SLOVENSKI STANDARD
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Eksplozivi za civilno uporabo – Detonatorji in zakasnilniki – 16. del: Ugotavljanje časa zakasnitve

Explosives for civil uses - Detonators and relays - Part 16: Determination of delay accuracy

Explosivstoffe für zivile Zwecke - Zünder und Verzögerungselemente - Teil 16: Bestimmung der Verzögerungsgenauigkeit

Explosifs à usage civil - Détonateurs et relais - Partie 16 : Détermination de la précision du retard

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EUROPEAN STANDARD

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English Version

Explosives for civil uses - Detonators and detonating cord relays - Part 16: Determination of delay accuracy

Explosifs à usage civil - Détonateurs et relais pour cordeau détonant - Partie 16: Détermination de la précision du retard

Explosivstoffe für zivile Zwecke - Zünder und Sprengschnurverbinder - Teil 16: Bestimmung der Verzögerungsgenauigkeit

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
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European foreword

This document (prEN 13763-16:2021) 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 13763-16:2003.

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

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

   1) it has been specified that this is a method for electric detonators, non-electric detonators, surface connectors and detonating cord relays with pyrotechnic delay elements;

   2) it has been added that the document applies to explosives for civil uses;

b) in Clause 3, *Terms and definitions*, the definition for term 3.2 has been updated;

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

d) Clause 5, *Apparatus*, has been revised;

e) Clause 6, *Preparation and handling of test samples and test pieces*, has been revised;

f) in Clause 7, *Procedure*:

   1) magnetically coupled detonators have been removed;

   2) subclauses for each product type including an addition of detonating cord relays have been added;

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

h) Annex C, Guidance for theoretical verification, has been moved to prEN 13857-3;

i) 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*

— *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*

Introduction

During blasting work, non-electric detonators, electric detonators, surface connectors and detonating cord relays with different delay times are used to ensure that the sequence of initiation of the explosive charges is executed in a way where the risk of overlapping is minimized. This test method describes the measurement of the delay time. It is checked that detonators of a certain delay interval do not detonate at the time of a different delay interval.

1 Scope

This document specifies a method for determining the delay time accuracy of electric detonators, non-electric detonators, surface connectors and detonating cord relays with pyrotechnic delay elements.

This document applies to explosives for civil uses.

NOTE The method for determining the delay time accuracy for electronic initiation systems is included in prEN 13763-27.

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
overlapping
detonation out of intended sequence

3.2
outlier
member of a set of values which is inconsistent of other members of that set

[SOURCE: ISO 5725-1:1994, 3.21]

4 Principle

The test piece is initiated by means of initiation dependent of its type. The delay time between initiation pulse and detonation is measured.

5 Apparatus

5.1 power source for electric detonators, able to produce a continuous current (i) in accordance with the manufacturer's specification and within $i_s \leq I \leq 2i_s$ the series firing current (i_s) for the specific type of electric detonator) with an accuracy of ± 1,0 %.

5.2 initiating device for non-electric detonators/surface connectors/detonating cord relays, for initiating shock tubes/detonating cord.

5.3 timer or oscilloscope to measure the delay time between the start pulse and the stop pulse with an accuracy of 0,1 ms.

5.4 electric triggering circuit for electric detonators, capable of providing an electric pulse at the time when the ignition current is applied; or

5.5 optical sensors or pressure sensors for non-electric detonators/surface connectors/detonating cord relays, capable of providing one electric pulse when the shockwave of the shock tube passes the sensor.

5.6 optical sensors, pressure sensors or two enamel insulated twisted copper wires for detonating cord relays capable of detecting the detonation wave of detonating cord.

5.7 optical sensors, pressure sensors or two enamel insulated twisted copper wires for non electric detonators/surface connectors, capable of providing one electric start pulse and one electric stop pulse.

5.8 conditioning chamber, capable of maintaining a temperature in the range 15 °C to 30 °C within ± 2 °C.

6 Preparation and handling of test samples and test pieces[1]

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

Select 30 non-electric detonators, electric detonators, surface connectors or detonating cord relays of each interval number (i.e. nominal delay time stated by the manufacturer) from a specific type, having the same chemical composition, charge, dimensions, material and construction. For non-electric detonators, the length of shock tube attached to the non-electric detonator/surface connector during the test shall be specified by the manufacturer.

7 Procedure

7.1 Conditioning

Condition the electric detonators, non-electric detonators, surface connectors or detonating cord relays in the conditioning chamber (see 5.7) for at least 2 h prior to testing, within ± 2 °C of a temperature specified by the manufacturer in the range 15 °C to 30 °C.

7.2 Electric detonators

The test shall be carried out within ± 2 °C of the conditioning temperature.

Insert the electric detonators in the apparatus to obtain a stop pulse from the sensor when the base charge of the electric detonator detonates.

Connect the electric detonators to the power source (5.1) and electric triggering circuit (5.4).

Initiate the electric detonators according to the manufacturer's specifications and record the individual delay times and the number of misfires.

7.3 Non-electric detonators and surface connectors

The test shall be carried out within ± 2 °C of the conditioning temperature.

Insert the non-electric detonators or surface connectors in the apparatus to obtain a stop pulse from the sensor when the base charge of the electric detonator, non-electric detonators or surface connector detonate.

For non-electric detonators or surface connectors, install the sensor (5.5) at the shock tube, at a distance specified by the manufacturer, but at least 1 000 mm from the initiation point at the end of the shock tube after removing the end sealing.

Connect the non-electric detonators or surface connectors to the initiating device (5.2).

[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.

Initiate the non-electric detonators or surface connectors according to the manufacturer's specifications and record the individual delay times and the number of misfires.

7.4 Detonating cord relays

Connect the relay between two pieces of detonating cord, so that after connecting the relay between the two pieces according to the manufacturer's instructions a minimum of 450 mm in one side and a minimum of 350 mm in the other side is free.

Tape a detonator (electric, non-electric or electronic) to the longest piece (donor piece) of detonating cord at a minimum distance of 25 mm from the free end of the detonating cord (see Figure 1).

Position the first sensor on the detonating cord piece to which the detonator is attached, at a distance of (250 ± 15) mm from the relay

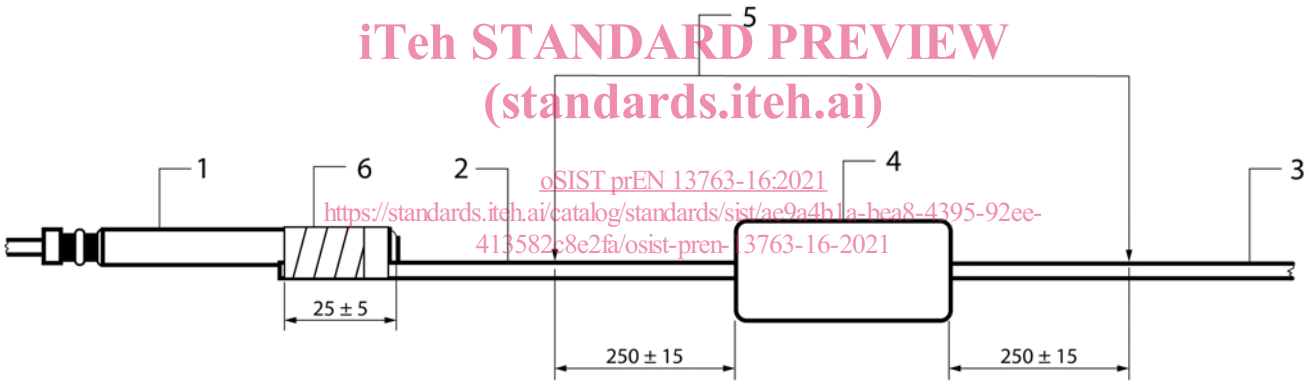
Position the second sensor on the opposite piece (receptor piece) of detonating cord at a distance of (250 ± 15) mm from the relay

Connect the sensors to the time-measuring equipment.

Connect the detonator to the initiation system and carry out the initiation.

Record the time taken for the detonation wave to traverse the distance between the two sensors

Dimensions in millimetres



Key

1 detonator
2 detonating cord
3 detonating cord
4 detonating cord relay
5 sensors
6 tape

Figure 1 — Procedure detonating cord relays

8 Expression of results

Calculate the results of the tests according to Annex A, A.1 to A.5.

NOTE A.6 can be used to present the results in A.1 and A.4 graphically.