SLOVENSKI STANDARD
oSIST prEN 13938-4:2021

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Eksplozivi za civilno uporabo - Smodniki in raketna goriva – 4. del: Ugotavljanje hitrosti gorenja v normalnih razmerah

Explosives for civil uses - Propellants and rocket propellants - Part 4: Determination of burning rate under ambient conditions

Explosivstoffe für zivile Zwecke - Treibladungspulver und Raketentreibstoffe - Teil 4: Bestimmung der Brenngeschwindigkeit bei Umgebungsbedingungen

Explosifs à usage civil - Poudres propulsives et propergols pour fusées - Partie 4: Détermination de la vitesse de combustion dans les conditions ambiantes

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ICS:

71.100.30	Eksplozivi. Pirotehnika in ognjemeti	Explosives. Pyrotechnics and fireworks

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English Version

Explosives for civil uses - Propellants and rocket propellants - Part 4: Determination of burning rate under ambient conditions

Explosifs à usage civil - Poudres propulsives et propergols pour fusées - Partie 4: Détermination de la vitesse de combustion dans les conditions ambiantes

Explosivstoffe für zivile Zwecke - Treibladungspulver und Raketentreibstoffe - Teil 4: Bestimmung der Brenngeschwindigkeit bei Umgebungsbedingungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 321.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 13938-4:2021) has been prepared by Technical Committee CEN/TC 321 "Explosives for civil uses", the secretariat of which is held by UNE.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13938-4:2003.

In comparison with the previous edition, the following technical modifications have been made:

a) Clause 1, *Scope*, has been updated;

b) the normative references have been updated;

c) in Clause 3, *Terms and definitions*, the terms 3.2 and 3.3 have been added;

d) technical revision of the method for clarification purposes;

e) Clause 8, *Calculation of results*, has been added to Clause 7, *Procedure*;

f) Annex A, *Range of applicability of the test method*, has been removed;

g) Annex ZA has been updated.

This document has been prepared under a Standardization Request (M/562) annexed to the Commission Implementing Decision C(2019)6634 final as regards Explosives for civil uses given to CEN by the European Commission and the European Free Trade Association, and supports Essential Safety requirements of Directive 2014/28/EU.

For relationship with Directive 2014/28/EU, see informative Annex ZA, which is an integral part of this document.

EN 13938, *Explosives for civil uses — Propellants and rocket propellants*, is currently composed of the following parts

— *Part 1: Requirements*

— *Part 2: Determination of resistance to electrostatic discharge*

— *Part 3: Determination of deflagration to detonation transition*

— *Part 4: Determination of burning rate under ambient conditions*

— *Part 5: Determination of voids and fissures*

— *Part 6: Solid rocket propellants — Guide for the determination of integrity of inhibitor coatings*

— *Part 7: Determination of safe and reliable ignition and complete deflagration of black powder*

1 Scope

This document specifies a method for the determination of burning rate under ambient conditions for solid gun propellants. It is applicable to solid gun propellants and black powder in their original form up to a grain size of 8 mm.

NOTE 1 Knowledge of burning rate is of high importance to manage risks associated with handling such explosives and of high importance to assess whether performance characteristics are met.

NOTE 2 In cases where propellants having grain size higher than 8 mm are generally used, their burning rate is more influenced and controlled by parameters of element containing thereof, and thus knowledge of their burning rate at ambient condition is not of high importance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

prEN 13857-1:2021, *Explosives for civil uses — Part 1: Terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 13857-1:2021 and the following apply.

3.1
burning rate
velocity at which the flame propagates through the sample along the trough

3.2
electric igniter
electrically actuated igniter comprising a hot wire coated with an explosive that is ignited by heat produced from electric energy

3.3
hot wire
flexible metallic conductor, without an insulating covering, producing a heat from electric energy while electric current passes through such conductor

4 Principle

The test sample is loaded into a trough and the sample is ignited at one end by means of a hot wire, safety fuse or electric igniter. The time of flame propagation through the sample along the trough is measured and the burning rate is calculated.

5 Apparatus

5.1 Trough, consisting of a half cylinder (2 000 ± 1) mm long with a diameter of (20,0 ± 0,8) mm, hollowed out from a stainless steel block. The block is marked at two positions, A and B, at distances of (400 ± 1) mm and (1 900 ± 1) mm from the end where the ignition is to take place, respectively. Each end of the trough shall be closed to prevent loss of material.

The trough shall be horizontal when set on its support.

5.2 Hot wire, as ignition device, consisting of a Ni/Cr wire, diameter (0,40 ± 0,05) mm, length (15 ± 1) mm, heated by a current of 4 A.

5.3 Electric igniter, as alternative ignition device, having no-fire current at least 0,45 A, loaded with current specified by its manufacturer.

5.4 Electric energy source, capable of loading hot wire with a current of 4 A or capable of initiating electric igniter.

5.5 Safety fuse, as alternative ignition device, of appropriate length.

5.6 Conditioning chamber, capable of maintaining the temperature (20 ± 5) °C and the relative humidity (60 ± 10) % for 24 h.

5.7 Timing device, consisting of a manual stopwatch with a scale division of 0,1 s or a recording chronograph activated by suitable detectors located at marks A and B or a high-speed video camera with a minimum capacity of at least 1 000 frames per second. Black powder and propellants with presumably high burning rate shall not be tested using a manual stopwatch.

NOTE For measurement alternatively, velocity of detonation meter with wire break method also can be used; for the wire, soldering tin wire is suitable as its melting point is around the flame temperature.

5.8 Adhesive tape, as a tool for securing ignition device to trough.

6 Preparation of test sample

Condition the test sample by storing at (20 ± 5) °C and (60 ± 10) % relative humidity for at least 24 h immediately prior to the test.

7 Procedure

7.1 Testing

Carry out two determinations, using separate test portions taken from the test sample with the same type of ignition device. Ensure that the test is carried out with the possible shortest preparation time.

Conduct the test under ambient conditions of temperature and humidity.

Ensure that the trough is dry and clean and was conditioned at (20 ± 5) °C for at least 1 h prior to the test.

Pour the test sample into the trough so as to fill it flush with the top edge, without packing down the test sample.

Level the surface by moving a blade across it and record the mass of the test portion.

Attach the ignition device to the sample at the one end of the trough and secure it to the trough by an adhesive tape. Connect the hot wire or electric igniter to the electric energy source and fire the electric igniter or, in case of hot wire, maintain the current at least until the sample ignites (maximum time 60 s) or ignite the safety fuse respectively in case such ignition device is used.

Record the following:

— t_b time of flame propagation from mark A (400 mm ± 1) to mark B (1 900 mm ± 1);

— t_f time from mark A to extinction, in case of partial propagation of the flame through the sample;

— d_f distance travelled by the flame in case of partial propagation of the flame through the sample.

7.2 Calculation

The burning rate of the sample under test shall be determined by means of the following equation:

$$V = \frac{1\,500}{t_b}$$

where

V is the burning rate, expressed in millimetres per second (mm/s)

1 500 is the distance between the marks expressed millimetres (mm)

t_b is the time of propagation between the marks, expressed in seconds (s)

8 Test report

The test report should conform to EN ISO/IEC 17025:2017, 5.10.2 and 5.10.3. In addition, the following information shall be given:

a) a reference to this document;

b) the identification of the sample (comprising trade name, manufacturer and production date), including its mass and grain size distribution as specified by the manufacturer;

c) temperature and humidity during testing;

d) the results of all tests in form of:

— time of flame propagation, t_b (s) and burning rate, V (mm/s)

or, in case of partial propagation of the flame through the sample:

— time from mark A to extinction, t_f (s) and distance travelled by the flame, d_f (mm)

e) the mean value of the burning rate obtained from the two tests (mm/s).

Annex ZA
(informative)

Relationship between this European Standard and the essential safety requirements of Directive 2014/28/EU relating to the making available on the market and supervision of explosives for civil uses aimed to be covered

This European Standard has been prepared under a standardization request M/562 annexed to Commission Implementing Decision C(2019)6634 final as regards explosives for civil uses to provide one voluntary means of conforming to essential safety requirements of Directive 2014/28/EU relating to the making available on the market and supervision of explosives for civil uses.

Once this standard is cited in the Official Journal of the European Union (OJEU), under Directive 2014/28/EU, compliance with the normative 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 corresponding essential safety requirements of that Directive 2014/28/EU, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2014/28/EU

Essential Safety Requirements[1)] of Directive 2014/28/EU Annex II	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
I.1.	4	
I.2.	4	
II.1.(a)	4	
II.3.4.(a)	7	

1) The Essential Safety Requirements are fulfilled together with the requirements in prEN 13631-1:2021.

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] prEN 13938-1:2021, *Explosives for civil uses — Propellants and rocket propellants — Part 1: Requirements*

[2] EN ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories*