

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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Explosives and related matters: additional criteria for Division 1.4 classification

Comments and Recommendations Regarding Additional Criteria for Explosives in Division 1.4 other than Compatibility Group S

Transmitted by the Institute of Makers of Explosives (IME)

Background

1. At the thirty-seventh session of the Sub-Committee of Experts on the Transport of Dangerous Goods, the expert from Canada proposed that the explosives working group of the TDG sub-committee consider additional criteria " ... for the purpose of addressing the 1.4 other than S classification process"¹. For classifications in Division 1.4 other than S, the expert suggested that test 6(d) could be used for this purpose, applying test 6(c) acceptance criteria to 6(d) results to accomplish this further assessment. The additional test criteria were proposed to address what the expert believes are situations where a Division 1.4 other than S classification may not meet the intent for such a classification based on the definition.

Comments

2. As it considers additional testing and criteria for classification in Division 1.4 other than Compatibility Group S², the IME requests that the Sub-committee consider the following factors:

(a) The "Principles Underlying the Regulation of the Transport of Dangerous Goods" in the Model Regulations state, "... regulations should be framed so as not to impede the movement of such goods, other than those too dangerous to be accepted for transport ... It is a matter therefore of safety no less than one of facilitating transport"³. Recently, without any evidence of transportation accidents resulting in serious injury or death associated with the transport of Division 1.4 explosives, additional tests and criteria to evaluate 1.4/not S explosives were proposed that could lead to elimination of any air transport option for certain of these explosives. IME believes that this would be contrary to the UN principle of not

¹ UN/SCETDG/37/INF.40

² Hereafter referred to as "1.4/not S"

³ United Nations, Recommendations on the Transport of Dangerous Goods, Model Regulations, 16th Revised Edition (ST/SG/AC.10/1/Rev.16), pg. 1, para. 4

impeding transportation. If this were to come about, it would lead to significantly increased public exposure to these explosive products as they would have to be moved more frequently, and in larger quantities, by highway and water, slower modes of transportation where the occurrence of accidents (not caused by explosives) is much more frequent and in greater proximity to the public. Additionally, should tests and criteria be developed that further limit the ability to transport explosives in Division 1.4, the only alternative will be to transport them as Division 1.1 and/or 1.2 explosives. This would result in elimination of the incentive to package explosives to the much safer level required for Division 1.4 (i.e., minimal hazard), resulting in significantly increased public exposure to products that are more dangerous and damaging (i.e., mass explosion and projection hazards) in the event of a transportation accident. As 1.1 or 1.2 devices, highway and water modes of transport would become much more difficult than they currently are, further impeding their transport.

(b) Based on the testing of the UN classification scheme, none of the products classified in Division 1.4 are “too dangerous to be accepted for transport” as described in the principles referred to above. Indeed, if these items were too dangerous to transport, they would never have been accepted into any division of Class 1. Since Division 1.4 explosives are not “too dangerous to be accepted for transport”, they should not be subjected to regulations (including tests and criteria) that impede their transport.

(c) Transport of explosives by air, particularly for international and intercontinental exports, is desirable because:

(i) There is much greater scheduling flexibility. There are many more planes moving cargo around the world than there are vessels that accept explosives as cargo.

(ii) There are many more airports accepting explosives shipments than there are vessel ports that accept explosives shipments. This allows the explosives to be flown much closer to the ultimate destination and reduces the amount of inland transportation (by highway, rail, or inland waterway) needed to get the explosives to the user.

(iii) Shipment of explosives by air can be done (and is actually required to be done) in much smaller quantities than by vessel.

(iv) Public exposure to explosives moved as cargo by air is significantly reduced since thousands of miles of that transportation is in dedicated cargo aircraft flying above the public rather than in trucks or rail cars travelling among the public.

(d) The Model Regulations describe Division 1.4 explosives as being those that present only a small hazard *if* they function during transport, and in such an event, the effects of that functioning are largely confined to the package and there are no appreciable fragments projected. The second part of this description is conditional upon an event actually occurring. Most 1.4/not S commercial explosives are shipped without a means of initiation and are incapable of functioning during transport. This has been shown by the application of the 4(b)(ii) test, which evaluates impact sensitivity in transport conditions and in the 6(c) test, which evaluates the behavior of the products if the packaging is consumed in a fire. In IME’s opinion, arming and intentionally triggering devices that have no means of initiation and are designed to not function during transport is unrealistic and unfair to the businesses that must transport their products within the UN system, and can

result in impeding the historically proven safe transport of these devices. IME suggests that the Sub-committee should consider a review of the definition of Division 1.4 with a view to providing guidance regarding this issue.

(e) Explosives have been accepted into 1.4/not S based upon UN tests and criteria that have been in use since the 1980s. This system has worked well and no evidence has been presented that indicates that these tests and criteria have resulted in incorrect or deficient classification. Additionally, no evidence has been presented that these products are being transported unsafely. On the other hand, these products have been transported, according to the UN system for nearly three decades without any transportation accident that resulted in death or serious injury due to inappropriate classification. What has been presented to the Sub-committee is anecdotal information of devices that some feel should not be accepted into 1.4/not S, regardless of whether or not they meet the test acceptance criteria for such classification.

3. In re-assessing the intent of Division 1.4, we suggest that it is important to understand the UN Working Group's history on the matter.

(a) When first developed, the Group of Experts on Explosives⁴ included in the first edition of the Recommendations on the Transport of Dangerous Goods, Tests and Criteria⁵, an explanation in para. 41.1.2 that Test Series 6 was to be used to determine the behavior of a product *if it is involved in a fire or an explosion from internal sources*. Through four subsequent revisions, this intent has remained unchanged.

(b) In the first edition of the Test Manual, the working group addressed the behavior of the product if involved in an explosion from internal sources by tests 6 (a) and 6 (b). Test 6 (a) assessed whether there is explosion of the total contents, and test 6 (b) assessed whether there is propagation to other packages and explosion of the entire contents. If there is explosion of the total contents the product is assigned to division 1.1. The criteria of tests 6 (a) and 6 (b) list evidence that might indicate that explosion of the total contents has occurred. The purpose, intent and criteria, do not state that the effects must be contained within the package,

(c) In the first edition of the Test Manual, the working group addressed the behavior of the product if involved in a fire resulting from internal or external sources by test 6 (c). Criteria for test 6(c) assessed how the surroundings were endangered by blast waves, thermal effects and/or fragment projection. Based on the assessment of test results, the product, as packaged, was assigned to hazard divisions 1.1, 1.2, 1.3, 1.4 (including 1.4S).

(d) The purpose of Test Series 6 and Division 1.4 was stated in the text of the first edition of the Test Manual. The intent was defined by the tests specified. The purpose and intent were further clarified at that time by a test series 6 demonstration test witnessed by the GEX, performed in Canada on 24 April 1985⁶, at CERL. The test was performed on oil well shaped charges containing, as we recall, 39 grams of explosive. The GEX observed and assessed the results, including the damage to the package, and concluded that the shaped charge, as packaged, was properly classified

⁴ Hereafter referred to as "the GEX"

⁵ Hereafter referred to as Test Manual

⁶ ST/SG/AC.10/C.1/R.167, para. 31

as 1.4D or 1.4S, depending upon the outcome of the 6(c) test. This demonstration served as a benchmark for assessment of 1.4D and 1.4S criteria.

(e) Shortly after the implementation of the first edition of the Test Manual, TNO in The Netherlands performed a Test Series 6 on oil well shaped charges to obtain experience in performing the test and in interpreting the results⁷. In the report, they stated that the most important aspect of Division 1.4 was the effect of “accidental functioning.” They further stated that accidental functioning “... *means the ignition of the explosive substance or article* as offered for transport *when it is involved in an external fire, or when it drops from greater height or* the other way around *when an object falls on the explosive substance or article*. The external fire is already a part of the investigation (test 6(c)); falling is not yet,” (emphasis added). IME does not understand the latter part of that statement since the 4(b)(ii) drop test had already been included in the first edition of the Test Manual, which was approved by the Committee of Experts on the Transport of Dangerous Goods at its thirteenth session in 1984. However, based upon this belief that falling was not “already a part of the investigation”, TNO substituted a test, somewhat like the 6(d) test, to determine the effect of an internal ignition in the package. While they suggested that it would be desirable to measure the effect of the 6(d)-like intentional ignition test, that thought was based on a mistaken belief that there was not a drop test already included in the Test Manual. As noted, the 4(b)(ii) test is a 12 meter drop test that is used to determine whether or not the product, as offered for transport, can be accepted as an explosive product and is not too sensitive for inclusion in Class 1. Since the 4(b)(ii) test is the “worst case” test to determine if a product is too sensitive for inclusion in Class 1, the 6(d)-like test was ultimately deemed unnecessary.

While they and other delegations studied the matter extensively, with special focus on oil well shaped charges, the GEX did not add additional tests. We believe this indicates that they considered that the tests in the Test Manual were satisfactory for the purpose of safe transport while not impeding transportation of goods. In the nearly three decades since classification has been based on the Test Manual, the safe transport record of oil well shaped charges clearly supports the conclusion of the work group.

(f) The Test Manual addresses mass detonation in tests 6 (a) and 6 (b) and behavior of the product if involved in a fire in test 6(c). Additionally test series 4 is used to determine if the product is too sensitive to be included in Class 1. IME believes that these tests meet the original intent of the classification system. These tests were based on specific procedures used by competent authorities prior to the development of test series 4 and 6, and not based on modern risk and consequence based analysis. The Test Manual should be examined to evaluate the need for expansion to better assess the hazards of new products. This could be best accomplished by a risk-based tests and criteria system. This would also help assure that the classification system meets the stated principles of the Model Regulations, including assuring safety while not impeding the movement of goods.

4. The expert from Canada cites an example of a shaped charge (as packaged for transport) assigned to UN0440/1.4D being limited to an NEQ of 25 grams per unit by some competent authorities, and otherwise being classified as UN0059/1.1D. It is IME’s experience that other competent authorities assign UN0440/1.4D to shaped charges (as packaged for transport) limited to an NEQ of 39 grams per unit, and otherwise classifying

⁷ J.H.C. Zwaneveld, TNO Report No. PML 1986, Files F5071 & F5233, October 1986

them as UN0059/1.1D. We understand that the 25 gram and 39 gram limits are arbitrarily chosen threshold values that are not based on UN test results, risk analysis, or accident history. Threshold values, if used, should be based on UN test results, risk analysis, or accident history. They should not be based on subjective opinion. Reduction of the arbitrary threshold from 39 grams to 25 grams would seriously impede the movement of those goods and conflict with the stated principles of the Model Regulations, without consideration for the decades-long history of transportation of these products without harm or deaths resulting from transporting commercial shaped charges.

5. The expert from Canada cites examples of articles with significant energetic content being accepted into Division 1.4, yet they would generate significant effects if accidentally initiated. No assessment has been provided as to whether accidental functioning as a result of a transportation accident is possible or likely; however, we agree that the UN tests should be reviewed to assure that they properly class new or unusual products. The examples cited by the expert may not have been anticipated when the tests were originated. We suggest, however, that changes be made with careful consideration to other products that have already been classified and extensively transported safely for many years.

6. The Model Regulations incorporate the concept that the classification of hazardous materials should be based on risk. Risk includes consideration of not only the consequence of an event, but also the probability of that event occurring. For example, the note to para. 2.1.3.3.1 states, “All articles containing primary explosive substances should be assessed to evaluate the risk and consequences of accidental functioning during transport” (emphasis added). Although this citation only addresses risk assessment when transporting articles containing primary explosives substances, it establishes the precedent that risk assessment should be used for other explosive articles. However, it has been stated previously in this sub-committee, and in other forums, that explosives classifications are consequence-based and are made with no apparent acknowledgement of the risk-based concept of the Model Regulations. As a result, certain explosives classification tests do not take into account the probability of an event occurring. Many other assessments for safety purposes are based on risk and consequence, and that concept is widely accepted to improve safety. A consequence-only approach to other dangerous goods would effectively eliminate their transportation. Why should Class 1 be held to a different risk standard than all other Classes?

Proposal

7. Any new tests and criteria and revisions to existing tests and criteria developed by the Sub-committee should be evaluated to ensure that they comply with the UN principle of not impeding transport of dangerous goods, other than those too dangerous to be transported. Said evaluation should be documented in the record of the development of new and/or revised tests and criteria so that the evaluation may be referred to by future sessions of the Sub-committee.

8. When evaluating effects arising from accidental functioning of explosives in transport accidents, consideration should first be given to the probability of said accidental functioning. If the probability of accidental functioning of explosives in transportation accidents is non-existent or significantly small, then waiver of tests examining the effects of accidental functioning should be allowed. The Sub-committee should define what is meant by “significantly small”. To address this issue, IME proposes that the definition of Division 1.4 provided in para. 2.1.1.4(d) of the Model Regulations should be amended as follows (blue, underscored text indicates new/revised text):

This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The Many explosives in this division are incapable of, or present an insignificant probability of, ignition or initiation during transport; however, where it has been demonstrated that such is not the case, the effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package;

9. In considering refinement of test series 6, the Sub-committee should undertake a full review and understanding of the original intent of the test series by examining the GEX records pertaining to the origination of test series 6.

10. In considering refinement of criteria related to acceptance of oil well shaped charges, the Sub-committee should consider a full review and understanding of the oil well shaped charge demonstration tests conducted in Canada in 1985 for the GEX.

11. In considering refinement of test series 6, the Sub-committee should assess transport hazards based on products packaged as transported. The insertion of initiators in products packaged without their own means of initiation should be performed only to assess whether the result is explosion of the total contents.

12. The Sub-committee should re-evaluate the fundamentals of the explosives product classification method, and the merits of a risk and consequence based classification system.
