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COMMITTEE OF EXPERTS ON THE TRANSPORT
OF DANGEROUS GOODS

REPORT OF THE COMMITTEE OF EXPERTS ON ITS SIXTEENTH SESSION
(3-12 December 1990)

Addendum 1

CONTENTS

GE.90-24597/2743B

Annex 1

1991/..... Work of the Committee of Experts on the Transport of Dangerous Goods

The Economic and Social Council,

Recalling its resolutions 1983/7 of 26 May 1983, 1985/9 of 28 May 1985, 1986/66 of 23 July 1986, 1987/54 of 28 May 1987 and 1989/104 of 27 July 1989,

Noting the ever-increasing volume of dangerous goods in world-wide commerce and the rapid expansion of technology and innovation,

Bearing in mind the continuing need to meet the growing concern for the protection of life, property and the environment through the safe transport of dangerous goods while facilitating trade,

Aware that, in order to achieve internationally harmonized laws, the specialized agencies and other international organizations and interested Member States are committed to taking the recommendations of the Committee of Experts on the Transport of Dangerous Goods as a basis for the formulation of their requirements and regulations and therefore rely on the work of the Committee,

Recognizing the increasing need for co-operation with other international bodies such as the International Labour Organisation and the United Nations Environment Programme involved in activities related to the transport of dangerous goods,

Reaffirming the desirability of widening the decision-making base of the Committee by encouraging the participation of developing countries and other non-member countries in its future work,

1. Takes note of the report of the Secretary-General on the work of the Committee of Experts on the Transport of Dangerous Goods in the biennium 1989-1990 and of the new and amended recommendations approved by the Committee for inclusion in its existing recommendations;

2. Requests the Secretary-General:

(a) To incorporate in the existing recommendations of the Committee of Experts on the Transport of Dangerous Goods all the new and amended recommendations approved by the Committee at its sixteenth session;

(b) To publish the new and amended recommendations in all the official languages of the United Nations, in the most cost-effective manner, not later than the end of 1991;

(c) To circulate the new and amended recommendations immediately after their publication to the Governments of Member States, the specialized agencies, the International Atomic Energy Agency and the other international organizations concerned;

3. Invites all Governments, the specialized agencies, the International Atomic Energy Agency and the other international organizations concerned to transmit to the Secretary-General their views on the Committee's work, together with any comments they may wish to make on the amended recommendations;

4. Invites all interested Governments and the international organizations concerned, when developing appropriate codes and regulations, to take full account of the recommendations of the Committee;

5. Recommends again that adequate funding be provided to support the work of the Committee as indicated in the report of the Committee on its sixteenth session, if possible by setting up a special fund;

6. Reiterates its request to the Secretary-General to make available, within existing resources, the staff necessary for the adequate servicing of the committee, namely one additional Professional and one additional General Service post, and regrets that the requests made in its resolutions 1983/7, 1985/9, 1986/66, 1987/54 and 1989/104 have not yet been met;

7. Requests the Secretary-General to submit a report to the Council in 1993 on the implementation of the present resolution.

Annex 2

PART I

Adopted text and amendments to the Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.1).

(1) Add after Test 3 (a) (v) "Modified Type 12 Impact Tool", Test 3 (a) (vi) "Impact Sensitivity Test".

IMPACT SENSITIVITY TEST

TEST 3 (a) (vi)

1. Introduction

The test is a standard small-scale impact sensitivity test for solid and liquid explosives. The test gives quantitative results for lower sensitivity limits in roller assembly 2 for solid explosives and roller assembly 3 for liquid explosives.

2. Apparatus and materials

2.1. Figure 1 shows a sketch of the impact apparatus. The main components of the apparatus are:

an anvil made of seamless steel;

vertical parallel guide columns for a falling weight;

a steel weight (10 kg) with a limit stop.

The weight impact head is made of hardened steel (Rockwell C hardness is 60-63):

a catching and dropping device;

a rack which prevents the weight from repeated falling and impacting a sample on the anvil;

a measuring rule with 1 mm scale.

2.2. The test sample is placed into the roller assembly 2 or 3. Dimensions and requirements for these roller assemblies are shown in figures 2 and 3.

2.3. A laboratory balance with weighing error of not more than 0.005 g.

2.4. A hydraulic press which provides compression pressure of 290 MPa.

2.5. A dropping tube or pipette.

2.6. Standard explosive tetryl with crystal sizes 0.200-0.270 mm recrystallized from acetone.

3. Procedure

3.1. Solid substances

3.1.1. As a rule substances should be tested as received. Wetted substances should be tested with the minimum quantity of humidifier required for transport. The substances should then be subjected to the following procedures:

(a) granulated, flaky, pressed, cast and similar substances are milled and screened; the tested substance particles should pass through a screen with 0.9-1.0 mm mesh gauge;

(b) elastic substances are cut with a sharpened knife on a wooden surface; ground particle sizes should not be more than 1 mm. Elastic substance samples are not screened;

(c) powdered and plastic explosives samples are not ground and screened.

Roller assemblies for solid samples are degreased with acetone or ethyl alcohol. Prepared test assemblies should have 0.02-0.03 mm difference between the diameters of the sleeves and the rollers. The components may be re-used if they remain within specification.

3.1.2. To determine the lower sensitivity limit of the explosive the sample with mass of 0.100 $\pm$ 0.005 g is placed on the roller surface in the opened roller of assembly 2. The sleeve should be aligned with the direction of the groove downwards. The second roller is placed on the explosive sample and the upper roller is used for smoothing it out by pressing and rotating. The assembly containing the explosive is placed on a hydraulic press, where it is compressed to a pressure of 290 MPa. For plastic, elastic and pasty explosives the pressure is preselected so that the explosive is not pressed out beyond the faces of the rollers. Wetted explosives are not compressed.

Then the sleeve with the rollers and the explosive is turned over in a tray and placed against the rollers as far as they will go. This ensures that the explosive is in contact with the sleeve groove. The assembly containing the explosive is placed on the anvil of the impact apparatus. The weight (10 kg) falls and impacts the sample. The reaction is detected by a sound effect, flash or burn traces on the rollers and sleeve. Discoloration of the sample is not considered as a sign of explosion.

3.1.3. The lower limit of explosive impact sensitivity is defined as the maximum drop height of the 10 kg steel weight which does not give positive results in 25 tests. The drop height is selected from the following range: 50, 70, 100, 120, 150, 200, 250, 300, 400, 500 mm.

Tests are carried out beginning with 150 mm drop height. If positive results are obtained at this height the test is repeated with the next lower drop height. Conversely when negative results are obtained the next higher drop height is subsequently used. Thus the maximum drop height for 10 kg mass is obtained when no positive reaction occurs in 25 tests. If, using the 50 mm drop height, positive results are obtained in 25 tests then it is established that the lower sensitivity limit of explosive tested in roller assembly 2 is < 50 mm. When no positive reactions occur in 25 tests for the 500 mm drop height, then the lower impact sensitivity limit for the explosive tested in roller assembly 2 is expressed as 500 mm or more.

3.2. Liquid substances

3.2.1. Roller assemblies 3 are degreased with acetone or ethyl alcohol. Usually 35-40 roller assemblies are prepared. The roller assemblies must have 0.02-0.03 mm difference between the diameters of sleeves and rollers.

3.2.2. To determine the lower sensitivity limit, the liquid substance is placed in the cap with a dropping tube or pipette. The cap is in the centre of the lower roller and is completely filled with the liquid substance. The second roller is carefully placed on the cap containing the liquid substance, the roller assembly is placed on the impact apparatus anvil and the steel weight (10 kg) is dropped. The result is noted.

3.2.3. The lower limit of the explosive impact sensitivity is defined as a maximum drop height of the 10 kg steel weight which does not give positive results in 25 tests. The drop height is selected from the following range: 50, 70, 100, 120, 150, 200, 250, 300, 400, 500 mm.

Tests are carried out beginning with 150 mm drop height. If positive results are obtained at this height the test is repeated with the next lower drop height. Conversely when negative results are obtained the next higher drop height is subsequently used. Thus the maximum drop height for 10 kg mass is obtained when no positive reaction occurs in 25 tests. If, using the 50 mm drop height, one or more positive results are obtained in 25 tests then it is established that the lower sensitivity limit of explosive tested in roller assembly 3 is < 50 mm. If no positive reaction occurs in 25 tests for the 500 mm drop height, then the lower impact sensitivity limit for the explosive tested in roller assembly 3 is expressed as 500 mm or more.

4. Criteria and method of assessing results

4.1. A solid substance is too hazardous for transport if the lower impact sensitivity in assembly 2 is < 100 mm and is noted as "+".

4.2. A liquid substance is too hazardous for transport when the lower impact sensitivity in assembly 3 is < 100 mm and is noted as "+".

5. Examples of results

5.1. Solid substances

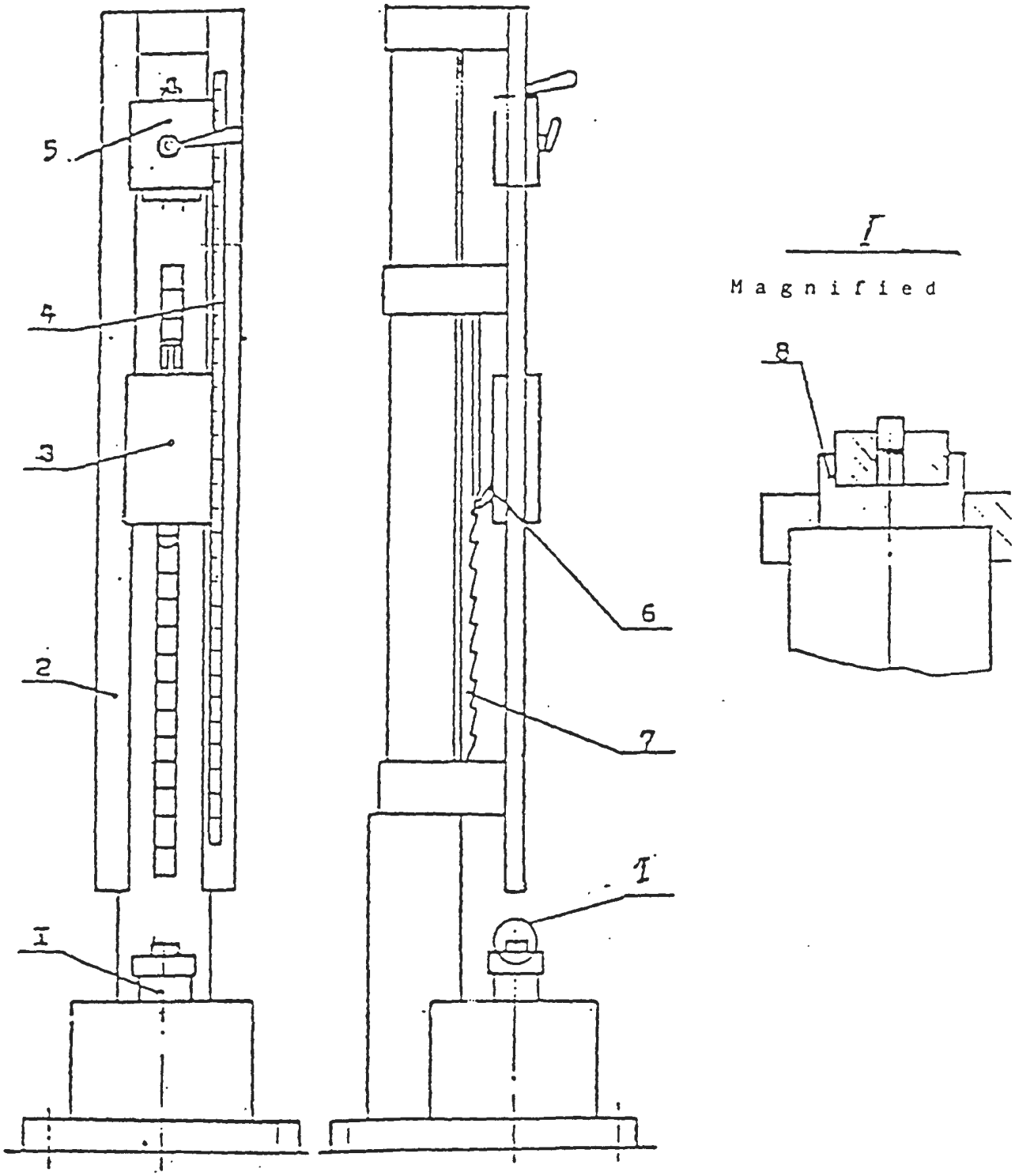
Table 1

Substance	Lower limit in assembly 2, mm	Result
Pentaerythritol tetranitrate (dry)	50	+
Pentaerythritol tetranitrate/paraffin 95/5	70	+
Pentaerythritol tetranitrate/paraffin 90/10	100	-
Pentaerythritol tetranitrate/water 75/25	100	-
Cyclotrimethylenetrinitramine (dry)	70	+
Cyclotrimethylenetrinitramine/wax 95/5	120	-
Cyclotrimethylenetrinitramine/water 85/15	150	-
Cyclotetramethylenetrinitramine (dry)	70	+
Tetryl	100	-
Trinitrotoluene	> 500	-
Granulite AS-8 (91.8% of ammonium nitrate, 4.2% of machine oil, 4% of aluminium)	> 500	-
Picric acid	> 500	-
Ammonal (80.5% of ammonium nitrate, 15% of trotyl, 4.5% of aluminium)	150	-
Ammonite 6ZhV (79% of ammonium nitrate, 21% of trotyl)	200	-
Ammonite T-19 (61% of ammonium nitrate, 19% of trotyl, 20% of sodium chloride)	300	-
Splitting ammonal N 1 (66% of ammonium nitrate, 24% of hexogen, 5% of aluminium)	120	-

5.2. Liquid substances

Table 2

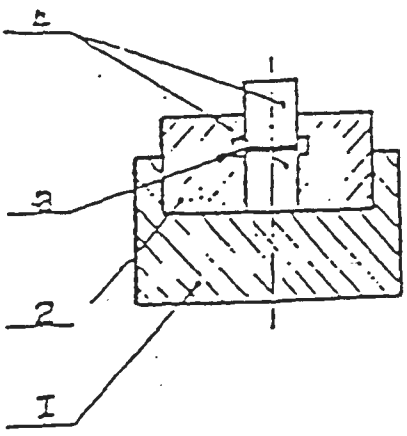
Substance	Lower limit in assembly 3, mm	Result
Nitroglycerine	< 50	+
Nitromethane	> 500	-
Isopropyl nitrate	> 500	-
Bis (2,2-dinitro-2-fluoro-ethyl) formal/methylene chloride 65/35	400	-



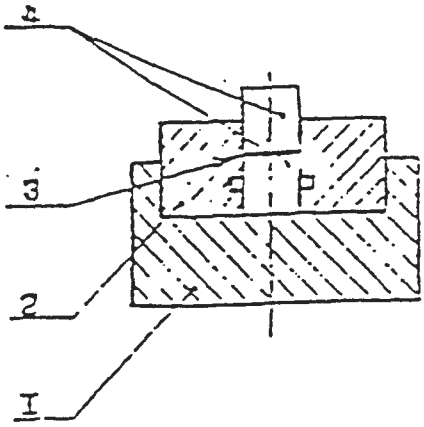
1 - anvil; 2 - column; 3 - weight; 4 - rule; 5 - catching and dropping device; 6 - stop; 7 - rack; 8 - roller assembly.

Fig. 1. Impact apparatus

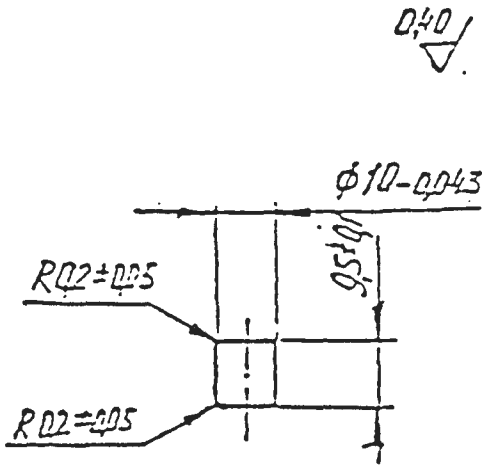
Sleeve position
"groove facing upwards"



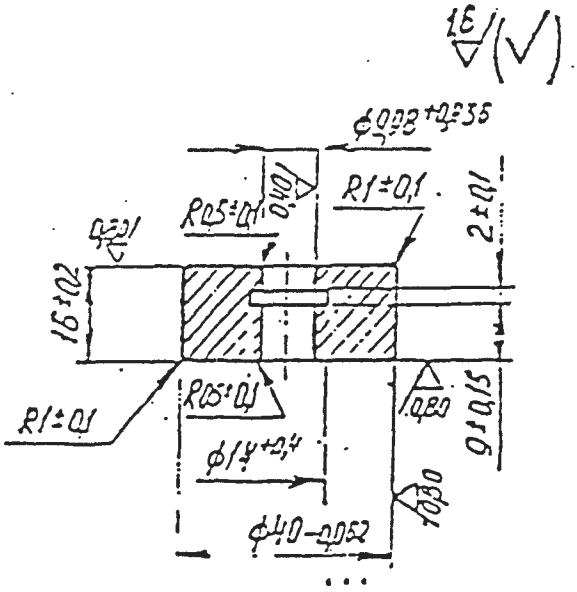
Sleeve position
"groove facing downwards"



1 - tray; 2 - sleeve; 3 - sample; 4 - roller

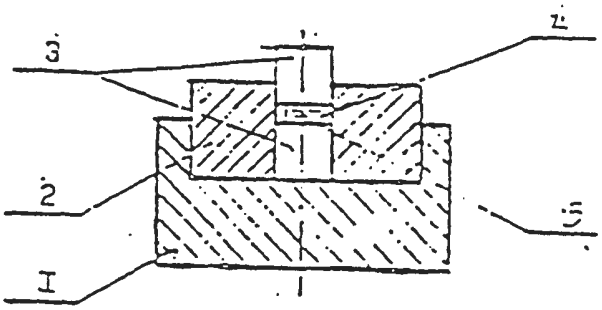


HRC 63 ... 66
Material: ball bearing steel
R o l l e r

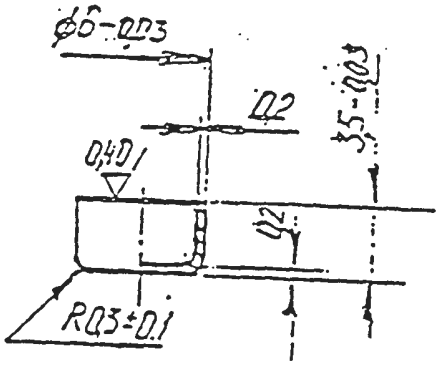


HRC 57 ... 61
Material: tool carbon steel
S l e e v e

Fig. 2. Roller assembly 2



1 - tray; 2 - sleeve; 3 - roller;
4 - cap; 5 - sample



Material: copper M2
Coating: nickel plating. 3 microns

Fig. 3. Roller assembly 3

(2) Add after "Test 3 (b) (ii) Rotary Friction Test", "Test 3 (b) (iv) Friction Sensitivity Test" as follows:

FRICTION SENSITIVITY TEST

TEST 3 (b) (iv)

1. Introduction

This is a small-scale friction sensitivity test for solid and powdered explosives. This test enables quantitative results to be obtained for lower limits of sensitivity.

2. Apparatus and materials

2.1. The general scheme of the friction test apparatus is given in figure 1. The apparatus consists of four main components: pendulum, pendulum holder, apparatus body and hydraulic press. The apparatus is mounted on a concrete base. The roller assembly 1 with explosive under test is placed in the apparatus body. The compression of the explosive sample placed between the two rollers, up to the prescribed pressure, is carried out by means of the hydraulic press. Then the movement of the upper roller along the test substance by 1.5 mm is carried out using the pendulum weight impact.

2.2. The roller assembly 1 consists of a sleeve and two rollers. Dimensions and requirements for it are shown in figure 2.

3. Procedure

3.1. As a rule substances should be tested as received. Wetted substances should be tested with the minimum quantity of humidifier required for transport. The substances should then be subjected to the following procedures:

(a) Granulated, flaky, pressed, cast and similarly packed substances are milled and screened; tested substance particles should pass through two screens with 0.50 ± 0.05 mm mesh gauge;

(b) Elastic substances are cut with a sharpened knife on a wooden surface; ground particle sizes should be not more than 1 mm. Elastic substance samples are not subjected to screening;

(c) Powdered, plastic and pasty explosives samples are neither ground nor screened.

Before use the roller assemblies are degreased with acetone or ethyl alcohol. The devices may be used again if they remain within specifications.

3.2. To determine the lower friction sensitivity limit of the explosive the sample of mass 0.020 + 0.002 g is placed in the open roller assembly. By gently pressing and turning the upper roller the explosive sample is evenly smoothed between the rollers. The roller assembly containing the sample is placed in the chamber of the apparatus body where it is compressed up to the chosen pressure. The sleeve is lowered by maintaining the pressure so that

the explosive sample pressed between the roller faces is raised above the sleeve. Then a striking pin is transferred so that its impact end touches the roller. The striking pin is impacted by the pendulum weight causing friction between the upper roller and the sample. The roller movement is 1.5 mm. The throw-off angle for the pendulum is chosen according to the table, depending upon the retaining pressure of the sample. The tests are performed until the maximum retaining pressure is found which does not give any explosion in 25 tests. An explosion is considered as a substance transformation accompanied by sound effect, flash or burn traces on the rollers. The lower friction sensitivity limit is considered as the maximum retaining pressure which gives no explosions in 25 tests and which distinguishes from the pressure which still gives explosions but differ by not more than:

10 MPa - at test pressure up to 100 MPa

20 MPa - at test pressure (100 ... 400) MPa

50 MPa - at test pressure above 400 MPa.

If no explosion is obtained in 25 tests at a pressure of 1,200 MPa, the lower friction sensitivity limit is expressed as "1,200 MPa or more". If one or more explosions are obtained in 25 tests at a pressure of 30 MPa, the lower friction sensitivity limit is expressed as "less than 30 MPa".

4. Criteria and methods of assessing results

A substance is considered too dangerous for transport if the lower impact friction sensitivity limit is less than 200 MPa. It is denoted by sign "+".

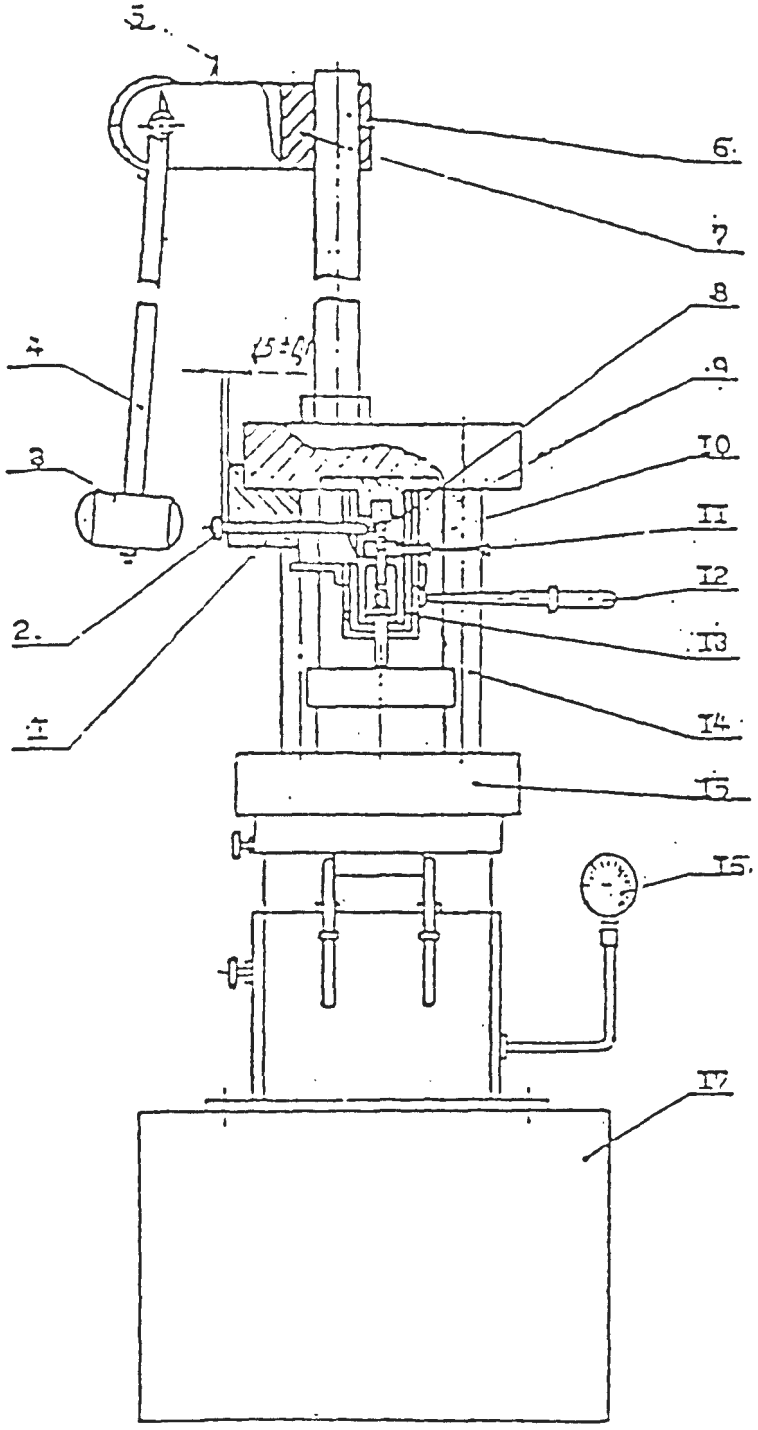
5. Examples of results

Explosive	Lower limit, MPa	Result
Pentaerythritol tetranitrate (dry)	150	+
Pentaerythritol tetranitrate/paraffin, 95/5	350	-
Pentaerythritol tetranitrate/TNT, 90/10	350	-
Pentaerythritol tetranitrate/water, 75/25	200	-
Cyclotrimethylenetrinitramine (dry)	250	-
Cyclotrimethylenetrinitramine/water, 85/15	350	-
Cyclotetramethylenetetranitramine (dry)	200	-
Cyclotetramethylenetetranitramine/water, 85/15	350	-
Picric acid	450	-
Trinitrotoluene	600	-
Lead azide	30	+
TATB	900	-
Ammonium nitrate	1 200	-

Table 1

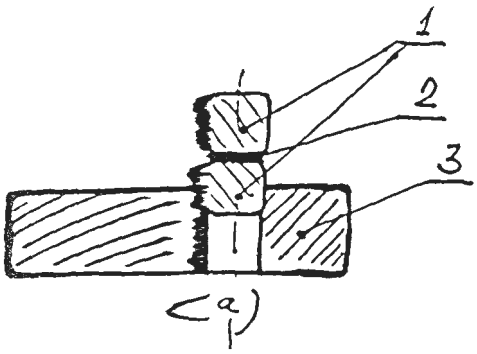
RELATIONSHIP BETWEEN RETAINING PRESSURE OF EXPLOSIVE SAMPLE AND THROW-OFF ANGLE OF PENDULUM PROVIDING THE CONSTANT VALUE OF ROLLER SHIFT

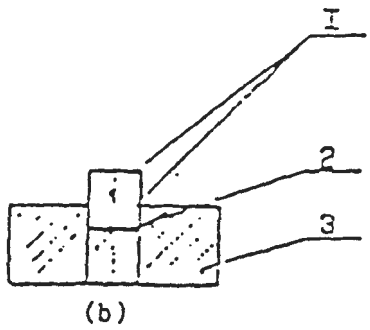
Retaining pressure of explosive sample, MPa	Throw-off angle of pendulum, ^{o} (from a vertical)
30	28
40	32
50	35
60	38
70	42
80	43
90	46
100	47
120	54
140	58
160	61
180	64
200	67
220	70
240	73
260	76
280	78
300	80
320	82
340	83
360	84
380	85
400	86
450	88
500	91
550	93
600	95
650	97
700	100
750	101
800	103
850	106
900	107
950	108
1 000	110
1 100	115
1 200	118



1 - guide of striking pin; 2 - striking pin; 3 - pendulum weight; 4 - pendulum lever; 5 - trigger; 6 - pendulum holder support; 7 - pendulum holder; 8 - chamber; 9 - roller; 10 - sleeve; 11 - roller assembly pusher; 12 - handle for sinking of roller assembly sleeve; 13 - apparatus body; 14 - apparatus support; 15 - hydraulic press; 16 - pressure gauge; 17 - base

Fig. 1. Apparatus for impact friction test

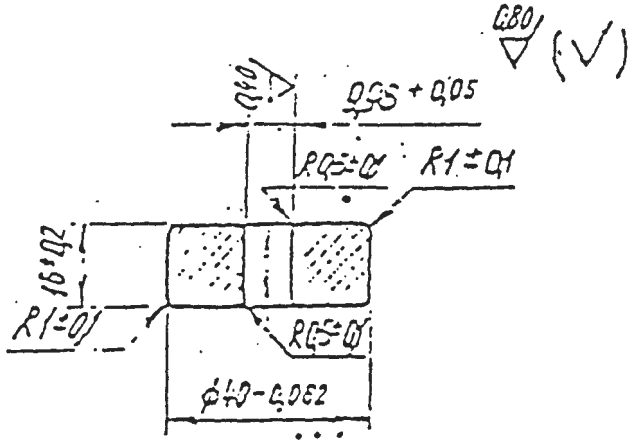




1 - roller; 2 - explosive sample;
3 - sleeve

(a) Initial position of rollers

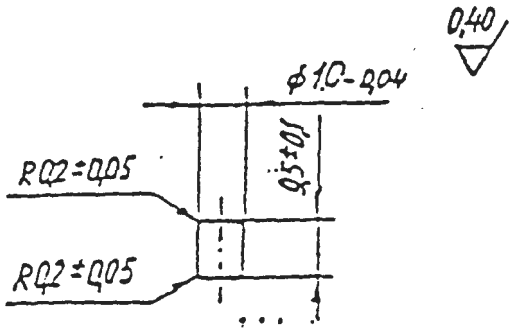
(b) Rollers in position for test



HRC 57 ... 61

Material: tool carbon steel

sleeve



HRC 63 ... 66

Material: ball bearing steel

Roller

Fig. 2. Roller assembly 1

PART II

ADOPTED AMENDMENTS TO THE MANUAL OF TESTS AND CRITERIA

(ST/SG/AC.10/11/Rev.1)

1. Amend the contents of Part I as follows:

for "7 (k) Article Propagation Test UN 56"
read "7 (k) Division 1.6 Article Stack Test UN 56".

2. In paragraph 45.11:

for "e.g. Test 7 (k) 1.6 Article Propagation Test"
read "e.g. Test 7 (k) Division 1.6 Article Stack Test".

3. Amend section 46.5 to read:

"EXAMPLES OF RESULTS

Test Substance	Results	Data Reference
Composition B	+	United States sources
PBx-9502	-	United States sources
Octorane 86A	-	French sources
B 3103	-	French sources
B 3003	+	French sources

Composition B: Cast material consisting of 60% RDX and 40% TNT.
PBx 9502: Pressed material consisting of 95% TATB and 5% Kel-F.
Octorane 86A: Cast Plastic-Bonded explosive consisting of 86% HMX and 14% of an inert binder.
B 3103: Cast Plastic-Bonded explosive, consisting of 51% HMX, 19% aluminium and 30% energetic binder
B 3003: Cast Plastic-Bonded explosive, consisting of 80% HMX and 20% energetic binder."

(Amend in the French version "inerte" to read "énergétique".)

4. Amend the end of the table in section 47.5 to read:

"

Test Substance	Results	Data Reference
TNT cast	+	FS/FE/287/03/87/005
Composition B	+	United States sources
PBx-9502	-	United States sources
B 3103	+	French sources
B 3003	+	French sources

"

and delete columns 2 and 3.

5. Amend the table in section 48.5 to read:

"

Test Substance	Results	Data Reference
Composition B	+	United States sources
PBx-9502	-	United States sources
Octorane 86A	-	French sources
B 3103	+	French sources
B 3003	+	French sources

"

and delete column 2 (French version only).

6. Insert at the end of the table in section 49.5 the following:

"

Test Substance	Results	Data Reference
Composition B	+	French sources
PBx-9502	-	French sources
Octorane 86A	-	French sources
B 3103	-	French sources
B 3003	+	French sources

"

7. Amend the table in section 50.5 to read:

"

Test Substance	Results	Data Reference
Composition B	+	United States sources
PBx-9502	-	United States sources
Octorane 86A	-	French sources
B 3103	-	French sources
B 3003	+	French sources

"

8. Amend the table in section 51.5 to read:

"

Test Substance	Results	Data Reference
Composition B	+	United States sources
PBx-9502	-	United States sources
Octorane 86A	-	French sources
B 3103	-	French sources
B 3003	+	French sources

"

9. Amend the table in section 52.5 to read:

"

Test Substance	Results	Data Reference
Composition B	+	United States sources
PBx-9502	-	United States sources
Octorane 86A	-	French sources
B 3003	+	French sources

"

10. Replace the existing Test 7 (k) by the following:

"TEST 7 (k)

DIVISION 1.6 ARTICLE STACK TEST

56.1 INTRODUCTION

The stack test is used to determine whether a detonation of a possible Division 1.6 article will initiate a detonation in an adjacent-like article, as offered for transport.

56.2 APPARATUS AND MATERIALS

The experimental set-up is the same as for test 6 (b) (see para. 43.2) however without confinement. The donor article should be provided with its own means of initiation or a stimulus of similar power.

56.3 PROCEDURE

The experimental procedure is the same as for the test 6 (b) (see para. 43.3). The test is to be conducted three times, unless a detonation of an acceptor is observed.

56.4 CRITERIA AND METHOD OF ASSESSING RESULTS

Fragment data (size and number of acceptor article fragments), damage to the witness plate and crater dimensions are used to determine whether or not any acceptor has detonated. Blast data may be used to determine whether or not any acceptor has detonated. Blast data may be used to supplement this decision. For a Division 1.6 article it has to be demonstrated that no propagation (detonation of an acceptor) has occurred during the test.

Acceptor article responses identified as no reaction, burning or deflagration are considered as negative results and noted as '-'."

11. PART III. Append the following text to 2.1.2:

"A combination of a test for explosive power (any test of series F except test F.5) with a test for the effects of heating under confinement (any test of series E except test E.4) may be used as a screening procedure for assessing the ability to propagate a detonation. A test of series A need not be performed if:

a 'no' result is obtained from the explosive power test; and

a 'no' or 'low' result is obtained from the heating under confinement test."
