DUS 1756-1

DRAFT UGANDA STANDARD

First Edition
2017-mm-dd

Commercial blasting explosives — Specification — Part 1: Emulsion Explosive

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DUS 1756-1: 2017

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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

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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 5, *[Chemicals and Environment]*

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*

Introduction

An explosive is a compound or a mixture of compounds, which when initiated by heat, impact, friction or shock undergoes a very rapid self-propagating exothermic reaction. This reaction produces more stable products, usually gases that exert tremendous pressure as they expand at high temperature.

Explosives can be classified into two broad groups, namely, the industrial explosive and the military explosives. Industrial explosives are also known as commercial explosives and include dynamites, slurries, emulsions and blasting powders. Military explosives are mainly used as ammunition in small arms as well as field guns and rockets. • Slurries consist of saturated aqueous solution of ammonium nitrate and other nitrates which also contain additional amounts of undissolved nitrates in suspension. Fuels are added to the composition in order to take up the excess oxygen of nitrates. Sensitizer in slurries can be monomethylamine nitrate, dispersed air bubbles, aluminium powder, etc.

Emulsions are made by mixing an aqueous solution of nitrates of ammonium, calcium and/or sodium and fuels like oil, LSHS, diesel oil and waxes in the presence of emulsifiers. Sensitivity is normally achieved by adding chemical gassing agents like sodium nitrite and/or micro balloons.

In permitted emulsion/emulsion explosives, coolants like sodium chloride are added to reduce the flame temperature.

Emulsion/Emulsion explosives can be manufactured at site through Site Mix Emulsion (SMS) or Site Mix Emulsion (SME) systems and charged into boreholes mechanically through pumping arrangement. These explosives are water resistant, fairly stable, sensitive and have good storage quality. They are sensitive to shock impact and fire and are non-toxic. They have excellent fume characteristics and post-blast fumes are non-irrita

Commercial blasting explosives — Specification — Part 1: Emulsion Explosive

1 Scope

The standard specifies requirements, tests methods and sampling of emulsion explosives

NOTE The requirements of this standard should be read in conjunction with the Act of 1964 cap 309 and other applicable regulations.

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.

DUS 1776:2017; light metal in hazardous location at mines — Guidelines for use

DUS 1757: 2017; Commercial blasting explosives — Terminology

DUS ISO 7010: 2011; Graphical symbols — Safety colours and safety signs — Registered safety signs

3 Terms and definitions

For the purposes of this document, the terms and definitions given in WDUS 1757 and the following apply.

3.1
authorized explosive
explosive which is authorized by the competent authority

3.2
competent authority
national body or authority designated, or otherwise recognized, for the control or regulation of explosives (see foreword)

3.3
emulsion explosive
is an intimate mixture of oxidizers and carbonaceous fuels made as water in oil type of Emulsion industrially produced by emulsification technologies.

3.4
permitted detonator
detonator which is authorized by the competent authority for manufacture and commercial use.

3.5
permitted explosive
explosive which is authorized by the competent authority for use in commercial work

3.6
regulations
regulations promulgated under the relevant national legislation

4. Requirement

4.1 General requirement

4.1.1 The explosive shall be a homogeneous mix and shall be capable of initiation by a permitted detonator.

4.1.3 A permitted explosive shall be Water-based explosive in an emulsified form.

4.2 Performance requirements

4.2.1 Continuity of detonation

When an explosive is tested in accordance with test method in Annex B, the explosive shall, in each case, detonate throughout the length of the explosives train.

4.2.2 Blast performance requirements

All permitted emulsion explosives manufactured for commercial use, in addition to meeting the general requirements stipulated is clause 4.1 above, shall comply with blast performance tests as specified in the table 1 below.

Table 1 —Blast performance requirements

Test	Expected Result	Test Method
Gap Distance/ Sensitivity	≥5cm	Annex C
Detonation Velocity	≥4200ms^{-1}	Annex E
Brisance	≥15mm	Annex F
Capacity for Work	≥260ml	Annex G

4.2.3 Density

When determined in accordance with Annex D, the density of the explosive shall be within ± 0.05 g/cm^3 of that claimed by the manufacturer and fall within a range of 1.00-1.2gcm^3

4.3 Shelf life

After storage for six months from the date of manufacture, under conditions specified in the relevant national legislation and approved by the competent authority, an explosive shall still comply with all the other requirements of the standard.

5 Inspection

5.1 General

Owing to the dangerous nature of explosives, extreme care and caution shall be exercised during the inspection, sampling and testing of explosives. All safety precautions and procedures laid down in the relevant national legislations shall be strictly followed.

The sampling procedure given in annex H shall be applied in determining whether a lot complies with the appropriate requirements of this standard.

5.2 Inspection

Inspect the explosives for compliance with the requirements of clause 6

6 Packaging and marking

6.1 Packaging

Explosives/ Cartridges shall be packed in rigid or semi-rigid cartridges consisting of paper, rigid cardboard or plastics. The cartridges shall be such that no leakage of the explosive occurs under normal conditions of transportation, handling and storage. Clips used for closing a cartridge shall be made from non-incendiary materials complying with the provisions of DUS 1776:2017 and shall be of mass not exceeding 1.2 g per clip. Cartridges shall be packed in accordance with the relevant national legislation

6.2 Labeling

6.2.1 Each package shall also be marked with appropriate explosive symbol as specified in IS0 7010.

a) Indication of the source of manufacture ;

b) Name of the explosives;

c) Batch / lot number;

d) Expiry and manufacture date

e) country of origin

f) gross and net weight

g) manufacture or trade mark

In addition to the above, the following cautionary note shall also appear on the label in red ink:

HIGHLY EXPLOSIVE. HANDLE WITH UTMOST CARE. DO NOT DROP OR SUBJECT TO HEAT. FRICTION OR SHOCK. DO NOT BRING ANY SPARK OR FLAME NEAR THE PACKAGE. DO NOT STORE OR STOCK WITH THE DETONATORS

6.3 Cartridges

Each cartridge shall bear the following information in prominent, legible and indelible marking:

a) the trade name of the explosive,

b) the diameter of the cartridge, and

c) the mass of the cartridge.

Annex A
(normative)

Gallery test

A 1 General

Gallery test is a type of test and it is not required to be carried out on every lot, if the particular type of composition has been tested and approved by competent authority. But repeat incendivity test shall be done once in every five years of each approved sample of permitted explosive for checking its consistency against safety

Annex B
(normative)

Continuity of detonation

B.1 General

This is a method for the determination of the continuity of detonation of commercial explosive.

B.2 Apparatus and materials

NOTE The procedures laid down for the specific test equipment used should be strictly adhered to.

B.2.1 Instantaneous permitted electric detonator, complying with SANS 1600.

B.2.2 Plastics film, of approximately 100 µm thickness and of length approximately (but at least) 1.0 m and capable of encircling the cartridge with at least half an overlap.

B.2.3 Steel pins, of length approximately 13 mm.

B.2.4 Wooden dowel sticks, of diameter approximately 10 mm and length approximately 200 mm longer than the explosives column under test.

B.2.5 Cylindrical piercer, of brass or stainless steel, of diameter 6.0 mm, of length 140 mm and pointed at one end.

B.2.6 Masking or insulation tape, of width approximately 20 mm.

B.3 Procedure

B.3.1 Take sufficient cartridges of the explosive under test so that, when the cartridges are laid end to end, the length of the explosives train is approximately 1 m.

B.3.2 Place the cartridges end to end along the length of the plastics film and ensure that they are firmly butted together to form an explosives train.

B.3.3 Wrap the plastics film around the explosives train and using the pins, pin the plastics film firmly in position.

B.3.4 Using the piercer, pierce a hole in one end of the explosives train along its longitudinal axis, for the insertion of the permitted detonator.

B.3.5 Lay the explosives train down and securely attach the wooden dowel stick to the explosives train with the masking or insulation tape so that the stick protrudes approximately 200 mm from the one end of the explosives train.

B.3.6 Using the protruding dowel stick, plant the explosives train in the sand so that it is in the vertical position and approximately 50 mm above the ground. Insert the permitted detonator at the top of the train and fire the shot.

B.3.7 Ascertain and record whether the explosives train has detonated throughout its entire length.

B.3.8 Repeat the test on a second explosives train.

B.3.9 Deem the explosive to have passed the test if both trains have detonated throughout their length.

Annex C
(normative)

Gap Sensitivity/Distance

C.1 General

The objective of this test is to determine the sensitivity of a charge of explosive (receptor) to initiation by another charge (donor) located at a known distance apart but in line with the first charge. The larger the distance over which transmission of propagation of detonation takes place; the more sensitive is the explosive.

C.2 Apparatus and materials

a) Round rod, 32mm or 35mm.

b) Steel ruler; 1mm division value.

c) Regular Size 0 detonator

C.3 Procedure

C.3.1 Take a cartridge of the explosive under test and .cut off the unevenness at the ends

C.3.2 Slice the explosive into two; to yield the master and the slave cartridges.

C.3.3 Both the master and the slave cartridges should be 150mm or above in length

C.3.4 Press the round rod onto the sand, until a half round slot is formed. Please note that the rod diameter shall be equal to or larger than cartridge sample and the slot length should be larger than the sum of the cartridge length and estimated gap distance.

C.3.5 Place the master and slave cartridges into the slot and measure the distance between the two cartridges accurate to 1mm.

C.3.6 Impurities between the two cartridges are not allowed.

C.3.7 Insert the detonator into the Master cartridge initiation end; insert depth is 2/3 of detonator length.

Initiate.

C.3.8 Sympathetic Detonation considered successful if no remaining explosive is found and a blasting crater left under the slave cartridge.

C.3.10 Perform 3 similar tests as above. The maximum distance between the two cartridges which could lead to Sympathetic Detonation is called Gap Distance.

Annex D
(normative)

Density

D.1 General

This is a method for the determination of the density of commercial emulsion explosive.

D.2 Apparatus and materials

NOTE The procedures laid down for the specific test equipment used should be strictly adhered to.

D.2.1 **Top-pan balance**, with a capacity of 1 500 g and accurate to within 0.01 g.

D.2.2 **Graduated measuring cylinder**, of 1 000 mL capacity.

D.3 Procedure

D.3.1 Fill the measuring cylinder to the 500 mL mark with water, place it on the balance and note it's mass.

D.3.2 Carefully remove the wrapper from the cartridge. Quantitatively add the explosive to the water in the measuring cylinder and determine the mass (m) of the explosive.

D.3.3 Determine the increase in volume (v).

D.3.4 Repeat the test with another cartridge.

D.3.5 Calculate the density to the nearest 0.01 g/cm$_3$, (see 6.2) of each sample of explosive and report the average of the two results as the density of the explosive under test.

D.4 Calculation

$$Density, g/cm_3 = m/v$$

Where,

m is the mass of the explosive, in grams;

v is the volume of the explosive, in cubic centimetres.

Annex E
(normative)

Determination of velocity of detonation

E.1 General

The time‘t’ taken by the detonation front to traverse a known distance‘d’ in the explosive is measured by the timer in micro-seconds. Thus the velocity of detonation (VOD) is denoted as d/t and is expressed as kilometer per second.

E.2 Principle

The time taken for the detonation front to pass between two sensors a known distance apart is measured.

E.3 Apparatus

a) Detonation velocity tester/ microtimer; The microtimer is an electronic instrument which is suited for measuring very short time intervals, such as those involved in detonation processes. Two signals which define the beginning and end of the time interval to be measured are used as ‘start’ and ‘stop’ signals to operate a gate. This gate turns on and off a constant current supply to a capacitor and the voltage developed across the capacitor is measured by an electrometer voltmeter circuit. Thus if the capacitor starts with zero potential difference across it, the .potential registered by the voltmeter circuit at the end of the time interval is directly proportional to the time interval. By suitably selecting the various circuit constants the voltmeter is made to read directly in microseconds.

b) Cartridge of emulsion explosive •

c) Steel Ruler; Minimum 1mm scale.

d) Enameled round copper wire, diameter 0.12-0.15mm

e) Regular Detonator, Size 0.

f) Other auxiliary tools such as steel needle and masking tape.

E.4 Procedure

E.4.1 Define the firing wire location on the explosive.

E.4.2 The distance between the two firing wires is 70mm for cartridges with length in the range of 150mm-300mm and 100mm for cartridges with length larger than 300mm. The distance shall be the same in one test.

E.4.3 The firing wire at Initiation end shall be as far from the initiation end as possible and the firing wire at the other end shall be based on the charging conditions, normally 15mm to 25mm.

E.4.4 After defining the inserting location, insert the firing wire vertically into the cartridge and fold the wire end on the cartridge surface. The two firing wires shall be parallel with each other.

E.4.5 After the insertion process, the electronic performances of the two firing wires shall be isolated from each other. ▪

E.4.6 Grind off the insulation paint at the wire connecting end with Abrasive Paper

E.4.7 System Connection and Initiation: While in the blasting test tower connect the firing wire with the signal transmission wire as required and check the system status. ▪

E.4.8 Insert the detonator at the cartridge initiation end, inserting depth is 2/3 of the detonator length. ▪

E.4.9 Adjust the detonation velocity tester and initiate, record the data (Detonation Velocity and time) read by the tester.

E.4.10 Repeat the experiment at least 3 times and obtain the Average.

E.5 Precautions

The following precautions shall be observed:

A. Keep the timer key and exploder key (in case of firing by exploder.) always in possession while connecting the detonator to the shot firing cable. In case of incomplete detonation, carefully collect all the fragments of the charge.

B. In case of misfire wait at least for 5 min in case of shot firing electrically or for at least 30 min in case of shot firing with safety fuse before approaching the shot.

C. The timer shall be calibrated once in 6 **months.**

Annex F
(normative)

Brisance Test

F.1 Brisance Test

This test shall be carried out to determine the instantaneous shock strength of a detonation to the surrounding.

F.2 Apparatus

a) Scale; 0.1g sensitivity

b) Vernier Caliper; 0.02mm division rule

c) Steel Plate; high Quality Carbon structural steel

d) Lead column

e) Steel Base; Middle Carbon steel plate

f) Round paperboard with holes

g) Paper roll

h) Regular size 0 detonator

i) Initiator.

F.3 Procedure

F.3.1 Measure the lead column height at four different places of the circular base with help of a vernier caliper, take the average value and record as ho

F.3.2 Explosive Charging: Weigh the paper tube and add 50±0.1g explosive. Cover the explosive with a paper board with a hole. Press the paper board so that the explosive fills the tube.

F.3.3 Mount the testing device and insert the detonator into the explosive charging previously made. The inserting length is 15mm. Then initiate.

F.3.4 The steel base is placed on solid surface (with concrete thickness more than 100mm), place the lead column on the base (with side marks on the bottom), steel plate and explosive charging in the same axis (visual inspection)

F.3.5 Fix the system with a rope/wire. Then initiate. • Wipe out the lead column and measure the new lead column height at four different places of the base, take the average value and record it as h1

F.3.6 Brisance = ho- h1 = pressed amount of lead column, unit mm.

F.3.7 Perform two parallel tests for each sample. The pressed amount of the explosive shall be 2cm. The average value of the two tests (accurate to 0.1mm) is the pressed amount.

F.3.8 If the value of the test of out of tolerance, please re-sample and perform two parallel tests. If the value is still out of tolerance, please stop testing and look for causes.

Annex G
(normative)

Capacity for Work.

G.1 Principle

The principle of operation is to place the explosive of certain mass and density into a hole in the lead block; the volume of the expanded lead is the working capacity of the explosive

G.2 Instruments and Material:

a) Lead block: 200mm height by 200mm diameter; hole depth:125mm, hole diameter:24.5mm

b) Sand; dried sand, with particle dimension ranges from Ɵ200×50/0.71 to Ɵ200×50/0.40; Bulk Density of 1.35-1.37gcm-3

c) Paper tube: rolled from sack paper. Cut the paper into a right angled trapezium. Use a round bar with 24mm diameter to roll the paper from the right angled side; the bottom part extent 15mm-20mm from rod end face, fold the extension part as tube bottom

d) Round paper board with holes: cut from the paper board; Thickness; 1.75±0.25mm; outer diameter: 23.75±0.25mm; hole diameter: 7.5±0.1mm.

e) Copper shell instantaneous detonator.

f) Test sieve: Ɵ200×50/0.71 square hole and Ɵ200×50/0.40 square hole

g) Volumetric Flasks: one 250ml flask and one 100ml flask; 1mm division value.

h) h. Burette; 50ml, 0.1mm division value.

i) Scale; 0.001g sensitivity

j) Glass thermometer; measurement range: -300C-+500C; with 10c division value

k) Initiator

l) Brush

m) Vernier Caliper: 0.02mm division value

n) Experimental device: consists of lead block, explosive and detonator

G.3 Preparations

Add 10±0.1g emulsion explosive into paper tube and put the round paper board with holes into the paper tube; insert detonator directly.

G.4 Operating Steps.

G.4.1 Use water as the medium, test the lead block volume; dry the lead block and reserve.

Measure the lead block temperature, and add explosive in the lead block; fill the surroundings with sand. Initiate.

G.4.1 Clean the hole with help of the brush, and measure the hole volume.

G.4.1 Calculation

G.4.1 Formula;

$$X = (V_2 - V_1)(1 - K) - 22$$

Where;

X—Working Capacity of explosive (expanded volume of lead block); unit ml

V2 – Lead block volume after explosion, unit: ml

V1 – Lead block volume before expansion, unit: ml

K – Correction factor of temperature

22 -- Correction factor of detonator.

Table 2—Temperature Correction Factor of Lead Block.

Lead Block Temp. 0C	Correction Factor, %	Lead Block Temp, 0C	Correction Factor, %
-30	+18	+5	+3.5
-25	+16	+8	+2.5
-20	+14	+10	+2.0
-15	+12	+15	+0.0
-10	+10	+20	-2.0
-5	+7	+25	-4.0
0	+5	+30	-6.0

G.5 Data Processing

Perform two Parallel tests for each sample and take the average value (accurate to 1ml). Of the tolerance of the parallel tests exceeds 20ml, do an additional test. If the average tolerance does not exceed 20ml for the three tests, take the average of the two smaller values. If the tolerance exceeds 20ml, the value collected is invalid.

Annex H
(normative)

Sampling and compliance with this standard

H.1 Sampling

H.1.1 Preservation

All sample shall be kept in water proof container/polythene cover till they are taken for testing to protect them from water and other atmospheric changes.

H.1.2 Lot

Cases of sluny/emulsion-based commercial blasting explosives of same variety (Permitted or non-Permitted), same type (Based on power) and same size belonging to different batches grouped together to constitute a lot

Cartridges of emulsion/emulsion-based blasting explosives constituting sample shall be drawn from each lot separately for deciding the conformity of the lot to the requirements of the specification.

H.1.3 Small Diameter Explosives

Number of emulsion explosives cartridges to be selected at random from the lot shall depend on the lot size and shall be in accordance with Table 2.

Table A.2 — Scale of Sampling of Emulsion Based Explosives

Lot Size (mt)	Sample size
Up to 10	10 No. of cartridges
Up to 10-20	20 No. of cartridges
Above 20	30 No. of cartridges
NOTE – Extra cartridges taken in case of larger lot size shall be used for repeating the following tests with additional cartridges for confirmation of uniformity.	

H.1.4 Number of Tests

The number of cartridges to be drawn from each lot for carrying out various tests shall be as given below:

Table A.3 — Number of samples required to carry out various test

Test Method	Number of Samples
gap sensitivity	2
Velocity of detonation unconfined. m/s	1
Continuity of detonation	5
Density	1

H.1.5 Gallery Test

Gallery test is a type of test and it is not required to be carried out on every lot, if the particular type of composition has been tested and approved by competent authority. But repeat incendivity test shall be done once in every two years of each approved sample of permitted explosive for checking its consistency against safety.

H.1.6 Scale of Sample

Samples for gallery test shall be carried out as in table below

Table A.3 — Scale of Sampling of Emulsion Explosives

Lot Size mt	Sample Size
Up to 10	8 to 10 No. Of cartriges
NOTE - All the tests shall be in accordance with 4.2.2	

H.2 Compliance with this standard

The lot shall be deemed to comply with the requirements of this standard, if taken in accordance with A.1, after inspection (see clause 5) and testing of the samples (see clause 6), for compliance with the requirements in clause 5, no defective is found.

Bibliography

[1] A.H.Begg, 2008. “Hazards in Emulsion Explosives Manufacture and Handling” EXSAR Consulting LTD

[2] IS 15447 (Part 2): 2008 Indian Standard Commercial blasting explosives part 2 Emulsion/emulsion explosives —Specification

[3] ISO 9001, Quality management systems — Requirements

[4] Hubei Kailong Chemical Group Handbook on Emulsion Explosives Production, 2016.

[5] J.K Emulsion Explosives Technology Handbook, 2016

[6] X.G.Wang, 2008. Emulsion Explosives, Metallurgical Industry Press, Beijing, China.

[7] X.H.Zhang, 2005. “Safety Evaluation Method of Explosives and Powders”, Proceedings of National Symposium on Explosion and Safety Technology, Chinese Ordnance Society.

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