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Sub-Committee of Experts on the Transport of Dangerous Goods (Eighteenth Session, Geneva, 3-14 July 2000, agenda item 5 (i))

MISCELLANEOUS DRAFT AMENDMENTS TO THE MODEL REGULATIONS ON THE TRANSPORT OF DANGEROUS GOODS

Explosives

UK Comments on Proposals contained in UN Document ST/SG/AC.10/C.3/2000/21 for the 18th Session of UN Sub-Committee of Experts, 3-14 July 2000.

Transmitted by the Expert from the United Kingdom

Background

1. The Expert from the United Kingdom welcomes the work done by the Informal Working Group (WG) on the classification of Ammonium Nitrate Emulsions, Intermediates for Blasting Explosives, and their proposals contained in UN Document ST/SG/AC.10/C.3/2000/21, and presents here some comments on those proposal for consideration by the Working group at their meeting to be held in Geneva in July 2000.

Concerning the Proposals to change Figure 10.2 and New Figure 10.4

2. The principle of adding a new box in Figure 10.2 for a specific type of product is undesirable for a number of reasons:

(i) it creates a precedent that may lead to proposals to add a new box whenever a new type of product which is suspected of having explosive properties is considered for classification;

(ii) it complicates the flow chart in a region which is currently both simple and comprehensive; and, more importantly,

(iii) it appears that positioning the new box in Figure 10.2 in the location proposed is not consistent one of the basic principles of the Class 1 Acceptance Procedure when a product may progress through the classification process to be a candidate for a substance of Class 1 (see below).

3. Before a substance possessing explosive properties can be considered for Class 1 its stability must have been assessed to ensure that it is sufficiently thermally stable and not too sensitive to initiation by flame, friction and impact. Paragraphs 2.1.3.2 and 2.1.3.3 of the Model Regulation state that in relation to the Classification of a substance considered for Class 1:

"2.1.3.2.1 ..... First, the potential of a substance or article to explode must be ascertained and its stability and sensitivity, both chemical and physical, must be shown to be acceptable.

In order to promote uniform assessments by competent authorities, it is recommended that data from suitable tests be analyzed systematically with respect to the appropriate test criteria using the flow chart of Figure 10.2 in Part I of the Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria. If the substance or article is acceptable for Class 1 it is then necessary to proceed to the second stage, to assign the correct hazard division by the flow chart of Figure 10.3 in the same publication."

and

"2.1.3.3.1 The results from preliminary tests and those from Test Series 1 to 4 are used to determine whether or not the product is acceptable for Class 1. If the substance is manufactured with a view to producing a practical explosive or pyrotechnic effect (2.1.1.1 (c)), it is unnecessary to conduct Test Series 1 and 2. If an article, a packaged article or a packaged substance is rejected by Test Series 3 and/or 4 it may be practicable to redesign the article or the packaging to render it acceptable."

In the proposal as it stands it is possible for an ammonium nitrate emulsion (ANE) to be classified as 1.1D (or 1.5D) without having first been shown to meet the stability requirements for inclusion in Class 1. Whilst it is appreciated that the WG experts know the properties of current formulations, it is necessary to write the regulations in such away that new formulations which may be developed in the future will be covered.

It is possible to avoid this inconsistency if:

(a) the text in box 2 of Figure 10.2 is modified to include the emulsions; and

(b) a relatively minor modification is made to Figure 10.3.

A possible scheme for consideration is given in Annexes 1 and 2 and is summarised in paragraph "4" below.

4. If the text in Box 2 of Figure 10.2 is amended to ask the question "is the substance a candidate for "ammonium nitrate emulsion, intermediate for blasting explosives"?" an affirmative response would direct the path through the classification chart via Box 8, on through Test Series 3 and, subject to the required stability, into Figure 10.3. An additional Box (Box 43) located immediately before Box 19 could then ask the question:

"Is the substance a candidate for "ammonium nitrate emulsion, intermediate for blasting explosives"?"

An ANE would be a "Yes" response and the path through the classification chart would proceed to the new Test Series 8. A positive result in any Series 8 test would direct the route of classification through the existing system via Box 19, but Box 38 would not be an option. Negative results in all Series 8 tests would allow the ANE to pass to Box 45 for classification in Division 5.1. Thus any

ammonium nitrate emulsion which meets the criteria of Class 1 would be classified in Class 1 having first been shown to be sufficiently stable. Figure 10.4 would be redundant.

5. A scheme such as this would require some changes to the proposed Test Series 8. In addition, the assessment of thermal stability for an ANE which is classified in Division 5.1, and likely to be transported in tanks, possibly at elevated temperature, should reflect

the transport temperature; and
the heat loss characteristics of a tank.

These are addressed in paragraph 7 below.

Tests of Test Series 8

6 It is proposed that classification of an ANE will be subject to the results from a new series of tests, Test Series 8. The outcome of the tests in this series determines whether the substance is 1.1D, 1.5D or an oxidiser of Division 5.1 i.e. "Not Class 1". Most of the tests are procedures currently applied to substances with explosive properties, or modifications of existing UN test procedures. Test 8(a) is from Test Series 3, Test 8(c) is from Test Series 2, Tests 8(b) and 8(d) are from (or a modification of) tests in Test Series 5.

7. *Thermal stability*: The thermal stability test is the same as Test 3(c) in Test Series 3. Test 3(a) is intended for packaged explosives transported at 'ambient temperature'. It is not sufficiently stringent for materials that will probably to be transported in tanks, possibly at elevated temperatures, where the substance temperature is likely to be significantly higher than 'ambient' and the heat losses from the system are significantly lower than from a package. The test should be representative of:

the transport temperature; and
the heat loss from a tank.

Two alternatives for consideration are presented below:

(a) If changes of the type detailed in paragraph 4 are considered appropriate, the thermal stability test at his point in the classification is not necessary, since Test Series 3 will have been performed. However, for an ANE classified in Division 5.1 some form of appropriate thermal stability test is necessary before transport in tanks or IBCs can be considered which takes account of the factors above (transport temperature and heat loss characteristics).

(b) If the proposals in 2000/21 are used as the basis of the classification scheme, a Test Series 8 thermal stability test must be performed. Test 3(c) is applied to explosives that are transported in packages at ambient temperature and has a built in safety margin i.e. the test is performed at 75°C whereas the maximum temperature likely to be experienced during transport is considered to be 50

or 55°C. As an ANE may be transported at a temperature at or above 75°C, it would be necessary to amend the test prescription of Test 3(c) so that the test for elevated temperature materials is equally as stringent. Since the results will be used to allow transport in IBCs or tanks it should reflect the conditions of transport (elevated temperature and heat loss characteristics in 'bulk') and be performed:

- At 75°C or the transport temperature (possibly the transport temperature plus some safety margin +10 or 15°C) which ever is higher.
- Under conditions that reflect the (substantially lower) heat losses from a tank or an IBC; a Dewar vessel with suitable heat loss characteristics is appropriate (See the Manual of Tests and Criteria Part II, Test Series H Test H4)

If a test of the type proposed is used, in view of the transport in tanks, the procedure should be limited to instrumented procedure which is more likely to identify problem materials (the criteria for the uninstrumented procedure in Test 8(a) is likely to miss materials that when hot in a tank for prolonged periods may undergo accelerating decomposition, and before tank transport is allowed an appropriate low heat loss (Dewar) test is essential.

8 *Cap Sensitivity Test 8(b):* The cap sensitivity test is taken from Test Series 5, it has low confinement (a cardboard tube), a small diameter and a short length (ammonium nitrate and many of its mixtures tend to have a large critical diameter). In Test Series 5 the test is used to determine whether or not a Class 1 explosive is sufficiently insensitive for inclusion in Division 1.5 - it is therefore used to differentiate between an explosive and a very insensitive explosive. For ANEs this test (as Test 8(b)) is used to differentiate between an explosive of 1.1D and (effectively) an oxidiser of Division 5.1 (i.e. not Class 1).

The suitability of the test should therefore be subject to some discussion to ensure it is sufficiently stringent and discriminating to perform the task for which it is intended in Test Series 8. Examination of the list of results in the Manual of Tests and Criteria (MTC) Table 15.4.1.5 shows that ANFOs and other sensitised AN based explosives of Class 1 ("AN+DNT" and "AN + alkali /alkaline earth metal nitrate + water + aluminium + combustible material") together with a number of other explosives of Class 1 give negative results. The Series 1 detonation test may be considered as an alternative, or at least a Series 2 Type test either Test 2(a) (possibly with a smaller GAP (25 mm ?)). A Cap sensitivity test with higher confinement such as the (old) Series 2 Test 2 (a)(i) BAM 50/60 Steel Tube Test may be more appropriate.

Whatever test is adopted for assessing the detonation properties of an ANE that will, if it passes the test, be allowed for transport in tanks must reflect the relatively high degree of self-confinement of transport in a tank. If transport is to be at elevated temperatures the test should be performed at the maximum likely transport temperature. If the emulsion is sufficiently fluid for cavitation during transport to be possible, a cavitated test may be necessary.

9 *Koenen Test 8(b)* - no comment.

10 *Modified USA DDT Test 8(d):* This test is also derived from a test in Test Series 5. Whilst Test 8(d) does use a larger initiation system (pyrotechnic charge), as a means of assessing the likelihood of a transition from a deflagration to a detonation the severity of the test may be suspect, and its ability to discriminate between emulsions which should be Class 1 and those of Division 5.1 may be questioned. The tube is short in length AND the igniter is located in the middle thus making the effective length even shorter - it is possible that there is insufficient run up length the allow a transition from a deflagration to detonation.

Reference to Table 15.5.2.5 in the MTC for tests, admittedly with the 5g igniter, shows even sensitised emulsion agents (with microspheres, NC or oil) give negative results in the Series 5 test.

A test with large diameter (such as this tube), but longer in length such as the French DDT test (~ 1000 mm), with end initiation would be preferable, with the test performed at the transport temperature.

Here again, for elevated temperature transport the test should be performed at the transport temperature.

11 *The Modified US Vented Pipe Test 8(e):* Whilst this is an attempt to examine heating under confinement on a large scale, there may be practical problems with the test:

- the sample loading is high (~40 kg) which because of the possibility of fragmentation will limit the sites available for the test to be performed;

- if a test gives a negative result, there are safety implications in disposing of the post test pipe and contents, the residues are likely to comprise ammonium nitrate and carbonaceous residues which are potentially explosive and disposal of the system 'as is', or emptying it, may well present a safety hazard as it is of a welded construction;

- notwithstanding the strength of the vessel, the vent size in the test is well in excess of the vent areas referred to in the special provision parts (c) and (d) (a factor in excess of 20).

In the current text, there is no wall thickness specified for the pipe and no specification for the steel of the pipe.

Packaging and tank requirements

12 *Packages:* In the proposed entry in Chapter 3.2, the entry for AMMONIUM NITRATE

EMULSION has been allocated to PGIII:

(a) Whilst it is normal practice that substances in PGIII are permitted to go as limited quantities, the entry in column (7) is “none”.

(b) If the inter-sessional working group adopted PGIII to restrict over-confinement the entry does NOT achieve this, as a package tested to PGI can apply a PGIII mark. The solution here is to apply Additional Requirements in the packing instruction; for example see P112(c) PP48 or P114(c) PP52.

(c) Packing instruction P503 is not appropriate:

(i) it is for Division 5.1 PG I SOLIDS

(ii) if the intention is to again restrict the quantity per package then a separate packing instruction has to be developed for Division 5.1 liquids

(iii) PGIII substances are normally allocated to P001 or P002 or P003

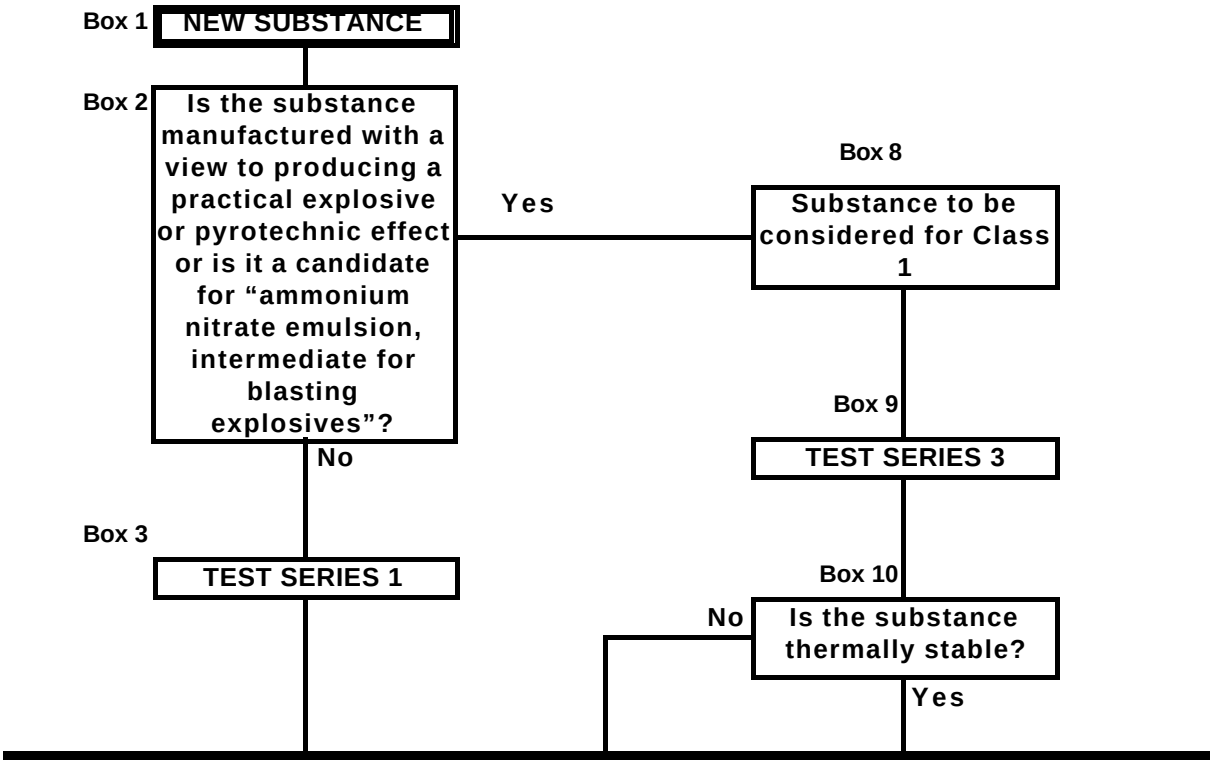
(d) Special packing provision Byz - IBCs are packagings and the definition of bursting discs is not normally specified in this way. The text would be non specific, see IBC02 B5 which in its current form may be suitable. Reference to SPP Byz is missing from column (9) in the proposed entry for the Dangerous Goods List. For comments on pressure relief requirements see paragraph 13.

13 *Tanks:* It is usual to include a tank provision relating to the degree of filling for portable tanks in column (11). For emulsions that will be carried under elevated temperature conditions TP3 is appropriate.

It is not clear what the pressure relief arrangements are intended to be. T2 calls upon the normal pressure relief requirements, cf. 6.7.2.8 in the Model regulations. If the proposed special provision TPxy is intended to deal with the emergency relief devices in a similar way to the requirements for self-reactive substances and organic peroxides then additional provisions may be necessary, since fire engulfment may lead to significant rates of decomposition with gas / vapour evolution. Related to this, is it the intention to preclude the use of spring loaded valves either on their own or in a combination with frangible discs or fusible elements? The second sentence of proposed TPxy appears only to deal with the situation where fusible elements are used and not spring loaded devices and frangible discs (i.e. the maximum setting(s) to avoid unnecessary confinement) and in this regard it is usual to state the pressure in relation to the test pressure (cf. 6.7.2.9 to 6.7.2.11 inclusive). Some of these issues are also likely to be applicable to the proposed SPP Byz in relation to metal IBCs.

ANNEX 1

MODIFICATION TO FIGURE 10.2



ANNEX 2

MODIFICATION TO FIGURE 10.3