



SLOVENSKI STANDARD
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Eksplzivni za civilno uporabo – Detonatorji in zakasnilniki – 18. del: Ugotavljanje toka za serijski vžig električnega detonatorja

Explosives for civil uses - Detonators and relays - Part 18: Determination of series firing current of electric detonators

Explosivstoffe für zivile Zwecke - Zünder und Verzögerungselemente - Teil 18: Bestimmung des Serienzündstromes elektrischer Zünder

Explosifs à usage civil - Détonateurs et relais - Partie 18 : Détermination du courant d'allumage de détonateurs électriques en série

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English Version

Explosives for civil uses - Detonators and detonating cord relays - Part 18: Determination of series firing current of electric detonators

Explosifs à usage civil - Détonateurs et relais pour cordeau détonant - Partie 18: Détermination du courant d'allumage de détonateurs électriques en série

Explosivstoffe für zivile Zwecke - Zünder und Sprengschnurverbinder - Teil 18: Bestimmung des Serienzündstromes elektrischer Zünder

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

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European foreword

This document (prEN 13763-18:2021) 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 13763-18:2003.

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

- a) Clause 1, *Scope*, now specifies that this document is applicable to explosives for civil uses;
- b) Clause 4, *Principle*, has been added;
- c) in Clause 6, *Preparation and handling of test samples and test pieces*, 6.1, *Handling of test samples*, has been added;
- d) in Clause 7, *Procedure*, 7.1, *Conditioning and test temperature*, has been added.
- e) Clause 8, *Expression of results*, has been added.
- 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 13763, *Explosives for civil uses — Detonators and detonating cord relays*, is currently composed with the following parts:

- *Part 1: Requirements*
- *Part 2: Verification of thermal stability*
- *Part 3: Determination of sensitiveness to impact*
- *Part 4: Determination of resistance to abrasion of leading wires and shock tubes*
- *Part 5: Determination of resistance to cutting damage of leading wires and shock tubes*
- *Part 6: Determination of resistance to cracking in low temperatures of leading wires*
- *Part 7: Determination of the mechanical strength of leading wires, shock tubes, connections, crimps and closures*
- *Part 8: Determination of resistance to vibration*

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- Part 9: Determination of resistance to bending of detonators
- Part 11: Determination of drop resistance of detonators and relays
- Part 12: Determination of resistance to hydrostatic pressure
- Part 13: Determination of resistance of electric detonator to electrostatic discharge
- Part 15: Determination of equivalent initiating capability
- Part 16: Determination of delay accuracy
- Part 17: Determination of no-fire current of electric detonators
- Part 18: Determination of series firing current of electric detonators
- Part 19: Determination of firing pulse of electric detonators
- Part 20: Determination of total resistance of electric detonators
- Part 21: Determination of flash-over voltage of electric detonators
- Part 22: Determination of capacitance, insulation resistance and insulation breakdown of leading wires
- Part 23: Determination of the shock-wave velocity of shock tube
- Part 24: Determination of the non-conductivity of shock tube
- Part 25: Determination of transfer capacity of relay and coupling accessories
- Part 26: Definitions, methods and requirements for devices and accessories for reliable and safe function of detonators and relays
- Part 27: Definitions, methods and requirements for electronic initiation system

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Introduction

During blasting using electric detonators, the detonators are usually connected in series. To avoid misfire, the electrical characteristics of the detonators need to be within narrow tolerances.

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prEN 13763-18:2021 (E)**1 Scope**

This document specifies a method to determine the series firing current of electric detonators. This document is applicable to explosives for civil uses.

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

The test pieces are connected in series and subjected to a current pulse of a specific duration. Record whether detonation of all test pieces occurs. The duration of the current pulse is determined by the current breakage time, which is evaluated in a previous step.

5 Apparatus

5.1 Regulated current source capable of producing square current pulses with a current overshoot of not more than 10 % of the specified current, and duration not greater than 1 ms (on pure resistive load) with adjustable amplitude and time period; The rise (10 % to 90 % of maximum value) and fall times (90 % down to 10 %) shall be not greater than 50 μ s; the accuracy of the amplitude shall be $\pm 1,0$ %.

5.2 Time measuring device to determine the time interval from the start of the current pulse to current breakage and / or detonation (current breakage time t_b) with a resolution of 10 μ s.

NOTE To account for the fact that delay detonators might not experience bridge wire breakage when the fuse head ignites, different methods determining the pulse duration are applied for instantaneous detonators and delay detonators.

6 Preparation and handling of test samples and test pieces¹**6.1 Handling of test samples**

Test samples for detonators, detonating cord relays, surface connectors and shock tubes should be handled according to EN ISO/IEC 17025:2017, 7.4.

6.2 Electric instantaneous detonators

Select 80 detonators of each specific type, having the same design and composition according to the manufacturer's specification, whose fuse head has the same design, chemical composition and electrical characteristics. Use 30 detonators to determine the current breakage time and use 50 detonators in the series firing test.

¹ The choice of sample size is based on acceptable failure rate for the kind of defects that have to be avoided. The defects have been classified according to ISO 2859-1, ISO 2859-2, ISO 2859-3, ISO 2859-4 and ISO 2859-5.

6.3 Electric detonators, part of a delay series including instantaneous detonators

Select 80 of the instantaneous detonators of each specific type, having the same design and composition according to the manufacturer's specification, whose fuse head has the same design, chemical composition and electrical characteristics. Use 30 detonators to determine the current breakage time and use 50 detonators in the series firing test.

If the design of the fuse head differs between instantaneous detonators and delay detonators, select 80 of the instantaneous detonators of each specific type, having the same design and composition according to the manufacturer's specification, whose fuse head has the same design, chemical composition and electrical characteristics and select 100 detonators of the shortest delay time (other than instantaneous) having the same design and composition according to the manufacturer's specification, whose fuse head has the same design, chemical composition and electrical characteristics. Use 50 detonators to determine the current breakage time and use 50 detonators in the series firing test.

6.4 Electric detonators, part of a delay series not including instantaneous detonators

Select 100 detonators of the shortest delay time having the same design and composition according to the manufacturer's specification, whose fuse head has the same design, chemical composition and electrical characteristics. Use 50 detonators to determine the current breakage time and use 50 detonators in the series firing test.

7 Procedure

7.1 Conditioning and Test temperature

Condition the detonators for at least 2 h at a temperature of (20 ± 2) °C and carry out the test at the same temperature.

7.2 Current breakage time

7.2.1 Adjust the current amplitude to the series firing current I_s stated by the manufacturer and select a pulse duration time of at least t_I given by Formula (1).

$$t_I = 5 \frac{W_{af}}{I_s^2} \quad (1)$$

where

t_I is the pulse duration time in milliseconds;

W_{af} is the all-fire-impulse stated by the manufacturer, expressed in J/Ohm;

I_s^2 is the series firing current stated by the manufacturer, expressed in Ampere.

7.2.2 Connect a detonator to the current source, and apply the current I_s for the time t_I .

7.2.3 Record the current breakage time t_b , in milliseconds.

7.2.4 Repeat steps 7.2.2 and 7.2.3 for each of the remaining detonators.

7.2.5 Determine the minimum value of the current breakage time $t_{b,min}$ and for instantaneous detonators, calculate the mean \bar{t}_k and standard deviation s_b .

prEN 13763-18:2021 (E)**7.3 Series firing test**

7.3.1 Adjust the current amplitude to the series firing current I_s stated by the manufacturer and select a pulse duration t_t given in Formulae (2) and (3):

$$t_t = \min\{t_{b,min}; \bar{t}_b - 3s_b\} \quad (2)$$

where

- t_t pulse duration in milliseconds for instantaneous detonators;
- $t_{b,min}$ is the minimum value of the current breakage time in milliseconds;
- \bar{t}_b is the mean value of the current breakage time for instantaneous detonators;
- s_b is the standard deviation for the current breakage time for instantaneous detonators.

$$t_t = 0,8t_{b,min} \quad (3)$$

where

- t_t is pulse duration in milliseconds for delay detonators;
- $t_{b,min}$ is the minimum value of the current breakage time in milliseconds.

7.3.2 Connect five detonators in series to the current source, and apply the current I_s for the time t_t .

7.3.3 Record the number of detonators that fail to initiate.

7.3.4 Repeat steps 7.3.2 and 7.3.3 for each of the remaining detonators.

8 Expression of results

Measured current breakage times t_b , and, for instantaneous detonators, the corresponding mean and standard deviation;

Test time t_t in the series firing test;

Number of detonators that did not initiate in the series firing test.

9 Test report

The test report should conform to EN ISO/IEC 17025:2017, 7.8. In addition, the following information shall be given:

- a) measured current breakage times t_b , and, for instantaneous detonators, the corresponding mean and standard deviation;
- b) test time t_t in the series firing test;
- c) number of detonators that did not initiate in the series firing test.