DUS 2141-1:2019

COMMITTEE DRAFT STANDARD

First Edition
2019

Detonator — Specifications — Part 1: Shock-tube Detonator

Reference number
DUS 2141-1:2019

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Foreword

Uganda National Bureau of Standards (UNBS) is a parastatal under the Ministry of Trade, Industry and Cooperatives established under Cap 327, of the Laws of Uganda, as amended. UNBS is mandated to co-ordinate the elaboration of standards and is

(a) a member of International Organisation for Standardisation (ISO) and

(b) a contact point for the WHO/FAO Codex Alimentarius Commission on Food Standards, and

(c) the National Enquiry Point on TBT Agreement of the World Trade Organisation (WTO).

The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of key stakeholders including government, academia, consumer groups, private sector and other interested parties.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

The committee responsible for this document is Technical Committee UNBS/TC ###, *[name of committee]*, Subcommittee SC ##, *[name of subcommittee]*.

This second/third/… edition cancels and replaces the first/second/… edition (US nnn-n:yyyy), which has been technically revised.

US nnn consists of the following parts, under the general title *Introductory element — Main element*:

- *Part n: Part title*
- *Part [n+1]: Part title*
- *Part [n+2]: Part title*

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Introduction

Initiator is a term used in the explosive industry to describe any device that may be used to start a detonation or a deflagration. There are four general classifications of initiators currently being used in blasting:

•Non-electric systems,

•Electric systems,

•Electronic systems, and

•Blasting-cap and safety-fuse systems.

Detonators are devices used to initiate high explosives.

A detonator is a complete explosive initiation device that includes the active part of the assembly (usually enclosed in a metal shell) and the attached initiation signal transmitter (for example, leg wires, a shock tube, or other signal-transmitting material).

A shock tube detonator is a non-electric explosive fuse or initiator in the form of small-diameter hollow plastic tubing used to transport an initiating signal to an explosive charge by means of a percussive wave traveling the length of the tube

Once it is initiated, the shock tube transfers a signal to a detonating output charge, characteristically incorporating an instantaneous output or a pre-determined delay.

Detonator — Specifications — Part 1: Shock-tube Detonator

1 Scope

This draft Uganda standard specifies requirements, sampling and test methods for permitted shock-tube detonators for commercial use.

The draft Uganda standard applies to shock-tube detonator No. 6 (surface) and No.8 (In-hole) for commercial use.

2 Normative references

The following referenced documents 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.

US EAS 124:1999, *Rounding off number values*

ISO 7010:2011, *Graphical symbols -- Safety colours and safety signs -- Registered safety signs*

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
Permitted Detonators
detonator which is authorized by the competent authority for manufacture and commercial use

3.2
regulations
regulations promulgated under the relevant national legislation

3.3
Detonator
is device used to initiate high explosives

3.4
Shock tube
is a non-electric explosive fuse or initiator in the form of small-diameter hollow plastic tubing used to transport an initiating signal to an explosive charge by means of a percussive wave traveling the length of the tube

3.5
delay time of a commercial detonator
is the time it takes from in-putting excitation energy to the detonator to beginning to detonate

4 Classification

A shock tube detonator comprises of mainly a Shock-tube and Detonator(s)

Shock-tube shall be classified by strength (plain or heavy-duty)

Detonator shall be classified by delay time (millisecond, quarter second, half-second and second)

The detonators shall be of two types, namely; No. 6 (surface) and No.8 (In-hole)

5 Requirements

5.1 General Requirements

The detonator shall be marked with a visible and distinguishable delay period number.

The surface of a plain detonator shall be free from obvious dust powder, rusty stains, major sand-holes, cracks and mechanical injuries. The shock-tube shall be free from breaks, break-off of powder lining, thinning off, water intrusion, foreign matters, poorly plasticized tube wall and un-tight sealing of tube end.

The shock-tube and detonator joint shall hold firmly and shall not become separated or loose.

5.2 Specific Requirements

5.2.1 Length of a shock-tube

The basic length of a shock-tube is 3(0/-0.1) m or as specified by the purchase contract. Measure with a ruler that can give an accuracy of not less than 0.01m.

5.1.2 Shock resistance

Put samples into a wooden box at the center of its bottom, fill the gaps around the samples in the box, jolt for a duration of 10 minutes with a frequency of 60 times/min. and a drop height of 150+2mm, then check to see if any detonators explode or the structure of any detonators become loose or damaged.

5.2.3 Initiating power

The explosion of a shock-tube detonator No.6 shall break through 4mm thick aluminium-plate, while the explosion of a shock-tube detonator No. 8 shall break through 5mm thick aluminium -plate. The hole broken through the aluminium -plate shall not be less than the outside diameter of the detonator when tested in accordance to annex A

5.2.4 Water resistance

5.2.4.1 Immerse a plain shock-tube detonator 1m deep into water for 8 hours, then make firing test for determination of delay time, the detonator shall not misfire or incompletely explode.

5.2.4.2 Immerse a water-resistant shock-tube detonator 20m deep into water or into a water container, which can produce 20m deep-water pressure, for 24 hours, then make firing test for determination of delay time, the detonator shall not misfire or incompletely explode in accordance to annex B

5.2.5 Tensile strength

5.2.5.1 For a plain shock-tube detonator, pull the shock-tube with a static force of 19.6N for one minute; it shall not come off the rubber sleeve/plug.

5.2.5.2 For a heavy-duty shock-tube detonator, pull the shock-tube with a static force of 78.4N for one minute; it shall not come off the rubber sleeve/plug.

5.2.6 Oil resistance

Immerse heavy-duty shock-tube detonators into diesel oil with a temperature of 75±5℃ and a pressure of 0.3±0.02Mpa for 24 hours, then take them out for functioning reliability test, the detonators shall not misfire or incompletely explode.

5.2.7 Delay time

5.2.7.1 Time measuring instrument shall meet the following requirements:

a) For millisecond shock-tube detonators, it shall give an accuracy of not less than 0.1ms;

b) For half second or quarter second shock-tube detonators, it shall give an accuracy of not less, than 1ms;

c) For second shock-tube detonators, it shall give an accuracy of not less than 10ms.

5.2.7.2 Test conditions are specified as follows

a) The initiating end should be 1.0m~1.8m away from the target;

b) The time should be measured at the temperature range of 15℃~30℃;

c) For shock-tubes of products with a length of over 3 meters, cut to 3 meters for measuring the time or take the actual length for the same purpose. For shock-tubes of products with a length of less than 3 meters, take their actual length for measuring the time.

d) Test procedure is as specified in Annex C

e) Supplementary rules for determination of delay time, please refer to Annex D.

5.2.7.3 The delay time for the shock-tube detonators of different delay periods shall conform to the requirements specified in Table 1 and the detonators of additional delay trains can also be produced based upon the actual needs and shall not exceed 10000 ms

Table 1 — Delay Time for Shock-tube Detonators of Different Delay Periods

Period No.	Delay Time in (nominal second)							
	MS shock-tube detonator in ms			QS shock-tube detonator in s	HS shock-tube detonator in s		S shock-tube detonator in s	
	1st. ser	2nd ser	3rd ser	1st ser	1st ser	2nd ser	1st ser	2nd ser
1	0	0	0	0	0	0	0	0
2	25	25	25	0.25	0.50	0.50	2.5	1.0
3	50	50	50	0.50	1.00	1.00	4.0	2.0

4	75	75	75	0.75	1.50	1.50	6.0	3.0
5	110	100	100	1.00	2.00	2.00	8.0	4.0
6	150	125	125	1.25	2.50	2.50	10.0	5.0
7	200	150	150	1.50	3.00	3.00	_	6.0
8	250	175	175	1.75	3.60	3.50	_	7.0
9	310	200	200	2.00	4.50	4.00	_	8.0
10	380	225	225	2.25	5.50	4.50	_	9.0
11	460	250	250	_	_	_	_	_
12	550	275	275	_	_	_	_	_
13	650	300	300	_	_	_	_	_
14	760	325	325	_	_	_	_	_
15	880	350	350	_	_	_	_	_
16	1020	375	400	_	_	_	_	_
17	1200	400	450	_	_	_	_	_
18	1400	425	500	_	_	_	_	_
19	1700	450	550	_	_	_	_	_
20	2000	475	600	_	_	_	_	_
21	_	500	650	_	_	_	_	_
22	_	_	700	_	_	_	_	_
23	_	_	750	_	_	_	_	_
24	_	_	800	_	_	_	_	_
25	_	_	850	_	_	_	_	_
26	_	_	950	_	_	_	_	_
27	_	_	1050	_	_	_	_	_
28	_	_	1150	_	_	_	_	_
29	_	_	1250	_	_	_	_	_
30	_	_	1350	_	_	_	_	_

6 Packaging, labelling, transportation and storage

6.2 Packaging

6.2.1 The detonators shall be packaged as agreed to between the purchaser and the supplier and the packaging material shall not compromise the performance of the product.

6.2.1 Each packaging box shall be accompanied by an operation manual.

6.2.1 Each packaging box and/or a batch shall be accompanied by a Material Safety Data sheet

6.3 Transportation

The transportation of shock-tube detonators shall conform to the requirements concerning transportation of dangerous goods specified by the State.

6.1 Labelling

Each shock-tube detonator shall be clearly marked with visible and distinguishable delay time code. The delay time codes for millisecond, quarter second, half second and second delay are respectively MS, QS, HS and S. The marking on the outside packaging box of shock-tube detonators shall at least contain the following items:

a) The name and physical address of the manufacturer.

b) The name, grade, strength and type shock-tube (No.6 or No.8) of the product;

c) The serial number of the production license;

d) “Explosive” marking conforming to ISO 7010;

e) Words such as “Handle with care”, “Inflammable”, “Keep dry”;

f) Batch number;

g) Quantity;

h) Manufacturing date;

i) Expiry date

6.4 Storage

The shock-tube detonators shall be in the original packing and kept in dry and well-ventilated storehouse at room temperature. The service life is two years from the manufacturing date.

7 Sampling

7.1 Batching regulation

The batch submitted for inspection and test shall consist of the products, which are of similar structure, made of similar materials and by similar process and equipment. The batch shall not exceed 35,000 pieces in size.

Detonators of same grade, same type and belonging to the same batch of manufacture shall be grouped together to constitute a lot.

Detonators constituting the sample shall be drawn from each lot separately for deciding the conformity of the lot to the requirements of the specification

If the samples conform to the requirements as specified in clause 5 when subjected to all inspection items, the batch of products represented by the samples should be accepted otherwise it should be rejected.

Annex A
(normative)

Method for aluminium plate test of a commercial detonator

A.1 Principle

Under the specified test conditions, the detonator is erected at the center of the Aluminium plate and detonated. The diameter of hole perforated in the Aluminium plate indicates the strength.

A.2 Apparatus

a. Detonator Resistance Checking Instrument: The maximum working current is not more than 30mA;

b. Vernier Caliper: graduation value 0.02mm;

c. Hole Sample Column: mm, $d_{-0.15}^{0}$mm is the basic size of the outer diameter of the detonator;

d. Explosion Device: It should be able to ensure that the detonator is standing upright in the center of the aluminium plate, and the hole diameter of aluminium plate support base is 20-25mm. There is an explosion-proof and safety protection device, which is convenient and safe to use, and its device is as shown as follows;

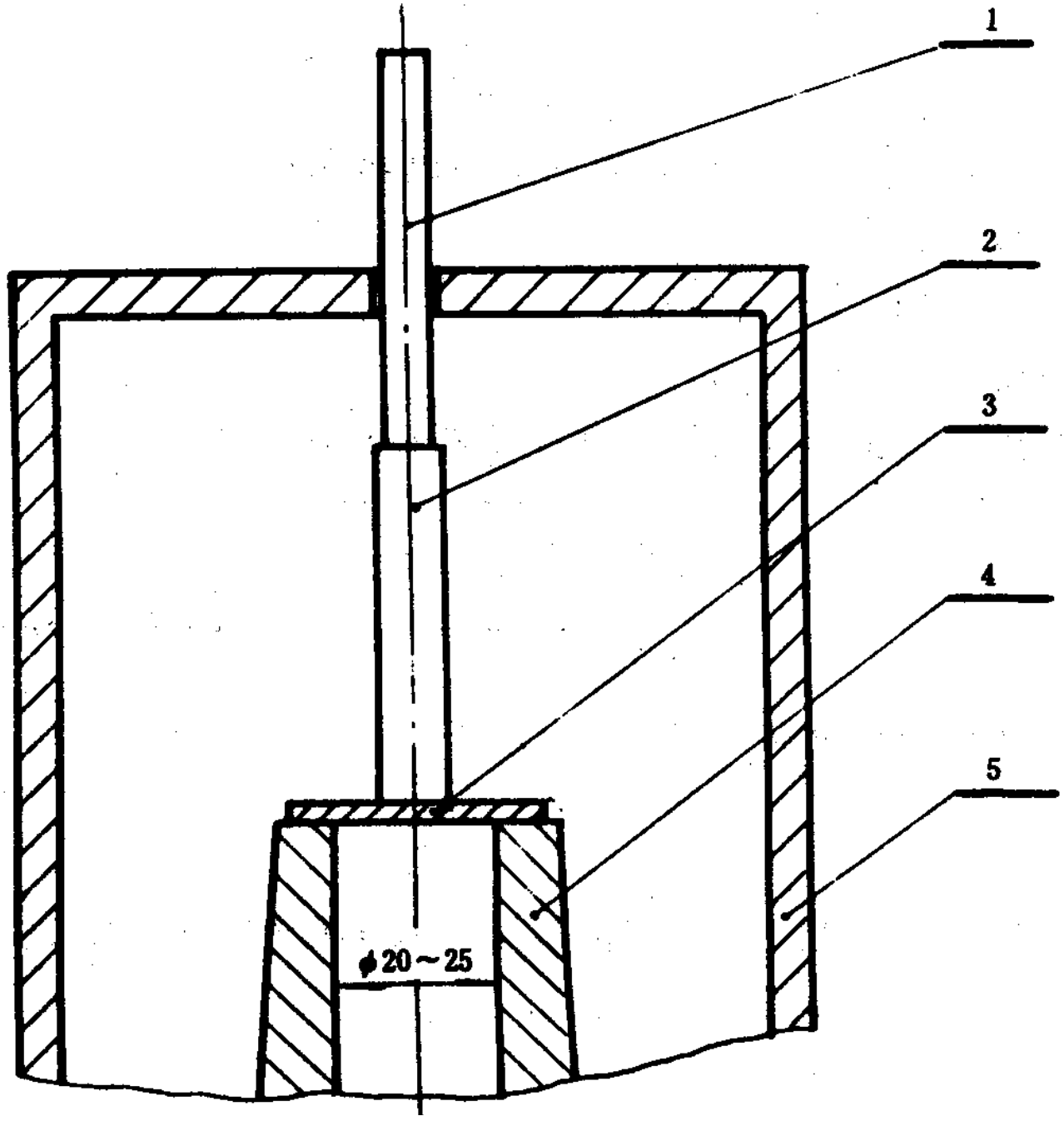
e. Fuse Cutter;

f. Crimping Machine;

g. Initiating Device: The output energy should meet the test requirements;

h. Aluminium Plate:

i. Safety Fuse:



Explosion Device Schematic

1. Safety Fuse;
2. Detonator Tube;
3. Aluminium Plate;
4. Aluminium Plate Support Base;
5. Explosion Box

A.3 Test Preparation

A.3.1 Take out a certain number of qualified aluminium plates for the test, and the quantity should be in accordance with the corresponding product standards.

A.3.2 Commercial plain detonator

Cut the safety fuse with a length of 70-100mm with a flat end face, put the inspected detonator into the hole of the crimping machine one by one, insert the safety fuse and put it in place, and crimp it.

A.3.3 Shock tube detonator:

Only qualified samples after the visual inspection can be used for test.

A.3.4 Test procedure

Place the aluminium plate horizontally in the explosion device, erect the test sample at the center of the aluminium plate, and the bottom of the sample must be close to the aluminium plate.

A.3.4.1 Initiate Detonator

a. **Commercial Plain Detonator**: Ignite the safety fuse and initiate the detonator;

b. **Shock Tube Detonator**: Initiate the sample with an explosion device.

A.3.4.2 After the explosion of the detonator, inspect the aluminium plates in the explosion device one by one, and record the number of non-fire and incomplete detonation (semi-explosion).

A.3.4.4 Check the hole diameter of the aluminium plate one by one with the hole sample column and record. If the diameter value of the hole is needed, measure one by one with a calliper; record the diameter value of the aluminium plate hole. Each aluminium plate is measured twice at the intersection of 90º, and the arithmetic mean of the two measurement results is taken as the measurement hole diameter of the perforation of the aluminium plate. The hole sample column can also be used for the measuring. The Vernier calliper is used for checking.

A.3.5 Report

A.3.5.1 Evaluate the results according to the requirements of this standard.

A.3.5.2 Report the arithmetic mean, maximum and minimum values of the perforation hole diameter of the aluminium plate in each set of tests in mm, and keep a single digit after the decimal point.

Calculate the arithmetic mean according to equation (1):

$$d = \frac{1}{n}\sum_{i}^{n} di \quad \text{..... (i)}$$

Where: d - in each set of tests, the arithmetic mean of the hole diameter of the aluminium plate perforation measurement, mm;

N—the number of perforations of aluminium plates in each set of tests;

I— the series number of aluminium plate perforation aperture in each set of tests;

di — the ith aluminium plate perforation measurement hole diameter, mm.

A.3.5.3 After calculation according to formula (2), report the standard deviation of a set of test aluminium plate perforation measurement hole diameter:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (di - d)2}{n - 1}}$$

Where: σ standard deviation of aluminium plate perforation hole diameter, mm.

A.4 Aluminium plate

A.4.2 The aluminium plate is made from the calendered sheet and allowed to be cast.

A.4.3 The diameter and thickness of the aluminium plates should comply with the following table:

Mm

No.	Diameter	Thickness	
		Basic size	limit deviation
1	30-40	4.0	0.1
2		5.o	

Note: The thickness deviation within 5mm from the edge may not be within the specified deviation.

A.4.4 Aluminium plates must be flat, corrosion, cracks, delamination, inclusions, or shape defects that affect the explosion are not allowed. It is allowed to have mechanical flaws such as depressions and scratches within the limit deviation of the thickness of the aluminium plate.

A.4.5 Aluminium plates melted from the same furnace form one or more batches.

A.4.6 Take 5% aluminium plates from each batch to be examined for appearance and thickness (diameter is guaranteed by tooling). It shall comply with the requirements of 4.3 and 4.4. If one item fails, the double inspection shall be repeated and no more fails, otherwise, the batch shall be returned.

A.4.7 Aluminium plates that have been tested or rejected are allowed to be re-melted, but the aluminium content must not be lower than 99.5%.

A.5 Precautions

A.5.1 The initiating operation shall comply with the relevant technical safety regulations;

A.5.2 Inspection of the detonator before the test and the crimping of the safety fuse and the plain detonator shall be carried out in the explosion-proof enclosure;

A.5.3 After detonation, it should stay for a certain period of time before entering the test site. The detonator failed in explosion should be disposed in accordance with relevant safety regulations.

Annex B
(normative)

Method for immersion test of a commercial detonator

B.1 Principle

Immerse the commercial detonator in a water-filled container that can simulate a certain water depth, endure for a specified water immersion time at certain temperature, take out the commercial detonator for performance test to determine the water resistance of the commercial detonator.

B.2 Equipment

B.2.1 Water-Filled Container:

a. Cylindrical pressure-resistant container with a diameter of 500mm and an effective net height of 1000mm, whose bottom has a porous partition. Other suitable pressure vessel is also allowed to be used;

b. Pressure resistance should meet the test requirements, and equipped with drainage and safety valve devices.

B.2.2 Sample Cage: A device for placing the commercial detonator under test.

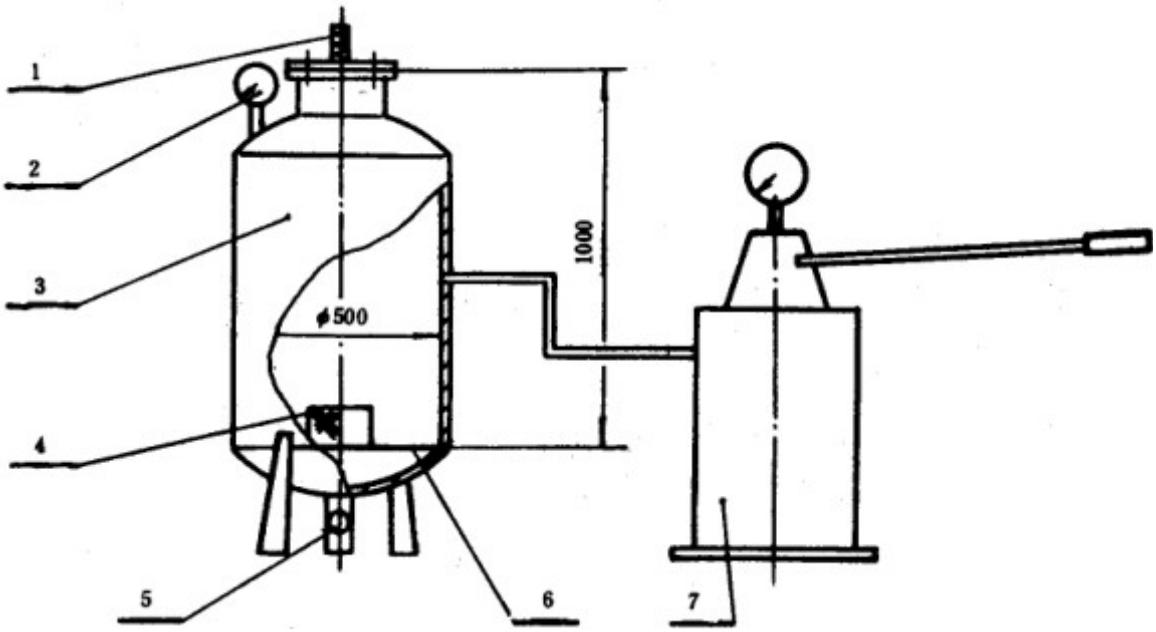
B.2.3 Pressure test pump: It should meet the test requirements. Other devices capable of maintaining a certain water pressure are also allowed.

B.2.4 Pressure Gauge: It is not less than level 1.5, and the test pressure value should be within 1/4 to 3/4 of the full scale value of the pressure gauge.

B.2.5 Thermometer: 0-100 ℃, the division value is 1℃.

B.3 Water Immersion Test Device

The water immersion test device is shown in the figure.



Schematic diagram of detonator immersion test device

1. Safety Valve;
2. Pressure Gauge;
3. Water-Filled Container;
4. Sample Cage;
5. Drainage Device;
6. Porous Partition;
7. Pressure Test Pump

B.4 Test Conditions

B.4.1 Ambient temperature 5-35°C.

B.4.2 The pressure fluctuation range is not more than 5% of the test pressure.

B.5 Test Procedure

B.5.1 Fill the water container with fresh water and adjust the water temperature to meet the test requirements.

B.5.2 Check the sealing of the water container.

B.5.3 Take a certain number of commercial detonators into the sample cage, hang the sample cage on the porous partition in the water-filled container, close the flange cover, and seal tightly.

B.5.4 Gradually apply water pressure to the water-filled container with the pressure test pump to the specified pressure value, and start timing.

B.5.5 After the test is completed, open the pressure relief valve of the pressure test pump and take out the commercial detonator to dry the water.

B.6 Report Results

Carry out the commercial detonator performance test according to the corresponding product standard, and report the test results.

B.7 Precautions

B.7.1 Commercial detonators shall be placed in the bottom of the sample cage at a height not exceeding 100mm.

B.7.2 When wiping the commercial detonator, the cotton fabric must be used behind the guard to dry the water gently.

A.1 Visual inspection

. Check with naked eyes.

A.7 Oil resistance

A.7.1 Apparatus

a) Container, which can be used for increasing temperature and pressure and is φ400mm×500mm in size;

b) Diesel oil

A.7.1 Test procedure

Put diesel oil not less than 300mm deep into a container, heat the container until the oil temperature reaches 75±5℃, then immerse the samples in the oil and lid the container.

Pressure the diesel oil in the container to 0.3±0.02Mpa, then stop heating and maintain the diesel oil at that pressure and cool in the air for 24 hours, then make functioning reliability test.

Observe the post-test phenomena and record the test results.

A.8 Delay time

Annex C
(normative)

Method for determination of delay time of a commercial detonator

C.1 Principle

The delay time determination is based on the principle of time interval determination, that is, the time between the beginning voltage pulse signal and the cut off voltage pulse signal is measured.

C.2 Apparatus

C.2.1 Instrument

The time measuring instrument shall have a DC constant current output power supply, a timing and electronically controlled switching device, an optoelectronic and piezoelectric signal receiving circuit.

a) Output Power Supply: The current is continuously adjustable within 0-2A, the load resistance varies within 1-10Ω, and the relative error of the output current is not more than 5%;

b) Ammeter: range 0-2A, accuracy level 1.0;

c) Timer: It should meet the product timing accuracy requirements.

C.2.2 Explosion Device

The piezoelectric sensor is mounted on the outside of the explosion chamber. The distance between the tested detonator and the sensor is not more than 0.5m.

C.2.3 Sensor

a. Photoelectric sensor: The response time of the photocell is not more than 10^{-7}s;

b. Piezoelectric sensor, piezoelectric crystal or piezoelectric ceramic component.

C.3 Operation Steps

C.3.1 Sample Preparation

Only the qualified samples in the appearance and resistance inspection can be used for the test.

C.3.2 Debug the instrument and check the explosion device. Turn on the instrument power, preheat, debug, and then check the device.

Shock Tube Detonator Time Determination: Initiate a shock tube, and start the digital tube counting. Then, make a vibration to the hammer box with a hammer, and the digital tube stops counting. The device is good.

C.3.3 Time Determination

According to the delay time of the detonator to be tested and the accuracy of the time determination, select and turn on the time base switch, and then place the detonator in the explosion box.

C.3.3.1 Shock Tube Detonator: Fix the shock tube and fix it on the photoelectric sensor socket, keep the distance between the photocell and the detonating end not more than 1m, then press the reset button to initiate the shock tube with a spark actuator (or other excitation device). After the detonator explodes, record the time value displayed by the digital tube.

C.4 Calculation and Processing of Results

Calculating the mean and standard deviation

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \qquad \cdots\cdots(1)$$

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2} \qquad \cdots\cdots(2)$$

Where: - the mean sample delay time, ms or s;

Xi— the delay time of the ith sample, ms or s;

n— the number of detonators tested;

S—standard deviation of sample delay time.

The number of significant digits of the calculation result is selected according to the corresponding product standard.

C.4.1 Processing of Outliers

Outliers is allowed not to be used in the calculations of mean and standard deviation. The abnormal value of the delay time shall be regarded as a defect when it is impossible to determine the technical failure of the test system. If it can be confirmed that the abnormal value is caused by the technical failure of the determination system, it shall not be regarded as a unaccepted product, and the delay time shall be re-determined after supplementing the sample size.

C.5 Precautions

C.5.1 In the test, if the detonator does not explode within the specified delay time, must cut off the detonation power supply at first, stay for a certain period of time before removing the detonator from the explosion chamber.

C.5.2 If a fault occurs during the test, disconnect the detonator wire connected to the current output of the instrument at first before eliminating the fault.

C.5.3 The terminal block for current and sensor must be secure and in good contact.

Annex D

(informative)

Supplementary rules for determination of delay time

D.1 Upper and lower limit of delay time

The upper limit (U) of a shock-tube detonator delay time is the mid-point of said delay period and its previous delay period while the lower limit (L) is the mid-point of said delay period and its subsequent delay period. When an instantaneous shock-tube detonator is used together with shock-tube detonators for arranging delay periods, the lower limit of said detonator delay period should be zero. The upper limit of the last shock-tube detonator delay period can be calculated by adding the previous delay period to the difference between the last delay period and its lower limit.

Example:

First delay period of HS detonator: L=0; U= (0+0.50)/2=0.25.

Tenth delay period of HS detonator: L= (4.00+4.50)/2=4.25;

U= (4.50-4.25) +4.50=4.75

D.1.1 Acceptance and rejection for the sample delay time

A.2.1 After testing for determination of delay time, use formulas (A.1) and (A.2) to calculate the values of abscissa (x) and ordinate (y) of the acceptance curve as shown in Fig. A. 1.

$$x = \frac{S}{U - L} \quad \text{..... (A. 1)}$$

$$y = \frac{\overline{X - L}}{U - L} \quad \text{..... (A. 2)}$$

Where:

S—— Standard deviation value of the sample delay time in second or millisecond;

U—— Upper limit of the sample delay time in second or in millisecond;

L—— Lower limit of the sample delay time in second or in millisecond;

X—— Average value of the sample delay time in second or in millisecond.

When recorded and calculated, the effective digits for the delay time and its average value, and standard deviation value should be same as those given in Table 1. For calculating values of abscissa and ordinate (x, y), three effective digits should remain, the subsequent digit should be rounded off in accordance with the requirements specified in **US EAS 124**.

A.2.2 Place a point (x, y) on a corresponding acceptance curve. If the point falls within the

acceptance curve (or on the curve), the tested sample will be considered satisfactory; otherwise it should be considered unsatisfactory

B.1.2 Misfire or incomplete explosion occurs during testing

During testing for determination of delay time, if one shock-tube detonator misfires or incompletely explodes not because of water intrusion, record the misfired detonator for investigation, then take one round at random for retest from samples satisfactorily passing the visual check, and use newly determined value of re-tested detonator and other values of tested detonators for calculation. If two or more than two shock-tube detonators misfire or incompletely explode not because of water intrusion, the delay time of the batch represented by the samples should be directly considered unsatisfactory, no retest will be made.

B.2 Upper and lower limit of delay time

B.2.1 Judgment

During testing for determination of delay time, if one extreme value occurs, accept or reject it or calculate statistical values (G_n) and ($G_n^{'}$) of the maximum and minimum values of the sample delay time by using formulas (A.3) and (A.4)

$$G_n = \frac{1}{S}(X_{\max} - \overline{X}) \quad \text{..... (A. 3)}$$

$$G_n^{'} = \frac{1}{S}(\overline{X} - X_{\min}) \quad \text{..... (A. 4)}$$

Where:

S —— Standard deviation value of the sample delay time in second or in millisecond;

$\overline{X}$ —— Average value of the sample delay time in second or in millisecond;

$X_{\max}$ —— Maximum value of the sample delay time in second or in millisecond;

$X_{\min}$ —— Minimum value of the sample delay time in second or in millisecond.

If G_n or $G_n^{'}$ is more than critical value, the extreme value is considered abnormal and rejected, otherwise it is considered normal and no value is rejected.

Example:

At an inspection level value of l5%, find that the critical value is $G_{0.95}$ (20)

=2.557 (n=20). If G_{20} or $G_{20}^{'}$ is more than 2.557, the extreme value is considered abnormal and rejected, otherwise it is considered normal and no value is rejected.

B.2.2 Disposal of extreme values

During testing if one extreme value occurs and is considered abnormal, reject the value and record it for investigation, then take one shock-tube detonator at random for retest from samples satisfactorily passing the static pull test to obtain a new value. During testing if two or more than two extreme values occur or after retest extreme value still occurs, no judgment will be made and the calculation will be made directly by using the values obtained.

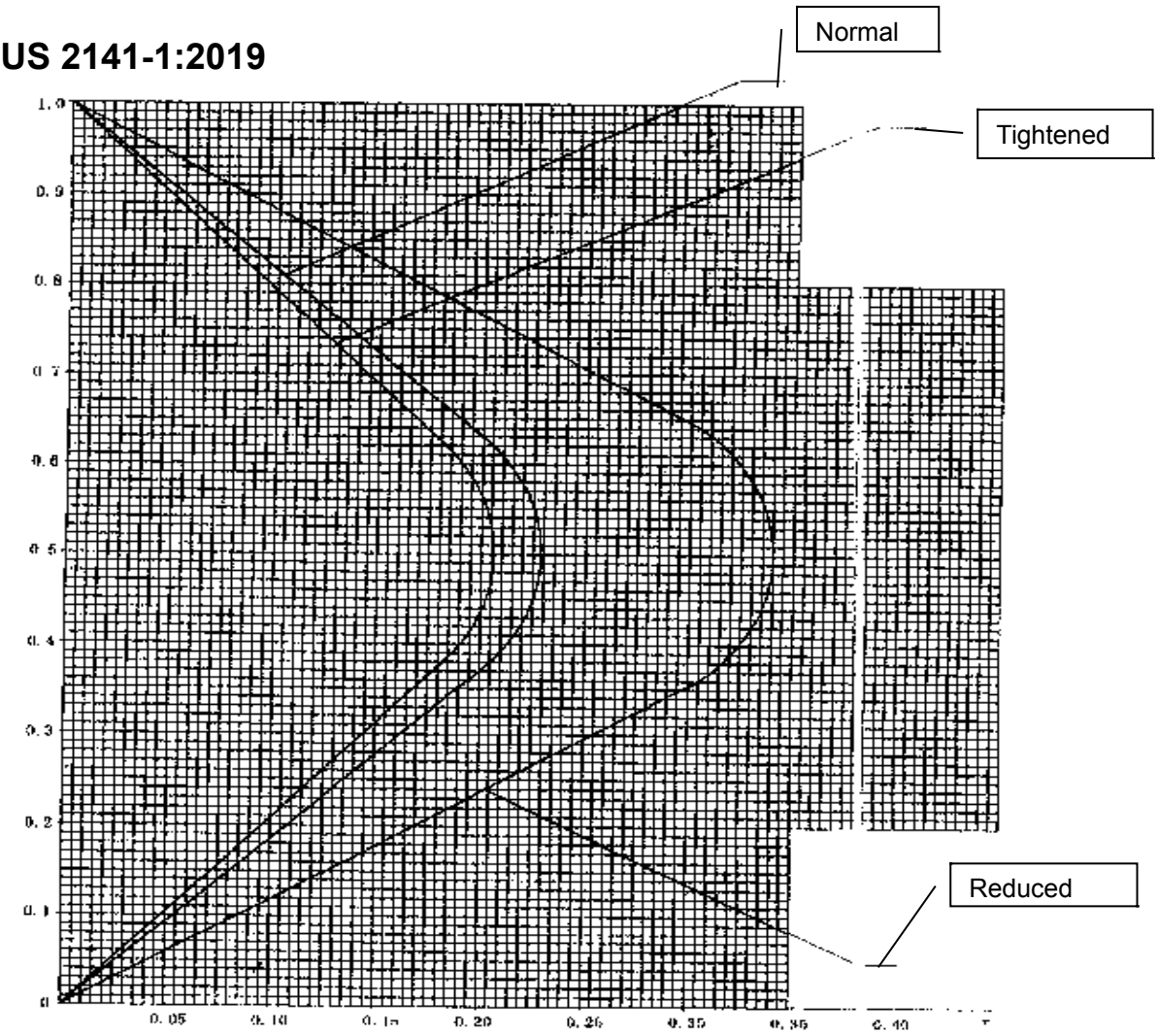


Fig.A.1 Delay Time Acceptance Curve

(The batch size is 3,201 pieces ~ 10,000 pieces.)

Bibliography

[1] GB 19417: 2003, Shock-tube Detonator

Certification marking

Products that conform to Uganda standards may be marked with Uganda National Bureau of Standards (UNBS) Certification Mark shown in the figure below.

The use of the UNBS Certification Mark is governed by the Standards Act, and the Regulations made thereunder. This mark can be used only by those licensed under the certification mark scheme operated by the Uganda National Bureau of Standards and in conjunction with the relevant Uganda Standard. The presence of this mark on a product or in relation to a product is an assurance that the goods comply with the requirements of that standard under a system of supervision, control and testing in accordance with the certification mark scheme of the Uganda National Bureau of Standards. UNBS marked products are continually checked by UNBS for conformity to that standard.

Further particulars of the terms and conditions of licensing may be obtained from the Director, Uganda National Bureau of Standards.

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