

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

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Item 2 (b) of the provisional agenda

Explosives and related matters

Review of Tests in parts I, II and III of the Manual of Tests and Criteria

Comparison of standard detonators

Transmitted by the expert from the Netherlands

Introduction

1. At the 47th session of the SCETDG the expert from Germany submitted proposal ST/SG/AC.10/C.3/2015/26 and .../47/INF.37 containing information on issues with the current European standard detonator and a possible way forward. Earlier, at the 45th session, IME had identified, as a result of a survey on experiences with using the tests in the Manual, that there was lack of availability of detonators meeting the specifications of the standard detonator that is described in Appendix 1. Given the fact that there were issues with both versions of the standard detonator, the working group on explosives generally agreed that it would be desirable to have a single UN standard detonator that could be used worldwide.
2. At the 49th session Germany presented in document .../C.3/2016/10 results of a comparison of the European standard detonator with a possible alternative. The comparison was made with the co-called 'underwater test' and based on peak pressure and bubble collapse time there was good agreement between both detonators.
3. At the same session IME submitted informal document .../49/INF.36 commenting on the German paper and proposing amendments to make the description of the detonator more general.
4. The working group concluded that not enough actual data exists to perform a thorough comparison of the two current versions, specifically in regards to net explosive weight, content, pressing pressure of the base load, material of construction (aluminium vs. copper), and bottom shape for the detonator shell.
5. In the informal discussions in the working group during the 50th session it was agreed that the Netherlands would ship a number of USA standard detonators from the stock of TNO to Germany (BAM) to allow direct comparison in the 'underwater test' with the European standard detonator and possible alternatives. Germany would send an equal number of the alternative detonator to TNO. Parallel to this, TNO and a member of the CEFIC delegation (i.e. AkzoNobel) agreed to perform a comparison of several detonators using test F.4 of the Manual, the Modified Trauzl test. The results of the latter comparison are given in this paper.

Test set-up

6. The Modified Trauzl test was chosen since it is believed that the influence of the strength of the detonator on the results of the tests is the largest.

7. Four detonators were used in the comparison:
- the USA standard detonator;
 - the detonators received from BAM, here called ‘Alternative #1’;
 - the detonator that AkzoNobel had chosen to replace the standard European detonator, here called ‘Alternative #2’; and
 - the European Standard detonator.
8. The lead blocks were made from extruded lead from one batch. The sample vials were also from one source.
9. The test samples were all organic peroxides, two solid and two liquid samples, and were selected for being borderline cases between “No” / “Low” and “Low” / “Not low”. The sample used are:
- Di-tert-Butyl Peroxide (liquid A)
 - Tert-Butyl peroxybenzoate (liquid B)
 - Di(4-tert-butylcyclohexyl) peroxydicarbonate (solid A)
 - Dibenzoyl peroxide (75% with water) (solid B)
10. As inert reference substances water and calcium carbonate are used.
11. Since for some of the detonators only a limited number was available duplicate tests were performed instead of the prescribed three tests. Since the tests are intended for comparison and not for classification this was considered acceptable.

Results

12. The results are given below in Table 1 and are expressed as net expansion, i.e. the increase of the volume of the cavity in the block over that given by the inert reference substance.

Table 1: Overview of the test results of the comparison of four detonators with several organic peroxides

Sample		Net expansion (ml)			
		USA detonator	Alternative #1	Alternative #2	European detonator
Liquid A	1	9.5	10.2	10.8	9.7
	2	8.8	11.5	9.9	10.8
	average	9.2	10.9	10.4	10.3
Liquid B	1	15.3	18.7	17.8	16.8
	2	16.2	19.5	16.6	15.6
	average	15.8	19.1	17.2	16.2
Solid A	1	1.8	2.9	2.8	3.2
	2	2.4	3.1	3.2	3.5
	average	2.1	3.0	3.0	3.4
Solid B	1	8.2	12.0	11.0	11.0
	2	7.0	9.7	12.2	11.2
	average	7.6	10.9	11.6	11.1
Inert liquid		8.9	9.7	9.4	10.7
Inert solid		4.7	5.4	5.5	6.5

13. To get an impression of the influence of the lead quality a limited comparison will be made between cast and extruded blocks. Liquid B and Alternative detonator #2 will be used in this comparison. The results are not yet available but will be shared later.

Conclusions

14. The two alternative detonators were found to be of the same type from the same manufacturer. The results compare well.

15. The general trend is that the USA detonator give somewhat lower results than the alternative detonators and the European detonator gives somewhat higher results. The differences seems more pronounced for solids than for liquids. It should be noted that the USA detonator has a net explosive mass of approximately 0.65 g while the European detonator contain 0.90 g. The main charge of the alternative detonator contains 0.60 g PETN, the mass of the primary explosive is not known at the moment.

16. When comparing the results with the criteria all detonators give the result "Low" for liquid A, "Not low" for liquid B and "Low" for solid B. The USA detonator and the two Alternatives give the result "No" while the European detonator gives "Low" for Solid A.

17. Based on the results it can be concluded that a detonator fitting the description of the alternative version used in the comparison may be a good replacement for both standard detonators.
