering tape

2 reinforcement of edges: Longs sides topstitched (2x with double needle), bordered and topstitched (1x with double needle); tight stiches with PTFE thread

3 warp direction

Figure 24 — Dimensions of collector bag

5.7.3 Procedure

Before carrying out the tests, the cartridges shall be conditioned at a temperature of (21 ± 1) °C and at relative air humidity of (60 ± 5) % for 96 h.

The collector bags and other equipment shall be conditioned at the same temperature and relative humidity as the laboratory for at least 24 h.

Each test consists of three series of 20 firings of the tested cartridges.

Testing shall be carried out at an ambient temperature of 20 °C to 25 °C and a relative air humidity of 30 % to 70 %. Testing shall be started within 1 h of removing the cartridges from the climate chamber.

The test rig is mounted vertically with the muzzle facing downwards. See Figure 25.

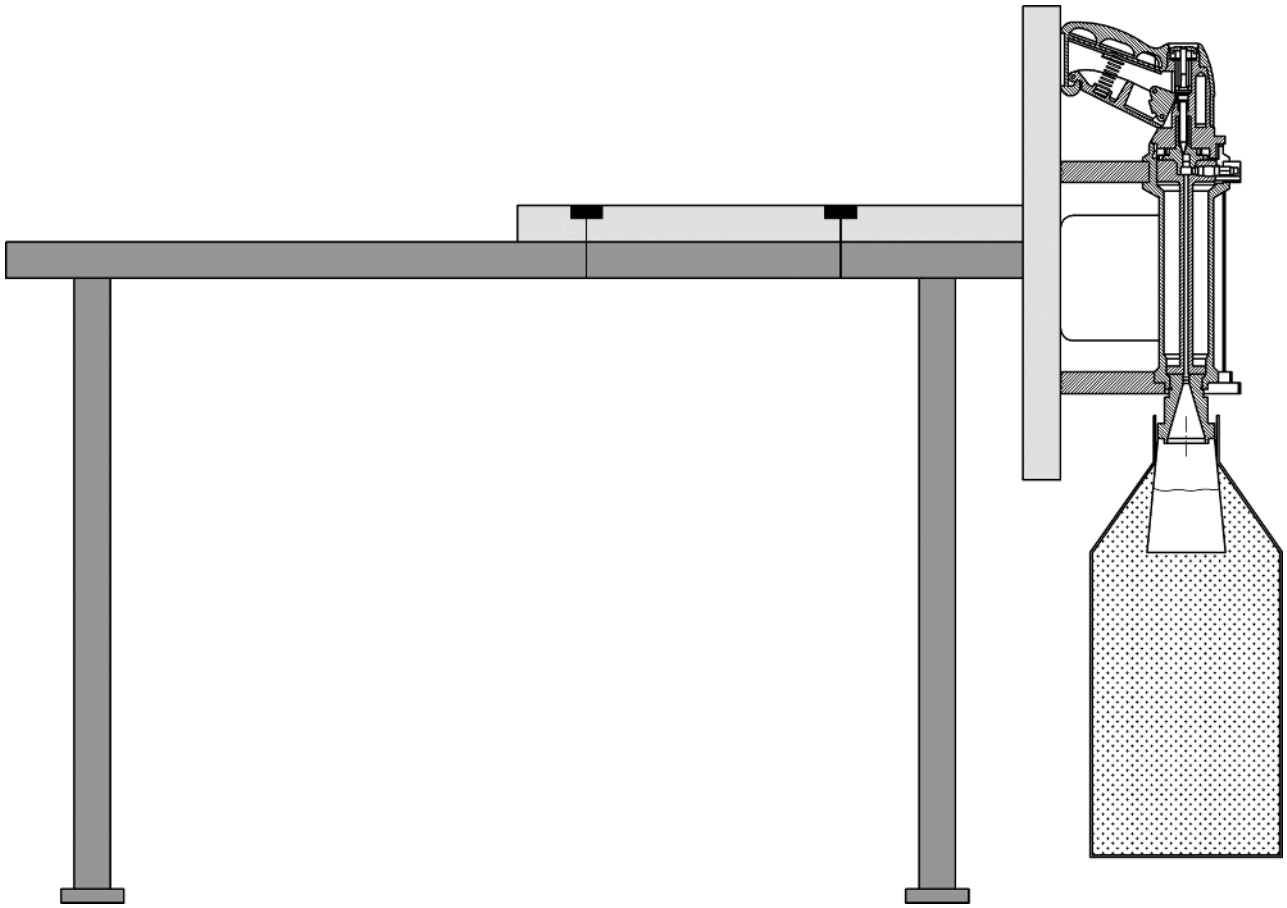
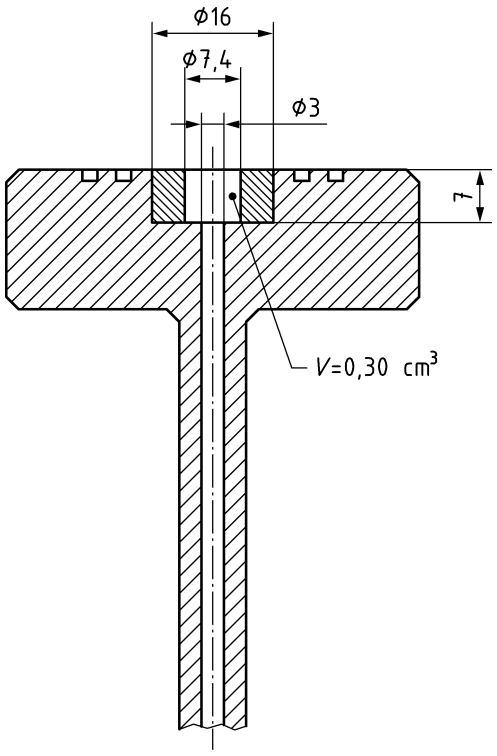


Figure 25 — Example of a test rig

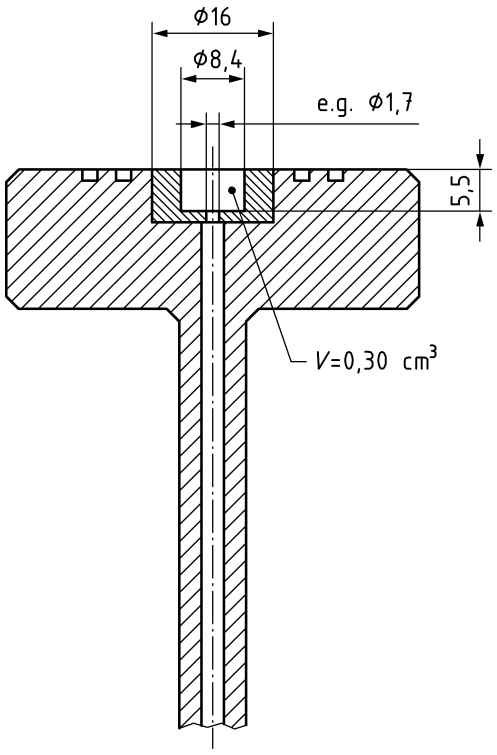
The combustion pressure shall be maintained at a level of at least 750 bar. For this purpose, with low power level cartridges which produce combustion pressures below 750 bar (e.g. 6,8/11 grey and brown), a pot shaped insert with a reduced diameter bore acting as a diaphragm shall be inserted instead of the ring-shaped insert described below (see Figures 26 a) and 26 b)). The bore diameter at the bottom of the pot-shaped insert shall be adjusted such that a combustion pressure of between 750 bar and 800 bar is achieved. The volume of the combustion chamber shall be maintained at the same volume defined for the calibre.

As shown in Figures 26 a) and 26 b), the inserts shall be placed in the bore of the test barrel.

Dimensions in millimetres



a) Test barrel with ring shaped insert (example of 6,3 calibre)



b) Test barrel with pot-shaped insert (example of 6,3 calibre)

Figure 26

For each series of 20 cartridges, use a new (unused) collector bag.

The test shall be aborted if any ignition of collected residue occurs in the collector bag.

Testing is done in the following steps:

a) the collector bag is weighed on the laboratory scales and its mass M_{b1} is noted;

b) the cartridges are removed from their collation;

c) the collector bag is attached to the end of the test barrel by means of a hose clip. Care shall be taken to adequately tighten the clip;

d) the first cartridge is inserted in the cartridge chamber and the firing unit is attached by closing the breech bayonet;

e) the seal of the breech is tightened by turning the muff clockwise thus pushing the nozzle, combustion chamber, and cartridge chamber upwards against the breech;

f) the cartridge is fired into the collector bag. Ignition of residue may be indicated by unusual flames inside the collector bag or negative weight differential of the collector bag before and after the test due to partial combustion of fabric. In such a case, the test series shall be repeated with a new unused bag. If residue ignites again the test has failed;

g) the breech is opened by turning the muff counter-clockwise and then removing the firing unit;

h) the cartridge chamber insert is removed from the test barrel. The spent cartridge is extracted from the cartridge chamber insert;

i) the cartridge chamber insert is inserted into the test barrel again for the testing of the next cartridge in the same manner as described above;

j) after all 20 cartridges have been fired, the collector bag is removed from the test barrel by opening the hose clip;

k) the bag is allowed to cool down for one hour, preferably by freely hanging it from a line;

l) the collector bag with the combustion residue inside is weighed and its mass M_{b2} is noted;

m) the relative amount of combustion residue in percent is calculated as:

$$R'(\%) = \frac{M_{res} - (M_{fr} \cdot 1{,}3)}{M_{powder}} \times 100$$

where

M_{res} is the total mass of residue collected in the collector bag from the firing of the 20 tested cartridges;

M_{fr} is the mass of incombustible frictionator contained in the primer mix of the 20 tested cartridges before firing;

M_{powder} is the mass of propellant contained in the 20 tested cartridges before firing.

The mass of unburned powder in the collected residue is considered to be:

$$M_{\text{powder residue}} = M_{\text{res}} - M_{\text{fr}} - \left(0{,}5 \cdot 0{,}15 \cdot (M_{\text{primer}} - M_{\text{fr}})\right)$$
$$\approx M_{\text{res}} - M_{\text{fr}} - \left(0{,}075 \cdot (M_{\text{primer}} - M_{\text{fr}})\right)$$
$$\approx M_{\text{res}} - 1{,}3 \cdot M_{\text{fr}}$$

NOTE The coefficient of 0,5 results from the fact that the mass of solid reaction products of the non-frictionator part of a typical leaded primer mix amounts to approximately 50 % of its original mass.

The coefficient of 0,15 results from the fact that only a minor fraction of approximately 15 % of the fine oxides of lead, barium etc. is retained in the filter bag.

The coefficient of 1,3 results from the fact that the mass of solids (metal oxides) from the non-frictionator part of the primer mix which is retained in the filter bag amounts to approximately 30 % of the mass of the frictionator in case of a typical leaded primer mix.

5.7.4 Acceptance criteria

The amount of powder residue per cartridge produced in the test shall not exceed a maximum limit value relative to the mass of powder contained in the cartridge before firing.

The maximum permissible residue level is *R*' = 13,5 %.

The test is passed if during none of the three test series the relative amount of unburned powder *R*' exceeds 13,5 % of this test series.

5.8 Physical and chemical stability test

5.8.1 General

The physical and chemical stability test shall be done in order to verify the stability of the article in all normal, foreseeable environmental conditions of use.

5.8.2 Equipment

The following equipment shall be used:

5.8.2.1 Climatic chamber (see 4.4);

5.8.2.2 Timing device type 2 (see 4.1).

5.8.3 Procedure

The cartridges, in smallest pack, shall be heated for 96 h in a climatic chamber having the following conditions:

— temperature: (+ 52 ± 1) °C;

— relative humidity: (60 ± 5) %.

The test shall be performed before using the cartridges for the extreme temperature test according to 5.10.

5.8.4 Acceptance criteria

During the test the cartridges shall neither ignite nor show any case cracks.

Visual inspection will be used to evaluate this.

5.9 Mechanical conditioning test

5.9.1 General

The mechanical conditioning test shall be done in order to demonstrate the insensitivity of the article to normal, foreseeable handling and transportation.

5.9.2 Equipment

The apparatus shall provide a deceleration of 490 m/s^2 (−50/+100) m/s^2 (when measured at the centre of an unloaded platform) and the mechanical conditioning impulse duration (time elapsed from the starting of the machine's deceleration to the time in which the deceleration reaches its maximum value during each first shock pulse) shall be 2 ms ± 1 ms working at a frequency of (1 ± 0,1) Hz.

An example of mechanical conditioning test equipment is given in Annex B.

Timing device: type 2 (see 4.1).

5.9.3 Procedure

The cartridges in the primary pack shall be fixed to the mobile plate of the mechanical conditioning apparatus and tested for 60 min.

5.9.4 Acceptance criteria

The test is passed, if during the test, the cartridges neither ignite nor release powder or primer mix.

Evaluation will be carried out by visual inspection.

5.10 Extreme temperature test

5.10.1 General

The extreme temperature test shall be done in order to verify the resistance of the cartridges to low and high temperature and to verify if safety or reliability of the functioning are adversely affected by the thermal conditioning.

5.10.2 Equipment

The following equipment shall be used:

5.10.2.1 Climatic chamber (4.4);

5.10.2.2 Pressure measuring equipment (5.4.2).

5.10.3 Procedure

5.10.3.1 General

After the performance of the tests as described in 5.10.3.2 or 5.10.3.3, the tested cartridges shall be used for a pressure test as described in 5.4.

5.10.3.2 High temperature test

The high temperature test shall be carried out on one primary pack in as received status, acclimatized at least 24 h at the following conditions:

— temperature: (+52 ± 1) °C ;

— relative humidity: (60 ± 5) %.

5.10.3.3 Low temperature test

The low temperature test shall be carried out on one primary pack in as received status, acclimatized at least 24 h at the following conditions.

Temperature: (–10 ± 1) °C.

A pressure measurement shall be conducted as indicated in 5.4.

The test shall be performed for the additional volume V_a = 0,16 cm^3 for rimfire and V_a = 0,4 cm^3 for centre fire.

The cartridges shall be removed from extreme temperature storage no more than 1 min before the test.

5.10.4 Acceptance criteria

The requirement for a cartridge to give no individual value for maximum pressure in excess of 1,25·p_{max} (V_a) shall be regarded as fulfilled if:

$$\overline{P_{10}} + K_{3.10} \cdot S_{10} \leq 1{,}25 \cdot P_{max}(V_a)$$

$$\overline{P_{10}} + K_{3.10} \cdot S_{10} = \overline{P_{10}} + 2{,}36 \cdot S_{10} \leq 1{,}25 \cdot P_{max}(V_a)$$

where

$P_{max}(V_a)$ is the maximum admissible pressure at 21 °C and reported in Table 8.

During the low temperature test 10 % of misfire is admitted.

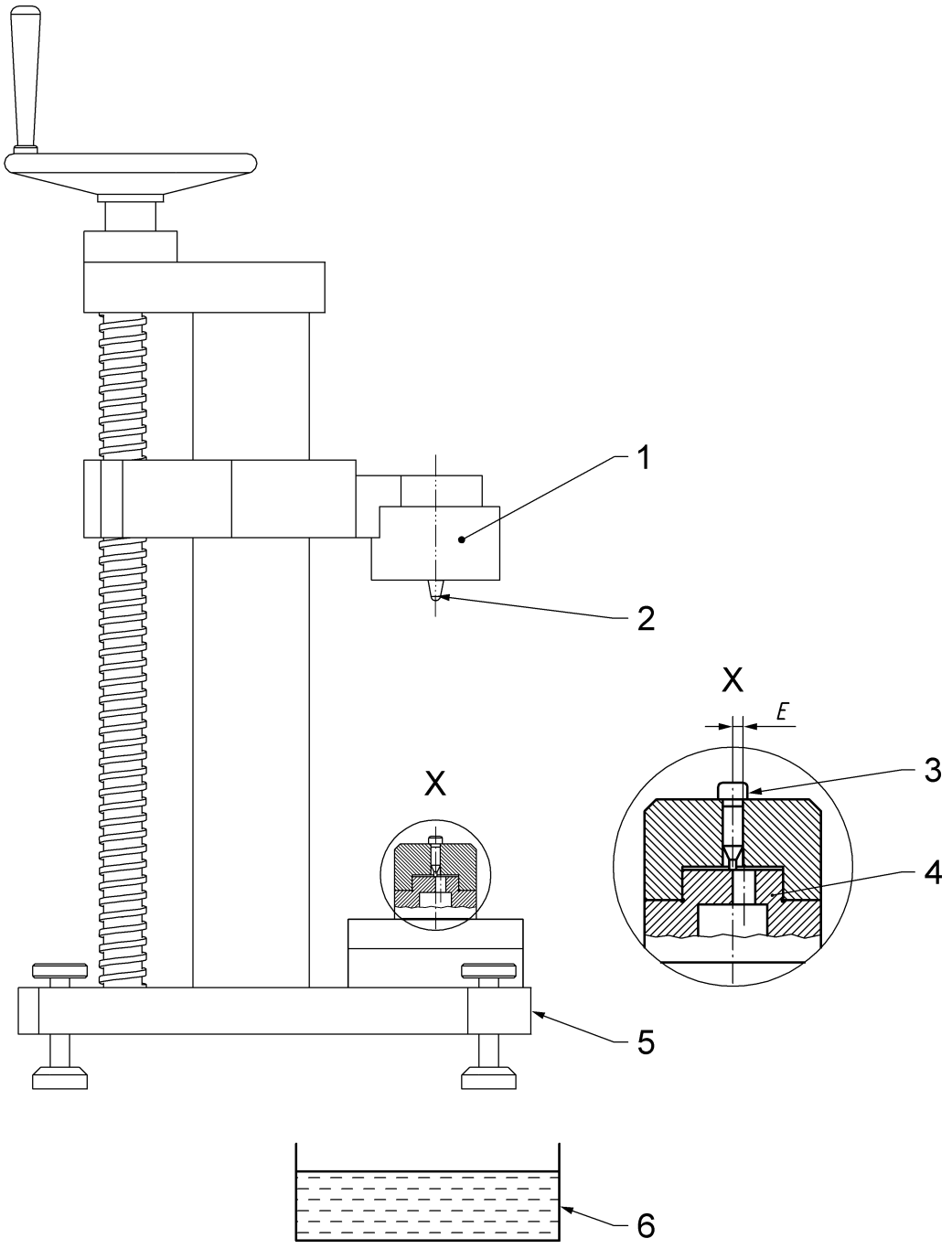
5.11 Safety test

5.11.1 General

The test shall be performed in order to demonstrate the safety of the cartridge against inadvertent ignition.

5.11.2 Equipment

An example of typical equipment which may be used is illustrated by the following Figure 27 (other equivalent technical solutions may be used).



Key

1	height adjustable electromagnet	5	solid adjustable base plate
2	steel ball	6	catchment tank (wet sawdust)
3	firing pin	*E*	eccentricity (see Table 13)
4	cartridge chamber	X	detailed view (see Figures 28 and 29)

Figure 27 — Test rig for safety test

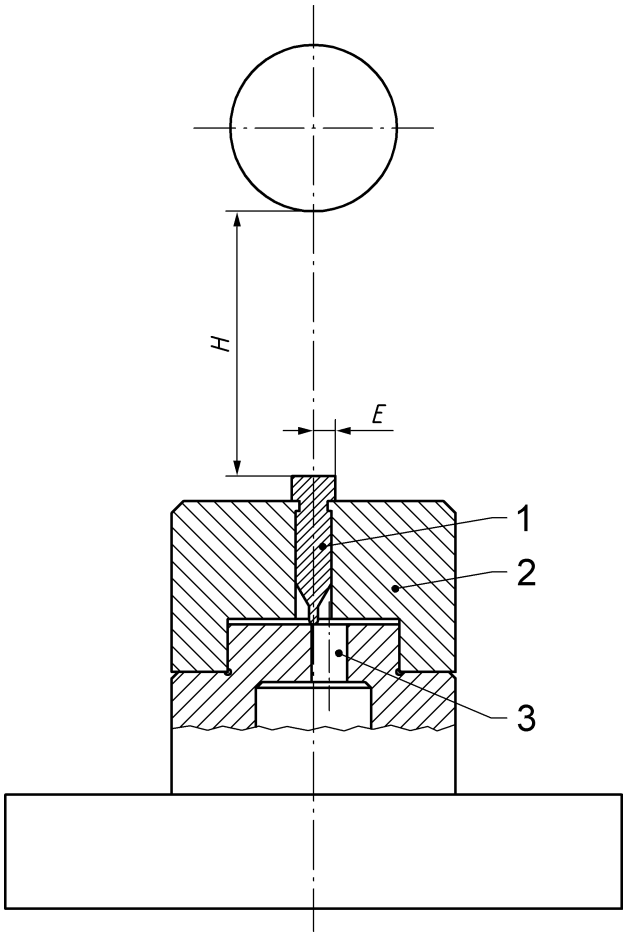
5.11.3 Firing unit

The firing unit (Figure 28 and 29) consists of a steel block with a bore matching the cartridge calibre acting as a cartridge chamber, a firing pin guide attached to this block and a firing pin which is contained in the firing pin guide. The firing pin shall have the tip diameter A and a tip radius R. Its axis is positioned in parallel with the

axis of the cartridge at an offset E. The tip of the firing pin contacts the bottom of the cartridge inserted in the cartridge chamber of the firing unit. The firing pin shall be free to move in the vertical direction for at least 3 mm.

The test setup allows a steel ball of mass M to be dropped on the firing pin from a height H.

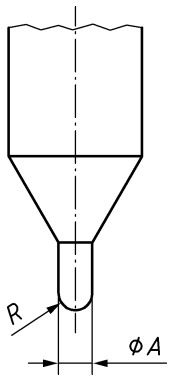
Values for A, R, E, M, and H shall be in accordance with the values given in Table 13.



Key

1 firing pin
2 firing pin guide
3 cartridge chamber
H drop height
E eccentricity (see Table 13)

Figure 28 — Firing unit



Key

R radius (see Table 13)

A diameter (see Table 13)

Figure 29 — Firing pin geometry

The mass and dimensions for the safety test are presented in Table 13.

Table 13 — Masses and dimensions for the safety test

	CARTRIDGE [a]	***M*** [g]	***E*** [mm]	***R*** [mm]	***H*** [mm]	***A*** [mm]
Rimfire type	22 NC (5,5/16)	112	2,70	1,25	40	2,50
	22 (5,6/16)	112	2,70	1,25	40	2,50
	22 EX (5,6/25)					
	5,7/16	112	2,70	1,25	40	2,50
	5,7/25					
	6,3/10	112	2,90	0,75	40	1,50
	6,3/12					
	6,3/14					
	6,3/16					
	6,8/11	112	3,25	0,80	40	2 [b]
	6,8/18					3 [c]
Centre fire type	9 × 17	112	none	0,80	25	2
	9 × 20	112	none	0,80	25	2
	9 × 27	112	none	0,80	25	2
	38 SP (9 × 29)	112	none	0,80	25	2

[a] Collated cartridges (collation strip or other form of collation) shall be tested as single cartridges.

[b] Two radii of R0,8 tangentially join the cylindrical pin with a flat end face of 0,4 mm diameter.

[c] Tolerance of eccentricity *E* ± 0,05.

5.11.4 Procedure

The test shall be carried out on 25 cartridges acclimatized at least 24 h at the following conditions:

— Temperature: (+21 ± 1) °C;

— Relative humidity: (60 ± 5) %.

A steel ball of mass M (according to Table 13) shall be dropped from an electromagnet located at height H on a firing pin (Figure 28 and Figure 29) which hits the cartridge inserted in the chamber.

5.11.5 Acceptance criteria

The test is passed if none of the 25 cartridges ignite at non-fire height H.

If any ignitions occur during the test, the test equipment shall be thoroughly checked.

If the test equipment is found to be satisfactory, then a new test according to 5.11.4 shall be conducted with 50 different cartridges, pre-conditioned in the same manner.

If the equipment is found defective, the results from the first test shall be disregarded and the test shall be repeated with 25 cartridges pre-conditioned in the same manner.

The test is passed, if none of the cartridges ignites.

6 Categorization

Cartridges that have passed the tests as required by Clause 5 shall be categorized P1, if the manufacturer / importer does not apply for the categorization as P2 during type test.

Cartridges having failed on one or more of the tests during type test shall not be categorized, neither as P1 nor as P2.

NOTE Having failed any of the tests, these cartridges comprise a significant safety risk, thereby endangering secure handling and/or use, so that they are not appropriate for use, not even by persons with specialist knowledge.

7 Minimum labelling

7.1 Single cartridges

7.1.1 General

Single cartridges are too small to affix the CE marking according to Article 11 paragraph 1 of the Directive 2007/23/EC and the necessary labelling information according to Article 12 on each individual cartridge, so that according to Article 11 paragraph 1, Article 12 paragraph 5 of the Directive 2007/23/EC, the CE marking and the minimum labelling information are to be provided with the primary pack.

7.1.2 Marking of single cartridges

Nevertheless, all single cartridges shall bear the following marks:

— the identity of the cartridge manufacturer or the importer into the EC, identification shall be provided by a manufacturer's mark or of the legal person for whom the cartridges were produced and who accepts

responsibility for their compliance with current regulations applied in indelible fashion either to the base or the body of the cartridge case;

— on the base of centre fire cartridges, the calibre and /or the commercial name of the cartridges. If it is impossible for technical reasons to show the calibre on the base, it may be marked in indelible fashion on the body of the cartridge case;

— the colour indicating the cartridge power as defined by Table 9.

7.2 Primary packs

Cartridges shall be packed in primary packs, which shall be suitably closed. Each primary pack shall bear the following minimum information:

a) name and address of the manufacturer or, where the manufacturer is not established in the Community, the name and the address of the importer;

b) the name and the type of the article;

c) the minimum age limit of 18 years except where a national provision requires another age limit according to Directive 2007/23/EC Article 7 paragraph 2; the relevant graphical symbol as defined in Annex C may be used instead;

d) relevant category;

e) Net Explosive Content (NEC) of the primary pack;

f) instructions for use: “Comply with tool manual” and the instructions as defined in Annex C; the relevant graphical symbols as defined in Annex C may be used instead;

g) the quantity of cartridges contained in the smallest package unit;

h) CE marking, followed by the identification number of the notified body responsible for checking the conformity to type according to Module C, or for monitoring the existing quality system according to Module D or Module E of the Directive 2007/23/EC;

i) registration number shall be in the following form: XXXX-YY-ZZZZ, where XXXX refers to the registration number of the notified body issuing the EC Type examination certificate, YY refers to the category of the article in abbreviated format (P1 or P2) and where ZZZZ is a processing number by the notified body responsible for the Module B;

j) tool type, reference to the system as defined in 5.6 (only for collated cartridges);

k) power level by colour and number;

l) calibre.

Where the information printed on the primary pack can be affected by opening the pack, the manufacturer shall ensure that the pack design prevents loss of information when the label is broken.

NOTE The given order of the information is not mandatory.

Annex A
(normative)

Testing of cartridges for powder actuated tools

A.1 Type Testing (module B 2007/23/EC Annex II)

Each cartridge type shall be type tested.

For type test purposes, a lot of at least three thousands cartridges shall be submitted to the notified body.

Upon the applicant's request, the notified body may approve minor configuration modifications that do not afflict the safe cartridge function without new type testing.

A.2 Batch tests by producer during production

A.2.1 General

If the manufacturer or the importer wishes to apply for CE approval with modules C, D or E, the size of the lot submitted to batch test shall not exceed:

— five hundred thousand cartridges for central percussion cartridges;

— one million five hundred thousand cartridges for rimfire cartridges.

A.2.2 Single Cartridge and collated cartridges

Table A.1 — Single and collated cartridges test

Test	Single Cartridges	Collated Cartridges
5.3 Verification of dimension	Only once for each calibre done as single cartridges [a]	
5.4 Pressure measurements	Strongest load for each calibre produced by the manufacturer [b]	
5.5 Energy measurements	Each type	
5.6 Collation test	Not applicable	Each type
5.7 Residue test	Not applicable	Each type
5.8 Physical and chemical stability	Only once for each calibre if the chemical compositions (powder and primer mix) are identical for all colours	
5.9 Mechanical conditioning test	Only once for each calibre [c]	
5.10 Extreme temperature low	Each type	
5.10 Extreme temperature high	Each type	
5.11 Safety test	Only once for each calibre if primer mix and cartridge cases are identical for all colours	

[a] Due to identical manufacturing process of cases.

[b] Low power cartridges produce less pressure.

[c] Due to similar cartridge configurations, the test shall be performed only with those cartridge types that the notified body considers most critical, e.g. small quantity of powder, small grain size of powder, etc.

A.2.3 Sampling

The following table indicates the quantity of cartridges that shall be used for each test as described in Clause 5.

The number of items prescribed for the manufacturing checks may be altered if the manufacturer has a quality control system.

Table A.2 — Sampling tests

Test	Test conditions		Test cartridges quantity	
	Temperature °C	Relative Humidity %	Type test (module B)	Batch testing according to Modules C,D [a],E
5.1 Design documentation	/	/	0	No
5.2 Design	/	/	1	No
5.3 Verification of dimension	/	/	30	Table A.3
5.4 Pressure measurements	+21°	60 %	12	
5.5 Energy measurements	+21°	60 %	12	
5.6 Collation test	+21°	60 %	3 × 4 × Tools [b]	No
5.7 Residue test	+21°	60 %	3 × 20	No
5.8 Physical and chemical stability	+52°	60 %	one primary pack	No
5.9 Mechanical conditioning test	+21°	60 %	one primary pack	No
5.10 Extreme temperature	−10°	/	12	No
5.10 Extreme temperature	+52°	60 %	12	No
5.11 Safety test	+21°	60 %	25	No

NOTE The samples are taken randomly from a testing lot.

[a] These tests alone are not sufficient for module D but complete production quality assurance shall be fulfilled.

[b] Test shall be performed for each tool declared by the cartridge producer. The tools used in the test will be indicated on the primary pack as indicated in Clause 7.

A.2.4 Acceptance quality level on production test

Table A.3 — Acceptance quality level on batch testing

Lot quantity	< 35 000		35 001 to 150 000		150 001 to 500 000		500 001 to 1 500 000	
Test Cartridges Quantity	125		200		315		500	
AQL	0,10	0,65	0,10	0,65	0,10	0,65	0,10	0,65
Quantity A/R	0/1	2/3	0/1	3/4	1/2	5/6	1/2	7/8

Batch testing is passed if independently of one another none of the A/R criteria are violated.

The following Table A.4 shall be used for visual and dimensional acceptance criteria.

Table A.4 — Visual and dimensional acceptance criteria for batch testing

Fault Description	AQL defect
Absence or incorrect of the head mark	0,10
Breaking of base of case	0,10
Depth of primer < 0 mm (i.e. protruding primer) for centre fire only	0,10
Not fitting in a minimum chamber gauge	0,10
Diameter at the top of the case (H_2) max.	0,65
Rim thickness R max.	0,65
Cartridge length L_6 max.	0,65

Annex B
(informative)

Mechanical conditioning test equipment

An example of typical equipment which may be used is illustrated by the following Figures B.1, B.2 and B.3 (other equivalent technical solutions may be used):

— A flat horizontal platform made of steel, 800 mm × 600 mm, 2 mm to 3 mm thick, with a rim 3 mm thick and having a height of 15 mm. The platform is reinforced with eight steel ribs, 5 mm thick with a height of 30 mm, which are welded to the underside and run from the centre to each of the four corners and to the middle of each edge;

— a 20 mm thick plate of fibreboard, firmly attached to the platform by screws;

— a cylindrical steel boss, diameter 125 mm and height 35 mm, located under the centre of the platform;

— a 284 mm long shaft, with diameter of 20 mm, fixed to the centre of the boss;

— a restraining peg, to prevent the platform from rotating; the mass of the platform assembly shall be (23 ± 1) kg;

— an annular, elastomer pressure spring, with a Shore A hardness of 68 when determined in accordance with EN ISO 868, outside diameter 125 mm, inside diameter 27 mm and height 32 mm, on which the cylindrical boss will rest;

— a shallow steel cylinder, inside diameter 126 mm, wall thickness 5 mm, outside height 30 mm, with a base 8 mm thick which has a 25 mm diameter hole drilled through the centre, to contain the elastomer spring;

— a supporting steel cylinder, outside diameter 80 mm, inside diameter 60,1 mm and height 92,4 mm, to which the shallow cylinder is screwed;

— a PVC liner, outside diameter 60 mm, inside diameter 20,2 mm and height 92,4 mm, located inside the supporting cylinder and attached by a screw;

— a steel mounting plate, thickness 12 mm with a 25 mm hole drills through the centre, to which the supporting steel cylinder is screwed;

— a steel base plate, thickness 12 mm;

— four supporting pillars, height 260 mm and diameter 32 mm, screwed to the mounting plate and to the base plate;

— a framework to support the based plate so that the complete assembly is at a convenient height;

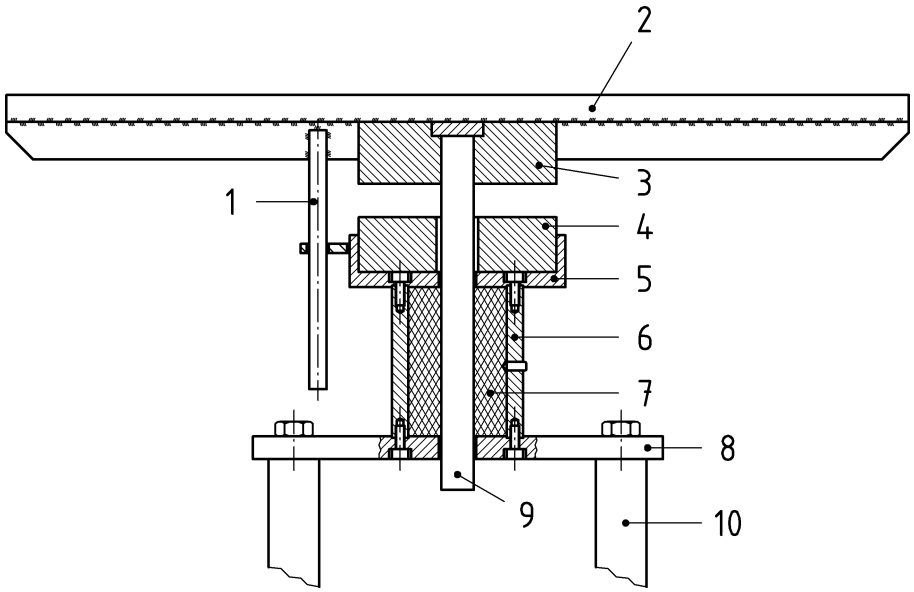
— an attachment to the shaft, allowing adjustment to the overall length, fitted with a cam wheel, outside diameter 30,0 mm, with a contact surface 8,0 mm wide;

— a cylindrical cam, outside diameter 120 mm, inside diameter 100 mm, wall thickness 10 mm, with a “vertical drop” of 50,0 mm between the high point and the low point (see Figure B.2); differently shaped cams with the same drop height may be used alternatively (see Figure B.3);

— a collar, outside diameter 50 mm, height 4,0 mm;

— an electric motor and suitable gearing, to rotate the cam at a rotational frequency of 1 Hz;

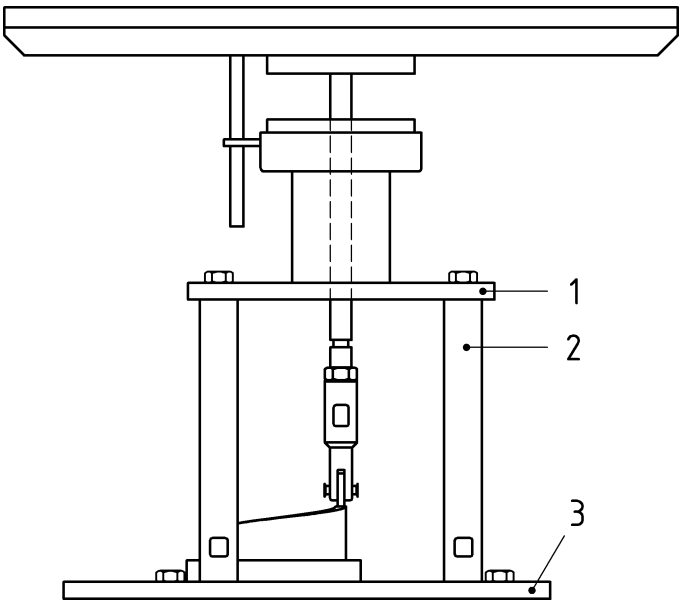
— cellular rubber sheet, 100 mm thick. The material used shall have an apparent density when determined in accordance with EN ISO 845, of 35 kg/m^3 and an indention hardness check, when determined in accordance with EN ISO 2439 of 215 N.



Key

1 restraining peg
2 platform
3 boss
4 pressure spring
5 cup
6 supporting cylinder
7 PVC liner
8 mounting plate
9 shaft
10 supporting pillar

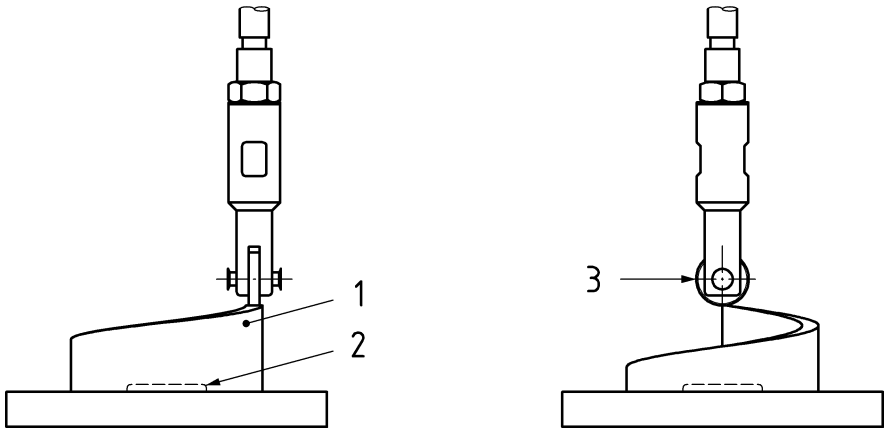
Figure B.1 — Detail of top section of mechanical conditioning apparatus



Key

1 mounting plate
2 supporting pillar
3 base plate

Figure B.2 — General assembly of mechanical conditioning apparatus



Key

1 cam
2 collar
3 cam wheel

Figure B.3 — Detail of shaft attachment and cam assembly of mechanical conditioning apparatus

Annex C
(normative)

Graphical symbols

As part of the minimum information for use, handling, storage and disposal for primary packs, these shall be provided with the following information either in instruction or in pictogram form:

Keep out of reach of children	
Smoking and naked flames forbidden	EN ISO 7010-P003, No open flame; fire, open ignition source and smoking prohibited 
Comply with tool manual	
Eye protection shall be worn	EN ISO 7010-M004, Wear eye protection 
Ear protection shall be worn	EN ISO 7010-M003, Wear ear protection 
Do not crush, strike or pry	

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2007/23/EC on the placing on the market of pyrotechnic articles

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 2007/23/EC on the placing on the market of pyrotechnic articles.

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 clauses of this standard given in Table ZA.1 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.

Table ZA.1 — Correspondence between this European Standard and Directive 2007/23/EC on the placing on the market of pyrotechnic articles

Essential Requirements (ESR) of Directive 2007/23/EC	**Clause(s)/subclause(s) of this** EN 16264	**Qualifying remarks/Notes**
(1)	5.3, 5.4, 5.5, 5.7	
(2)	5.1, 5.2	
(3) first paragraph	5.4, 5.5, 5.6	
(3) second paragraph	5.5, 5.9, 5.10	
3 (a)	5.1, 5.2, 5.3	
3 (b)	5.8	
3 (c)	5.9	
3 (d)	5.8	
3 (e)	-	Not applicable
3 (f)	5.10	
3 (g)	5.11	
3 (h)	Clause 7	
3 (i)	5.8, 5.9, 5.10	
3 (j)	Clause 7	
3 last sentences	5.9	
4 (a)	Clause 1	
4 (b)	Clause 1	
B1	5.2, 5.4, 5.6	
B2	Clause 7	
B3	5.7, 5.11	
B4	-	Not applicable

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

Bibliography

[1] EN 15895:2011, *Cartridge operated hand-held tools — Safety requirements — Part 1: Fixing and hard marking tools*

[2] EN ISO 845, *Cellular plastics and rubbers — Determination of apparent density (ISO 845)*

[3] EN ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868)*

[4] EN ISO 2439, *Flexible cellular polymeric materials — Determination of hardness (indentation technique) (ISO 2439)*

[5] EN ISO 7010:2012, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2011)*

[6] ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

[7] Comprehensive edition of adopted C.I.P. Decisions (Permanent International Commission for the Proof of Small-Arms), Brussels/Belgium, 2009

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