

Specification for

Detonators for civil use

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mining Requisite Standards Policy Committee (MRE/-) to Technical Committee MRE/33, upon which the following bodies were represented:

- British Aggregate Construction Materials Industries
- British Coal Corporation
- Federation of Civil Engineering Contractors
- Health and Safety Executive
- Institute of Explosives Engineers

This British Standard, having been prepared under the direction of the Mining Requisites Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 November 1994

© BSI 1994

The following BSI references relate to the work on this standard:
Committee reference MRE/33
Draft for comment 93/712067 DC

ISBN 0 580 23182 8

Amendments issued since publication

Amd. No.	Date	Text affected

Contents

	Page
Committees responsible	Inside front cover
Foreword	3
Introduction	4
Specification	
Section 1. General	
1.1 Scope	6
1.2 References	6
1.3 Definitions	6
Section 2. All types of detonators	
2.1 Items to be agreed and documented between the contracting parties	7
2.2 Type tests	7
2.3 Marking	9
Section 3. Electric detonators	
3.1 General	10
3.2 Type tests	10
3.3 Leading wire colour coding (direct coupling only)	12
3.4 Precautions against radio-frequency ignition	12
Section 4. Non-electric detonators	
4.1 General	13
4.2 Type tests for shock tube denotators	13
Section 5. Detonators intended for use in potentially explosive atmospheres such as mines susceptible to firedamp	
5.1 General	15
5.2 Construction	15
5.3 Electrical characteristics	15
5.4 Initiation time	15
5.5 Type test on incendivity	15
5.6 Detonators used for infusion shot firing	15
Annex	
A (informative) Test procedure for determining the all-fire and no-fire currents for electric detonators	16
Tables	
1 Delay accuracy and precision for general purpose delay detonators	7
2 Waterproofing test	8
3 Long term storage test	8
4 Colour coding of leading wires	12
5 Electrical characteristics	15
A.1 Example of test results	16
A.2 Transformation of percentages to probits	18

	Page
Figures	
1 Lead plate initiating power test: comparison photographs	8
2 Leading wire abrasion test rig	11
3 Arrangement for testing of initiation risk	13
A.1 Relationship between firing current and probability fusehead firing	17
A.2 Probit versus logarithm of current	17
A.3 Relationship between percentages and probits	18
A.4 Example of tests on fuseheads to determine all-fire current	19
List of references	Inside back cover

Foreword

This British Standard has been prepared under the direction of the Mining Requisites Standards Policy Committee.

Attention is drawn to the Health and Safety at Work etc. Act 1974, the Mines and Quarries Act 1954, the Regulations made under these Acts, and also any other appropriate statutory requirements or byelaws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user. The address of the recognized test house in the United Kingdom for detonators for use in mines susceptible to firedamp and from where further information may be obtained is:

The Chief Testing Officer
Explosives Section
Explosion and Flame Laboratory
Health and Safety Executive
Harpur Hill
Buxton
Derbyshire SK17 9JN

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Introduction

Detonators, commonly available for civil use may be divided into different types. There are electric detonators (including transformer coupled detonators) and non-electric detonators (including shock tube initiated detonators). There are detonators which are designed to explode instantaneously and those which are manufactured as part of a series with defined delay times. There are special detonators intended for use in potentially explosive atmospheres such as may be encountered in mines susceptible to firedamp.

If a detonator malfunctions in use, potentially the greatest dangers arise as a result either from its failure to explode or from it being initiated inadvertently. The detonator may fail to explode at all, either as a result of a construction defect or a failure to receive a sufficient exploding impulse, or may explode at an unintended time.

General conditions

For safety and security reasons it should be possible to identify clearly the manufacture of the detonator. The identification should also, where applicable, enable the delay period of the individual detonator and the essential explosive output characteristics of the type of detonator to be unambiguously determined. Detonators not having identical characteristics should not be used together where this may create a hazard.

The mechanical strength of the detonator casing should be such that the detonator can be expected to remain intact and without diminution in safety to the user under the normally expected conditions of carriage and use.

Detonators should have sufficient explosive output strength and be of a suitable design to detonate reliably the explosives with which they are intended to be used.

Detonators, including any permanently attached shock tube where appropriate, should be able to withstand the ingress of water and be proof against the effects of humidity.

The performance of a detonator should be maintained for a defined shelf life. This shelf life should be stated by the manufacturer and be achieved by the detonators when stored under conditions recommended by the manufacturer.

Electric detonators

Failure of an electric detonator to explode may be due to one or a combination of the following causes:

- faulty exploder;
- faulty shotfiring cable;
- current leakage to earth;
- wiring errors in the firing circuit;
- faulty detonator;
- broken or detached leading wires;
- insufficient firing impulse.

The first four of these are outside the scope of this standard and are largely eliminated by good shotfiring practice.

Failure to explode because of a construction fault in the detonator itself may be generally attributable to quality defects at the point of manufacture and a possible failure to meet the defined construction parameters for the detonator.

Breaking the leading wires of a detonator might be caused by friction or by excessive load, aggravated by extremes of temperature. The leading wires should be able to withstand such extremes of temperature, abrasion and tensile loading without failure. The closure of the detonator should efficiently prevent the leading wires and/or fusehead being pulled from the detonator.

Insufficient exploding impulse may be given to a detonator when any of the following occurs;

- there are detonators of different characteristics in the firing circuit;
- there is too little energy produced by the exploder;
- the exploder and/or detonators are incompatible with the electrical characteristics of the firing circuit.

Inadvertent initiation of an electric detonator may be caused by:

- stray currents;
- electrostatic discharge;
- lightning;
- induced radio frequency currents;
- sympathetic detonation;
- mechanical damage.

The electrical characteristics of the detonator which influence many of these parameters are its resistance, its series firing current and the all-fire and no-fire currents. It is necessary to define these and to control them in manufacture. By this means the selection of a detonator, exploder and circuit configuration may be made on a calculated basis.

Non-electric detonators

Failure of a non-electric detonator to explode may be due to one or a combination of the following causes:

- faulty exploder/igniter;
- faulty connection of detonators to the fuse or shock tube;
- faulty detonator;
- broken or damaged fuse or shock tube.

Damage to the fuse or shock tube may arise from a number of causes, of which abrasion and tensile load and kinking may be readily identified. Shock tubing should therefore be capable of resisting tensile loads, kinks and abrasion at extremes of temperatures.

The design of the detonator casing and any closure should be such that the fuse or shock tube intended to be used with the detonator may be effectively attached to the detonator and may be expected to remain attached during normal conditions of handling and use.

Delay detonators

For detonators used in delay firing it is necessary to maintain the accuracy of the delay times. This is so that the probability of an overlap between adjacent delay periods may be minimized. Overlap may give rise to environmental problems, misfires, flyrock and a number of hazards in demolition. There could be an increased probability that an explosive charge with detonator could be ejected from the shothole or point of placement.

Detonators for use in potentially explosive atmospheres

The construction of detonators for such use demands additional factors to be taken into account. The casing and internal construction of the detonator should be of materials and of a design which, upon the functioning of the detonator, does not readily give rise to incendive sparks. The delay accuracy of the detonators in a delay series should be such that the probability of overlap is reduced to an acceptable level to minimize the danger from a blown-out shot.

Section 1. General

1.1 Scope

This British Standard specifies the design, construction, testing and acceptance requirements for detonators intended for civil use.

Detonators for use in military operations, weapons, firearms, railway warning systems, special effects, fire protection systems, or reference detonators (explosives testing) are not intended to fall within the scope of this standard.

Detonating relays, shock tube interconnection detonators and exploding bridgewire detonators and electronic detonators are normally excluded, unless they can meet the requirements of this standard.

This standard is presented in five sections. It is essential that all detonators conform to 2.2 and 2.3. Additional requirements for specific types and application are given in sections 3, 4, and 5:

Section 3: Electric detonators;

Section 4: Non-electric detonators;

Section 5: Detonators intended for use in potentially explosive atmospheres such as mines susceptible to firedamp.

1.2 References

1.2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest edition.

1.3 Definitions

For the purposes of this British Standard the following definitions apply.

1.3.1 detonator

A device normally containing a primary explosive and a high explosive designed to initiate an explosive train.

1.3.2 delay detonator

A detonator designed to explode a pre-determined period after the application of the initiating impulse.

1.3.3 instantaneous detonator

A detonator designed to explode instantaneously on application of the initiating impulse and which does not form part of a delay series.

1.3.4 plain detonator

A detonator designed to be attached to and initiated by a safety fuse.

1.3.5 electric detonator

A detonator comprising a primer charge, a base charge and an electrically initiated bridgewire fusehead with insulated connecting leads which may be either directly coupled or indirectly coupled (i.e. inductive or capacitive coupling) to the firing circuit.

1.3.6 bridgewire fusehead

An electrical resistance heating wire surrounded by an incandive material, which is connected to an electrical source to ignite the explosive charge.

1.3.7 shock tubing

Hollow tubing containing a minute explosive charge coating the internal surfaces, intended to transmit an explosive signal along its entire length when initiated by suitable means.

1.3.8 shock tube detonator

A detonator intended to be fired by the transfer of a signal from shock tubing to which it is attached.