SLOVENSKI STANDARD
oSIST prEN 13938-3:2021

01-april-2021

Eksplozivi za civilno uporabo - Smodniki in raketna goriva - 3. del: Ugotavljanje prehoda deflagracije v detonacijo

Explosives for civil uses - Propellants and rocket propellants - Part 3: Determination of deflagration to detonation transition

Explosivstoffe für zivile Zwecke - Treibladungspulver und Raketentreibstoffe - Teil 3: Bestimmung des Überganges der Deflagration in die Detonation

Explosifs à usage civil - Poudre propulsive et propergol - Partie 3: Méthode de détermination du passage de la déflagration à la détonation

Ta slovenski standard je istoveten z: **prEN 13938-3**

ICS:

71.100.30	Eksplozivi. Pirotehnika in ognjemeti	Explosives. Pyrotechnics and fireworks

oSIST prEN 13938-3:2021 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

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prEN 13938-3

April 2021

ICS 71.100.30

Will supersede EN 13938-3:2003

English Version

Explosives for civil uses - Propellants and rocket propellants - Part 3: Determination of deflagration to detonation transition

Explosifs à usage civil - Poudres propulsives et propergols pour fusées - Partie 3 : Méthode de détermination du passage de la déflagration à la détonation

Explosivstoffe für zivile Zwecke - Treibladungspulver und Raketentreibstoffe - Teil 3: Bestimmung des Überganges der Deflagration in die Detonation

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.

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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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 13938-3:2021) 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 13938-3:2003.

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

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

b) the normative references have been updated;

c) Clause 4, *Principle*, has been added;

d) Clauses 5, *Test sample*, has been added to Clause 6, *Preparation of test sample*, have been merged;

e) a technical revision of the method has been carried out for clarification purposes;

f) 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 to determine the tendency of a propellant to undergo transition from deflagration to detonation (DDT). It applies to propellants of a grain size up to 8 mm. This method does not apply to black powder and rocket propellant.

NOTE 1 Due to the nature of the shape of grains (heterogeneous), the combustion of the rocket propellant can cause a crack of the grain causing an explosion of the rocket motor.

NOTE 2 Black powders properties differ significantly from propellant and explosives because black powders are capable of maintaining stable combustion at high velocities without experiencing deflagration – detonation transition.

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 apply.

4 Principle

An electric direct current is injected through an ignition wire inside a tube load of propellant to undergo the transition from deflagration to detonation. The pressure from (not yet a shock wave) is initially behind the flame front.

Due to the rapid generation of gases by the burning propellant, the pressure front is simultaneous increased in magnitude, and accelerated toward the flame front.

5 Apparatus

5.1 Seamless steel tube, (P235S or equivalent grade), external diameter (48,3 ± 0,5) mm, thickness (4,0 ± 0,6) mm and length $1\,200_{0}^{+5}$ mm. The tube is threaded at both ends and it is closed by two cast-iron screw caps.

5.2 Lead witness plate(s), thickness (20 ± 10) mm. Alternatively, multiple layers of lead sheets can be used, up to the previously mentioned thickness.

5.3 Ignition wire consisting of an insulated Ni/Cr wire, diameter (0,40 ± 0,05) mm, length (15 ± 1) mm, located at one end of the tube and internally attached to the cap.

In case this ignition wire cannot be used, an insulated Ni/Cr wire with other dimensions can be used but this wire shall provide a current that ignites the sample.

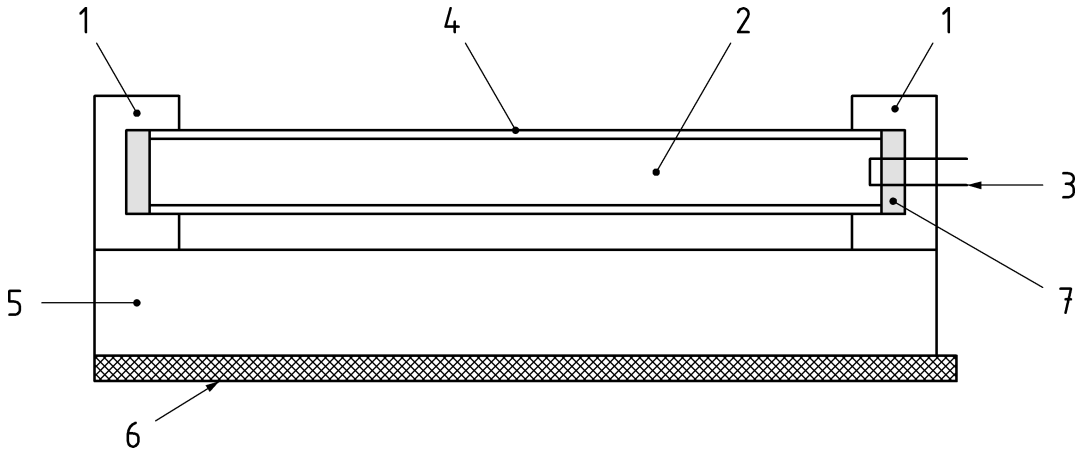
5.4 Inert rod, of at least 1 300 mm length, with major length indications at every 100 mm and minor length indications at every 5 mm and a diameter slightly smaller than the inner diameter of the steel tube.

5.5 Inert fill plate, consisting of an inert non-metallic material for filling the free space in caps.

5.6 Anvil, consisting of a steel plate, minimum thickness 80 mm, to be put on the ground for supporting lead witness plate(s).

5.7 Conditioning chamber, capable of maintaining the temperature (20 ± 5) °C for 24 h.

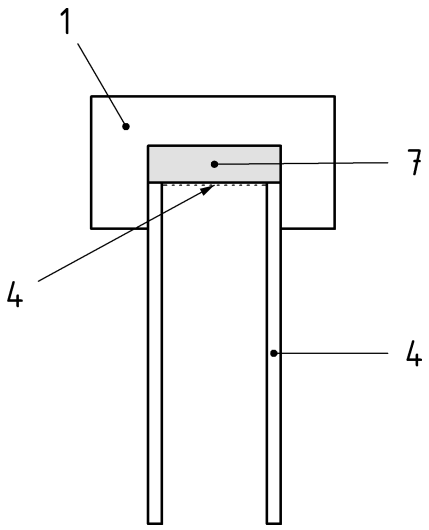
5.8 Electric device, with an electric current of up to 8 A.



Key

1 screw cap
2 propellant charge
3 ignition wire
4 steel tube
5 lead witness plate(s)
6 anvil
7 inert fill plate (like PU foam sheet, rubber sheet, etc.)

Figure 1 — Apparatus (not to scale)



Key

1 screw cap
4 steel tube
7 inert fill plate

Figure 2 — Apparatus (detail)

6 Preparation of test sample

The test sample shall comprise approximately 5 kg of the propellant and shall be conditioned at (20 ± 5) °C for at least 24 h.

7 Procedure

Close the tube at both ends with the screw caps. At each end, note the length of the tube penetrating into the screw caps. After removal from the tube, fit the screw caps internally with an inert fill plate up to the position to which the end of the tube penetrated. Then close the tube at one end with the appropriate screw cap including the internal inert fill plate.

Fill the tube with the test sample in portions of 100 g.

After each portion, place the inert rod in the steel tube and note the height of the propellant. Remove the inert rod and submit the tube to five vertical free falls from about 50 mm height. Measure the height of the propellant again with the inert rod. Repeat until no further settling is detected. Add another portion of the propellant and repeat the whole process. For the last increment, a slightly different way of filling is necessary because the tube shall be filled to 5 mm from the end. This can be achieved by using a portion m of propellant, determined by the following formula:

$$m = 100 \times \frac{l - 5}{l_{100}}$$

where

m is the portion of propellant, expressed in grams (g)

l is the remaining height of tube, expressed in millimetres (mm)

l_{100} is the height corresponding to a portion of 100 g, expressed in millimetres (mm)

Add this last portion m without the five vertical free falls.

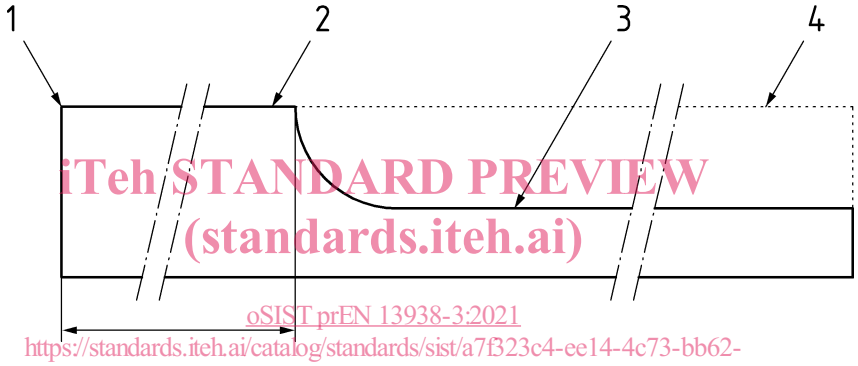
After completion of filling up to 5 mm from the end of the tube, close the tube carefully with the other screw cap containing an inert plate and equipped with the ignition wire, i.e. the metal wire attached to the inside of the screw cap.

Place the closed tube horizontally on the witness plate(s) so that the tube is in direct contact throughout its length with the plate(s).

Switch on the electric device and use an electric direct current of up to 8 A for a maximum of 3 min to heat the wire and to ignite the propellant. Perform the test twice.

“Deflagration to Detonation Transition” (DDT) is shown by the compression of the lead witness plate or plates in a manner characteristic of detonation (see Figure 3). If DDT occurs record the “Length Before Detonation” (LBD) by measuring on the lead witness plate(s) the length without indentation before detonation (see Figure 3, key number 2) and adding the length of tube penetrating into the screw cap equipped with the ignition wire.

NOTE To help to visualize the LBD length, shallow markings with 1 cm increments can be obtained on the upper led plate.



Key

1 end of the plate
2 section of plate(s) without indentation
3 compression of the plate(s)
4 initial upper level of the plate(s)

Figure 3 — Compression of the lead witness plate(s)

Record the individual results as follows:

— deflagration to detonation transition: LBD = ... mm,

or

— no deflagration to detonation transition: LBD > 1200 mm.

The test result is given by the value of LBD.

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 complete identification of the sample, including loading density and grain size distribution;

c) the individual results (LBD value).