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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

Forty-fifth session
Geneva, 23 June – 2 July 2014
Item 2 (b) of the provisional agenda
Explosives and related matters: review of test series 6

Proposal for an alternative for the test 6 (c) for the testing of CARTRIDGES, SMALL ARMS (UN No. 0012)

Transmitted by the expert from Germany[1]

Introduction

1. In accordance with paragraph 16.6.1.1 of Section 16 of the Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.5), the Test 6 (c) is performed on packages of an explosive substance or explosive articles, or unpackaged explosive articles, to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning or any other dangerous effect when involved in an external fire.

2. In the case of CARTRIDGES, SMALL ARMS (UN No. 0012), the general effects when involved in a fire are sufficiently well known. The general design of the ammunition has not changed in the last century. Thus, there are numerous test reports: the real hazard is not a mass explosion or radiant heat but projections. In the bonfire test used up to now, the hazard is assessed on the basis of the depth of the perforation of the witness screens or the throw distance and mass of the projections.

3. Within the framework of the Test 6 (c), at least 0.15 m^3 of packages have to be stacked. In the case of ammunition of calibre .22, this amounts to more than 100,000 articles. In the case of calibre 9mm Luger, it amounts to 37,500 rounds. Even in the case of the relatively large cartridges of calibre 308 WIN, 6,000 pieces have to be tested. Only a

[1] In accordance with the programme of work of the Sub-Committee for 2013-2014 approved by the Committee at its sixth session (refer to ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

small percentage of these hits the witness screens during the test. The search for the projections cast farthest away is difficult due to their small size. After the test, the majority of the articles is scattered across the test range; some of them are damaged but have not exploded and therefore pose a latent hazard during clear-up activities. For reasons of environmental protection and occupational health and safety but also with a view to the informative value of the test itself (problem of the correlation between perforation depth and energy), an alternative test method 6 (c) (i) for ammunition is proposed.

Proposal

4. Insert a new test type in section 16.1.1:

"Type 6 (e): a test for determining the maximum energy of projectiles from CARTRIDGES, SMALL ARMS (UN 0012) that may be generated in the case of an inadvertent actuation, e.g. in a fire.

5. In section 16.2.2, insert the following before the last paragraph:

Test type 6(e) is only applied for articles of UN 0012 CARTRIDGES, SMALL ARMS and, replaces test type 6(c) in the series if it is to be determined whether, based on the criterion for the energy of projections, classification 1.4S is correct.

6. Add a new section 16.8:

"16.8 Series 6 type (e) test prescription

16.8.1 Test 6 (e): Determination of the energy of projectiles from cartridges

16.8.1.1 *Introduction*

This test with a single cartridge with a projectile serves to determine the maximum possible energy of a projectile that may be generated in an actuation if no packaging reduces the energy and the cartridge is supported by a fixed anvil block.

16.8.1.2 *Apparatus and materials*

The following items are required:

(a) An appropriate actuator;

(b) A ballistic pendulum with an interception device for the projectile for determining the energy; or

(c) A high-speed camera and a background with a scale to determine the velocity of the projectile.

16.8.1.3 *Procedure*

The test is performed on single cartridges. The cartridge is actuated by means of the primer cap and a firing pin, as in the weapon. The cartridge, actuator and measuring device are arranged along the flight path in such a way that angle errors are minimized.

The test is performed three times.

16.8.1.4 *Test criteria and method of assessing the results*

The energy of the projectile is calculated either from the maximum displacement of the ballistic pendulum or from the velocity determined by the high-speed camera taking the mass of the projectile into account.

If the energy of the projectile is not greater than 8 J in any of the test runs, the article, in the appropriate packaging in accordance with section 3.2, may be assigned to Division 1.4 Compatibility Group S.

Reasoning

7. The test method proposed here simulates the worst case of projection effects due to exposure to fire for cartridges for small arms:

(a) What is measured is the energy of the projectile, as the projectile is the projection with the highest mass, the highest energy density and thus the most dangerous.

(b) Neither packaging components nor other cartridges reduce the velocity of the projectile.

(c) The energy is measured when the velocity is at its maximum and not at a distance of 4 m.

(d) The cartridge case has a fixed anvil block and can thus provide a stronger impulse than an cartridge openly exposed to fire.

(e) The primer cap of the cartridge is actuated in accordance with the provisions and can thus ignite the propelling charge in an optimal way.

(f) During the test, the primer cap of the cartridge remains in the base of the cartridge case as it is supported by the actuator. In this way, a higher pressure can build up in the cartridge and the projectile receives more energy.

(g) The smokeless powder has not been subjected to thermal stress and is thus still fully effective.

(h) The cartridge is actuated at ambient temperature and not in hot fire where the strength of the brass and thus the maximum possible internal pressure of the cartridge would be reduced prior to the burst.

8. Numerous tests have shown that the dispersion in the velocities of projectiles of the same ammunition is relatively low (less than ±5 %). This is the reason why the informative value of this test method is especially high. The test setup and representative findings are presented in the Annex.

Justification

9. The proposed test method can, with considerably less test effort, yield reproducible findings on the maximum energy of projections from projectiles for small arms if these are exploded by means of an external fire. The test can also be performed in buildings. Therefore, there no longer is a dependency on weather conditions.

10. Compared with the conventional bonfire test, also the environmental impact (CO^2 emissions, harmful flue gases, large quantities of waste) is considerably lower and occupational safety is improved. The total costs of the test are reduced.

Annex

1. Tests performed by the Federal Institute for Materials Research and Training (BAM) to determine the kinetic energy of cartridges for small arms UN 0012 by means of a high-speed camera

Within the framework of the tests, individual cartridges were actuated with the BAM actuator (see INF.27 43rd session) and recorded in front of a scale with a high-speed camera with either 10,000 fps or 5,000 fps. By evaluating the single frames, the velocity can be easily determined.

Fig. 1: Projectile after firing without barrel at t = 0

Fig. 2: Projectile at the end of the scale at t = 3.2 ms

Table 1 shows the energies of the projectiles of various cartridges determined by BAM

Table 1: Energy of various cartridges after actuation without barrel

Calibre	*Mass of projectile [g]*	*Velocity [m/s]*	*Energy [J]*
.308 WIN	11.61	32.0	5.94
.308 WIN	11.61	31.5	5.76
.308 WIN	11.63	31.4	5.73
.308 WIN FC	11.664	28.9	4,87
.223 REM	3.569	24.4	1.06
.44 MAG	15.63	29.6	6.85
.22 LR	2.399	39.1	1.83
9x19mm	8.045	37.0	5.51

2. Tests performed by BAM to determine the kinetic energy of cartridges for small arms UN 0012 by means of a ballistic pendulum

The test setup can be seen from Figure 3: the ballistic pendulum was installed by bifilar suspension (using two 1,000 mm long fishing lines) at the end of the visual measuring section. The projectile was intercepted by mineral modelling clay in the pendulum. The pendulum gauge was read by means of a video recording (Figure 4).

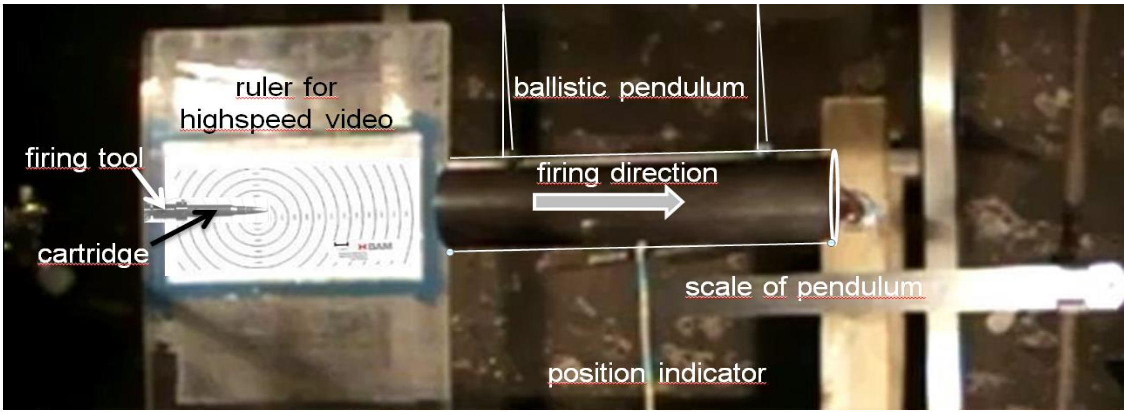

Fig. 3: Test setup ballistic pendulum

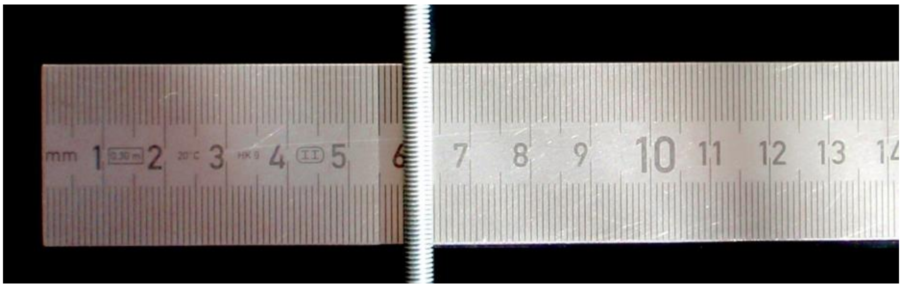

Fig. 4: Highest reading on pendulum gauge

The evaluation of the test results showed that the pendulum is capable of producing the same results as the evaluation of high-speed video recordings but with less evaluation effort. In the specific case, a projectile velocity of 32.6 ±0.5 m/s was determined by means of the pendulum. The evaluation of the high-speed video yielded a value of 33.0±0.6 m/s.

BAM is currently building the prototype of an improved pendulum that will be easy to use and ensures a high degree of occupational safety.