UN Decisions and the Explosives Industry

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Summary. This paper reviews the changes in the UN Model Regulations, the Globally Harmonized System of Classification and Labelling, and the Manual of Tests and Criteria as they pertain to the explosives industry. IME participates in the fora related to these instruments. The key changes adopted during the recently completed 2017/2018 biennium include the creation of additional entries for electronic detonators, revision to an entry for ammonium nitrate, and a new test for AN emulsions, water gels and suspensions.

Introduction. Within the United Nations, there are two bodies whose work significantly influences national and international regulations worldwide. These are the Sub-Committee of Experts on the Transport of Dangerous Goods (TDG) and the Sub-Committee of Experts on the Classification and Labelling of Chemicals (GHS). The former develops model regulations related to the transport of dangerous goods including classification, packaging, marking, labeling, placarding, shipping papers, and other transport related activities. The latter develops recommendations for classification and provision of hazard information in the form of labels and safety data sheets for all work activities including transportation (deferring to the TDG), manufacturing, storage, distribution, use, and so forth.

A sub-group within the TDG is its working group on explosives[1] that provides technical support related to the classification and testing of explosives under both the TDG and GHS systems. Due the specialized nature of issues related to explosives that arise at the TDG, they are assigned usually to the EWG that meets separately from, but concurrently with, the TDG. The EWG also consults with the GHS on issues related to physical hazards of explosives. The outcome of this work is reported back to the relevant sub-committee at which time a decision is taken whether to adopt or reject a proposal or to request additional information be developed before the proposal is considered further.

The two sub-committees work on a biennial basis and that work results in amendments to the following documents:

- Recommendations on the Transport of Dangerous Goods, Model Regulations (TDG, ST/SG/AC.10/1)[2] – related to transportation of dangerous goods, this manual addresses subjects such as classification, security, packaging, and hazard communication. The

[1] Referred to as EWG (explosives working group) throughout this paper
[2] Referred to as "Model Regulations" throughout this paper

document serves as the basis of national and international regulations on the transport of dangerous goods.

- Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (TDG/GHS, ST/SG/AC.10/11)[3] – this document provides logic for classification of dangerous goods under the TDG and GHS systems. The document also provides tests and criteria to support those classifications.

- Globally Harmonized System of Classification and Labelling of Chemicals (GHS, ST/SG/AC.10/30)[4] – Deferring to the TDG system where applicable, this document provides classification criteria for chemicals in all sectors including transport, manufacturing, storage, distribution, and use. The document also globally harmonizes communication elements used in hazard communication including labels and safety data sheets.

IME's participation. Various groups participate in the work of these subcommittees including member states (also known as "experts"), observer nations, UN specialized agencies, other international bodies, and non-governmental organizations (NGOs). All groups are allowed to present proposals, comment on proposals and participate in various working groups; however, only the "experts" have the right to vote on proposals.

The Institute of Makers of Explosives (IME) participates as an NGO on both the TDG and GHS sub-committees. IME's participation is led by its UN Consultant and, presently, two subject matter advisers, Dr. Noel Hsu (IME member company Orica USA, Inc.) and Dr. Jackson Shaver (IME member company Special Devices, Inc.). IME is an active participant in the work of the EWG as well, with IME's UN Consultant serving as the working group's secretary.

2017/2018 Recap. The following presents a summary of work addressing explosives and related matters completed in the 2017/2018 biennium. It should be noted that the work of the two sub-committees extends well beyond the subject of explosives; however, this paper only addresses those proposals addressing explosives.

1. **Electronic detonators** – Based on a proposal from the NGO Australian Explosives Industry & Safety Group (AEISG), the TDG sub-committee, on the recommendation of the EWG, adopted three new entries to distinguish between electronic and electric detonators To accomplish this, the TDG:

    - Added 3 new entries into the Dangerous Goods List (DGL) of Chapter 3.2 of the Model Regulations. Once published in the 21st Revision of the Model Regulations (expected in mid-2019), these entries will appear in the DGL as shown in Table 1.

[3] Referred to as "MTC" throughout this paper
[4] Referred to as "GHS Purple Book" throughout this paper

Table 1: New Electronic Detonator Entries

UN No.	Name and description	Class or division	Subsi-diary hazard	UN packing group	Special provi-sions	Limited and excepted quantities		Packagings and IBCs		Portable tanks and bulk containers	
(1)	(2)	(3)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)
0511	DETONATORS, ELECTRONIC programmable for blasting†	1.1B				0	E0	P131			
0512	DETONATORS, ELECTRONIC programmable for blasting†	1.4B				0	E0	P131			
0513	DETONATORS, ELECTRONIC programmable for blasting†	1.4S			347	0	E0	P131			

- Added UN 0512 and 0513 to the indicative list of high consequence dangerous goods found in Table 1.4.1 of Chapter 1.4 (Security Provisions) of the Model Regulations. Since all Division 1.1 explosives are included in the list, it was not necessary to add UN 0511 to the list.

- Modified the definition of "Detonators" found in Appendix B of the Model Regulations to include a reference to electronic detonators. Beginning with the 21st Revision, the definition will appear as follows:

  Detonators

  Articles consisting of a small metal or plastics tube containing explosives such as lead azide, PETN or combinations of explosives. They are designed to start a detonation train. They may be constructed to detonate instantaneously, or may contain a delay element. The term includes:

  DETONATORS FOR AMMUNITION and

  DETONATORS for blasting, ELECTRIC, NON-ELECTRIC, and ELECTRONIC programmable.

  Detonating relays without flexible detonating cord are included.

- Added a new definition to Appendix B to describe electronic detonators. That definition will read as follows:

  DETONATORS, ELECTRONIC programmable for blasting

  Detonators with enhanced safety and security features, utilizing electronic components to transmit a firing signal with validated commands and

secure communications. Detonators of this type cannot be initiated by other means.

2. **UN 0222 Ammonium nitrate** – Based on a proposal from IME, the TDG subcommittee amended Special Provision (SP) 370[5] of Chapter 3.3 of the Model Regulations to clarify to what types of ammonium nitrate (AN) the 1.1D entry UN 0222 applies. The revised SP will read[6]:

   370 This entry only applies to ammonium nitrate that meets one of the following criteria:

   - *Ammonium nitrate with more than 0.2% combustible substances, including any organic substance calculated as carbon, to the exclusion of any added substance; ~~and~~or*
   - *Ammonium nitrate with not more than 0.2% combustible substances, including any organic substance calculated as carbon, to the exclusion of any added substance, that gives a positive result when tested in accordance with Test Series 2 (see Manual of Tests and Criteria, Part I). See also UN 1942.*

   This entry shall not be used for ammonium nitrate for which a proper shipping name already exists in the Dangerous Goods List of Chapter 3.2 including ammonium nitrate mixed with fuel oil (ANFO) or any of the commercial grades of ammonium nitrate.

3. **New test for UN 3375** – Extensive research was carried out by IME's member company Orica on the Koenen Test, which demonstrated that for certain ANEs[7] this test generates false positives. Based on a proposal from IME and Canada, the TDG subcommittee added a new test to Test Series 8 to evaluate ANEs suspected of yielding false positives in the 8(c) Koenen test due to high water content and/or the presence of low volatility oils. The new test, designated "8(e) Canmet/CERL Minimum Burning Pressure (MBP) Test", will only be used to evaluate those ANEs that fail the 8(c) test and meet criteria of reaction time and water content. Several amendments to the MTC and the GHS Purple Book were required to add the 8(e) test:

   - Amended the last sentence of SP 309 of Chapter 3.3 of the Model Regulations to read as follows:

[5] SP 370 only applies to UN 0222

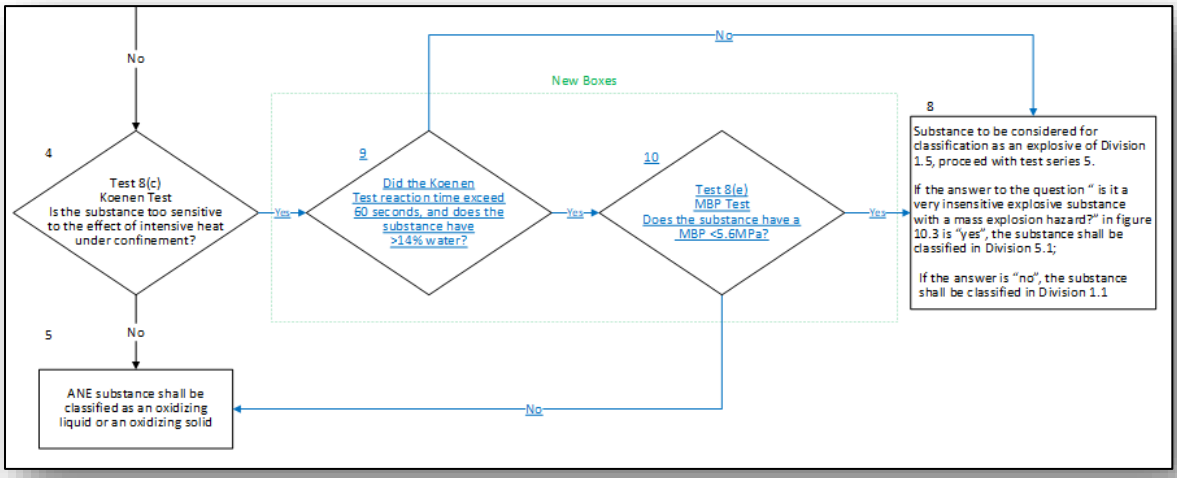
[6] Throughout this paper, *blue underscore* = new text, ~~*red strikethrough*~~ = deleted text, *black text* = unchanged text

[7] Ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives

Substances shall ~~satisfactorily pass Tests 8(a), (b) and (c)~~ satisfy the criteria for classification as an ANE of Test Series 8 of the Manual of Tests and Criteria, Part I, Section 18 and be approved by the competent authority.

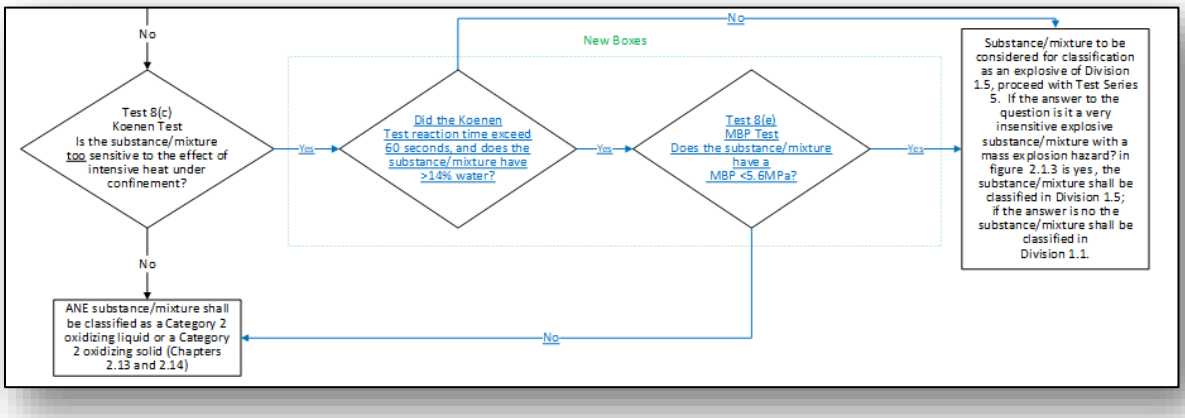
- Inserted the 8(e) MBP test into the ANE classification flowchart in Figure 10.4 of the MTC (see Figure 1).

Figure 1: New boxes added to MTC Figure 10.4



- Inserted the 8(e) MBP test into the ANE classification flowchart in Figure 2.1.4 of the GHS Purple Book (see Figure 2).

Figure 2: New boxes added to GHS Purple Book Figure 2.1.4



- Amended MTC Section 18.1 to add appropriate references to the 8(e) test:

  The assessment whether a candidate for "ammonium nitrate emulsion or suspension or gel, intermediate for blasting explosives (ANE) is insensitive enough for inclusion in Division 5.1 is answered by series 8 tests and any such candidate for inclusion in Division 5.1 should pass each of the three types of tests comprising the series 8(a), 8(b), and 8(c), or if the substance failed the 8(c) and the substance had a time to reaction in 8(c) longer than 60 seconds and a water content greater than 14%, the series 8(a), 8(b), and 8(e). The ~~three~~ test types are:

  Type 8 (a): a test to determine the thermal stability
  Type 8 (b): a shock test to determine sensitivity to intense shock
  Type 8 (c): a test to determine the effect of heating under confinement
  Type 8 (e): a test to determine the effect of pressure on combustion

- Added the 8(e) test to the list of Series 8 tests in MTC Section 18.2:

Test Code	***Name of Test***	***Section***
8(a)	*Thermal Stability Test for ANE[a]*	*18.4*
8(b)	*ANE Gap Test[a]*	*18.5*
8(c)	*Koenen Test[a]*	*18.6*
8(d)	*Vented Pipe Tests[b]*	*18.7*
8(e)	*CanmetCERL Minimum Burning Pressure (MBP) Test[a]*	*18.8*

- Amended MTC Section 18.6.1.4 to indicate when the 8(e) test can be used if a false positive is suspected in the 8(c) test:

  The result is considered "+" ~~and the substance should not be classified in Division 5.1~~ if three negative (-) results cannot be achieved within a ~~minimum~~maximum of five tests. In such a case, the ANE candidate may either be assigned to the class of explosives or, if the time to reaction exceeds 60 seconds and the substance has greater than 14% water, it can be subjected to Test 8 (e) (as described in 18.8) to determine whether it may be classified in Division 5.1.

- Added the new 8(e) test procedure as section 18.8. Too lengthy to be reproduced here, the procedure may be found in the 54th Session EWG Report, UN/SCETDG/54/INF.50, Annex 3, Amendment 5 (begins on page 15), available at: http://www.unece.org/fileadmin/DAM/trans/doc/2018/dgac10c3/UN-SCETDG-54-INF50e.docx

4. **New test and data to evaluate nitrocellulose** – Based on proposals from the NGO European Chemical Industry Council (CEFIC), the TDG adopted new tests and data for evaluating the stability of nitrocellulose:

   - Added two special provisions to Chapter 3.3 indicating when tests should and should not be applied:

     393 The nitrocellulose shall meet the criteria of the Bergmann-Junk test or methyl violet paper test in the Manual of Tests and Criteria Appendix 10. Tests of type 3 (c) need not be applied

     394 The nitrocellulose shall meet the criteria of the Bergmann-Junk test or methyl violet paper test in the Manual of Tests and Criteria Appendix 10.

   - Added SP number 393 to column 6 of the DGL for entries UN 0340, 0341, 0342 and 0343.

   - Added SP number 394 to column 6 of the DGL for entries UN 2555, 2556, 2557 and 3380.

   - Added Appendix 10 (Stability Tests for Nitrocellulose Mixtures) to the MTC. Appendix 10 provides test method for determining nitrocellulose stability. Too lengthy to reproduce here, the complete text of this new appendix may be found in the consolidated list of draft amendments adopted during the 51st – 53rd sessions, ST/SG/AC.10/C.3/2018/65, beginning on page 57, available at: http://www.unece.org/fileadmin/DAM/trans/doc/2018/dgac10c3/ST-SG-AC.10-C.3-2018-65e.docx

   - Reworded Section 51.4.5.1 of the MTC to read, "A compilation for the test results and classification data for more than 200 industrial nitrocellulose products is given in Appendix 11."

   - Added Appendix 11 (Compilation of classification results on industrial nitrocellulose for the purposes of supply and use according to GHS chapter 2.17, which can be used for the classification of Industrial NC products) to the MTC. Too lengthy to reproduce here, the complete text of this new appendix may be found in the consolidated list of adopted texts, ST/SG/AC.10/C.3/2018/64, beginning on page 2, available at: http://www.unece.org/fileadmin/DAM/trans/doc/2018/dgac10c3/ST-SG-AC.10-C.3-2018-64e.docx

5. **Use of the MTC in the context of the GHS** – over the past two biennia (2015 – 2018), the EWG was engaged in a review of the MTC with the intent to broaden the

applicability of the document from solely transport-related to applicability for all sectors within the GHS system. The goal of the review was to remove references to "transport" except where essential, make the document applicable to both TDG and GHS purposes, and not affect current transport classifications. The review was completed at the end of the 2017/2018 biennium and will result in the publication of a 7th revision of the MTC. As this work continued through the last meeting of the biennium (TDG 54th session), and last minute corrections and amendments were made during that session, a clean version of all the amendments is currently pending. Readers are encouraged to look for Addenda 2 (ST/SG/AC.10/46/Add.2) to the TDG/GHS Committee report (ST/SG/AC.10/46) that, once published, will be available at: http://www.unece.org/trans/main/dgdb/dgcomm/ac10rep.html

6. **Review of GHS Chapter 2.1** – also over the past two biennia, the EWG has been engaged with a GHS informal correspondence group (ICG) to review Chapter 2.1 (Explosives) of the GHS Purple Book. The mandate of this review was to review the technical criteria for assignment of explosives within the GHS to make that classification system appropriate to all sectors covered by the GHS without consequential changes to the current classification system in transport. By the end of the biennium, a 2-category classification system for GHS purposes was proposed and generally agreed by the EWG and ICG with Category 1 being those explosives that, for whatever reason, have not been assigned a transport classification and Category 2, those explosives that have been assigned a transport classification. Category 2 would be further divided into three subcategories: 2A (high hazard), 2B (medium hazard) and 2C (low hazard). In general, criteria have been tentatively agreed; however, this work will continue into the 2019/2020 biennium.

7. **Others** – The previous sections of this paper discuss major additions and amendments to the Model Regulations, the MTC, and the GHS resulting from the work of the EWG. Other amendments were also considered and adopted during the 2017/2018 biennium:

   - Added Division 1.6 to the indicative list of high consequence dangerous goods found in Table 1.4.1 of Chapter 1.4 (Security Provision) of the Model Regulations.

   - Amended the outdated reference to "ISO 12097" in section 2.1.3.6.4(b) of the Model Regulations to read "314451-2 using a heating rate of 80 K/min". Section 2.1.3.6 deals with exclusion from Class 1 and section 2.1.3.6.4 provides the criteria for such an exclusion.

   - In the Spanish edition of the Model Regulations, amended the description for "Charges, shaped, flexible, linear" (UN 0237 and UN 0288) to read "CARGAS MOLDEADAS LINEALES FLEXIBLES".

- Removed an unnecessary reference to para. 2.1.1.1(c) contained in Section 2.1.3.3.1 of the Model Regulations:

  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.

- Amended Section 16.5.1.4(c) of the MTC to better define what criteria should be used in determining what means of initiation to use when performing the 6(b) test on non-intentional explosive substances:

  Substances not intended for use as explosives, but provisionally accepted into Class 1, should be tested using whichever initiation system ~~gave a "+" result~~ gave evidence of a mass explosion in a type 6 (a) test.

2019/2020 Biennium. The following summarizes those items that have been included on the EWG work program for the current biennium:

1. **Review of test series 6.** The mandate of this review is to remove over specifications, redundancies, impractical specifications (due to limited or no availability of test materials), and to otherwise provide improvements to the test series drawing upon decades of experience performing the tests and assessing test results.

2. **Improvement of test series 8.** Work will continue with a goal to improving the 8(c) Koenen Test used for classifying ANEs into UN 3375 (Division 5.1) and seeking practical improvements or alternatives to the 8(d) Vented Pipe Test used for evaluating the suitability of ANEs for containment in tanks as oxidizing substances (i.e., UN 3375).

3. **Review of tests in parts I, II and III of the Manual of Tests and Criteria.** Nothing specific has yet been identified for this item.

4. **UN standard detonator.** The current standard detonators, described in Appendix 1 of the MTC are no longer commercially available. Additionally, there are two versions (European and USA) of the detonator. The goal of this review is to develop a single specification that will meet the use requirements for a standard detonator and that will be readily available to those performing sensitivity tests on explosives.

5. **Review of packing instructions for explosives.** Nothing specific has yet been identified for this item.

6. **Application of security provisions to explosives N.O.S.** Nothing specific has yet been identified for this item.

7. **Test N.1 for readily combustible solids.** Nothing specific has yet been identified for this item.

8. **Review of Chapter 2.1 of the GHS Purple Book.** The work will continue to refine the GHS classifications generally agreed during the last biennium and to develop appropriate label and SDS specifications. Once that is complete, a rewrite of the chapter will be undertaken. Presently, the goal for completion is the end of the 2019/2020 biennium. This project will be led by the ICG chair (Sweden) with input, as needed from the EWG.

9. **Energetic samples.** Nothing specific has yet been identified for this item.

10. **Issues related to the definition of explosives.** Nothing specific has yet been identified for this item.

11. **Review of packaging and transport requirements for ANEs.** Nothing specific has yet been identified for this item.

UN Website. Details of the work of the TDG and GHS sub-committees can be followed by reviewing the information available at UN's Dangerous Goods website. There, one will find information regarding meetings and meeting documents (agendas, report, working papers, and informal papers), bodies involved in the work, and publications. The website is available here: http://www.unece.org/trans/danger/danger.html

About the Author. Active with IME since 1985, David Boston has served as IME's UN Safety Consultant since 1995. He has been an IME board member since 1992, has served as chairman of IME's Transportation & Distribution Committee, Safety & Health Committee, UN Committee, GHS Subcommittee, and several other working subcommittees.

During his tenure as IME UN Safety Consultant, David has served as head of delegation on both the United Nations Sub-Committee of Experts on the Transportation of Dangerous Goods (TDG) and Sub-Committee of Experts on the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). He also serves as secretary of the TDG's Working Group on Explosives. Among other things, David was instrumental in IME's recognition by the TDG and GHS as a Non-Governmental Observer (NGO), the TDG's inclusion of a harmonized identification marking standard in that Sub-Committee's Model Regulations, and the TDG's acceptance of a non-explosive classification for ammonium nitrate, suspension, and gels.

David holds a BA in Business Administration and has worked in the explosives regulatory compliance field for more than 40 years. He founded (1993) and is president of Owen

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Born and raised in the Dallas/Fort Worth, Texas area, David still lives in the North Texas area with Patty, his high school sweetheart and wife of over 40 years. He enjoys landscape and wildlife photography in his spare time.

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