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Working Party on the Transport of Dangerous Goods

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**PROPOSALS FOR AMENDMENTS TO ANNEXES A AND B OF ADR**

Provisions for Mobile Explosives Manufacturing Units (MEMUs)

Transmitted by the Government of Germany <sup>\*/</sup>

**SUMMARY**

Executive Summary:	Mobile explosives manufacturing units (MEMUs) exist in many states for the on-site production of explosives for civil use. These mobile units carry various dangerous goods on the road in containers which are connected with each other, but currently the ADR does not contain any provisions applicable to these vehicles. This document describes amendments to the ADR with the objective of treating these mobile units in future as dangerous goods vehicles in the meaning of the ADR.
Action to be taken:	Adoption of the new provisions for the inclusion of mobile explosives manufacturing units.
Related documents:	INF.18 (80th session) ECE/TRANS/WP.15/188 paras.73 and 74 ECE/TRANS/WP.15/192 para. 7 INF.23 (83rd session).

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<sup>\*/</sup> The present document is submitted in accordance with paragraph 1(c) of the terms of reference of the Working Party, as contained in document ECE/TRANS/WP.15/190/Add.1, which provides a mandate to "Develop and update the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)".

## Introduction

1. At its 80th session in May 2006, the Working Party acknowledged an information submitted by Germany (INF.18) which described the situation of the mobile explosives manufacturing units as follows:
2. In various ADR Contracting Parties mobile explosives manufacturing units are used to carry dangerous goods for the on-site manufacture of explosives (see also Annex 1).
3. The relevant vehicle equipment (mixing devices) for the actual production of the explosives (the “mixing”) are tested and approved according to the national explosives legislation. However, the explosives legislation does not take into account the manner of transport of the dangerous goods, i.e. the transport of the various dangerous goods from the place of loading via public roads to the place where the explosives are manufactured on these vehicles and where the explosives are offloaded, e.g. into a borehole of a quarry. Since the transport involves more than 10 000 kg of dangerous goods, the Working Party accepted the offer of the representative of Germany to organise an international informal working group on this subject.
4. The working group was chaired by Germany and held five two-day meetings. The following Contracting Parties participated: Austria, Finland, France, Germany, Ireland, Latvia, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom. Furthermore, representatives of the European Commission and of the industry were present.
5. The aim of the working group was the development of a proposal of amendments for the inclusion of provisions for mobile units into ADR 2009.
6. Since for years the mobile units had been in operation under the exclusively national responsibility of the various states, certain safety philosophies for the design and use of these vehicles had been developed which differed considerably. There were, among other things, great differences concerning the question of carrying on board igniters, boosters and other goods of Class 1.
7. Despite the different national opinions, the clear intention of the participants to find a consensus guided the work of the Group. For some very complex sections of regulations, however, it was only possible to find a consensus by transferring in the draft text the final evaluation to the individual competent national authority.
8. Germany hereby would like to thank all the participants in the working group for their commitment. Without the assistance of small sub-working groups concerning certain chapters or sections and the definitions of new terms as well as the flexibility of all the participants which was already mentioned it would not have been possible to reach a satisfactory outcome.

## Proposal

9. Adopt the provisions on mobile explosives manufacturing units (MEMUs) as shown in Annex 2.

## Justification

10. Parts of the wording which are particularly safety-relevant and important for the overall concept are summarised or justified and explained as follows:

### 1.2.1 Definitions

11. The term mobile explosives manufacturing unit (MEMU) is introduced, and a note states that the scope of the ADR for MEMUs only refers to the transport operation as such and not to the manufacture of the explosives in the mixing equipment or to the loading of the boreholes.

### 1.6.5 Transitional provisions

12. MEMUs which were in operation before entry-into-force of the ADR requirements for MEMUs and which do not comply with these requirements can continue to be used with the agreement of the competent authorities of the countries in which they operate (which means that for international transport at least the authorities of all the countries concerned have to be involved).

### 4.7 Operation of MEMUs

13. It is permitted to transport dangerous goods of all classes on MEMUs which comply with Chapters 4.2, 4.3, 4.4 and 7.3. Substances which are transported in special tanks or special compartments according to the new Chapter 6.12 may only be assigned to Classes 1, 3, 5.1, 6.1 and 8. While the operational requirements for “regular” tanks (according to Chapter 6.7 or 6.8) apply without any changes and completely, there are facilitations for the operation of tanks which are designed according to Chapter 6.12. The requirements for tanks concerning the calculation pressure and safety equipment, for example, which result from the tank code do not have to be fulfilled, since these tanks according to 6.12 do not have any tank codes. However, the special provisions “TU” assigned in column (13) of Table A for some substances have to be complied with.

## Part 5 - Consignment procedures

14. The provisions on placarding and marking of the tanks on the MEMUs are included into the existing regulatory system.

### 6.12 Requirements for the design, equipment, approval and testing of tanks, bulk containers and special compartments for explosives on MEMUs

15. This describes possible derogations for MEMU tanks, that is only facilitations from the general ADR tank provisions of Chapter 6.8. This chapter is based on the philosophy that larger tanks (with a capacity greater than or equal to 1000 l) have to fulfil more requirements than smaller tanks with a capacity of less than 1 000 l).

16. A tank calculation is always required, for example, for the tanks  $\geq 1000$  l, in some cases where the tanks have a special shape (e.g. prismatic design) the ability to withstand the

permissible stress shall at least be determined by a pressure test specified by the competent authority.

17. The safety of the containments of both tank sizes is ensured through pre-determined minimum wall thicknesses dependent on the tank material.

18. The small tanks with a capacity of less than 1000 l do not need an approval. For these tanks the user or manufacturer has to bear the responsibility for suitable tests.

19. Due to the processing functions of the MEMUs (a large number of pipes and wires between the tanks and the mixing equipment) special requirements also apply to the equipment (closures and wires).

20. It is permitted to have special compartments for packaged explosives on the MEMUs. These special compartments may contain: igniters or ignition devices and substances or articles of compatibility group D of Class 1.

#### 7.5 Loading, offloading and handling

21. It is permitted to load a maximum of 200 kg of explosives of compatibility group D and 400 pieces of igniters/ignition devices in addition to an unlimited quantity of dangerous goods, unless otherwise approved by the competent authority. The majority was of the opinion that these quantities were sufficient for a daily operation of a MEMU. The authority has the possibility, however, to make other determinations concerning the mass and number of pieces.

#### 8.2 Training of the vehicle crew

22. Drivers of MEMUs shall hold a training certificate valid for the carriage in tanks and for the carriage of goods of Class 1, because they transport dangerous goods in tanks as well as goods of Class 1.

#### 8.4 Supervision of vehicles

23. Requirements for stopping/parking of the MEMUs were laid down. The areas now have to be under surveillance or the general public has to be kept away from the MEMUs in an appropriate manner.

#### 9.1 Definitions and requirements for the approval of the vehicles

24. With regard to their approval MEMU vehicles are assigned to the usual regulations of the other vehicles EX/II, EX/III, FL, OT, AT (no special features which need to be considered).

#### 9.2 Requirements for the design of the vehicles

25. MEMU vehicles have to fulfil the same requirements as EX/III vehicles, because they transport goods of Class 1 (in accordance with table 9.2.19). However, the term MEMU

separates them from the others, because an EX/III vehicle is permitted to carry a maximum of 16 000 kg goods of Class 1, but a MEMU clearly less (see requirements in 7.5).

#### 9.8 Additional requirements for MEMUs

26. In addition to the general safety requirements also applicable to MEMUs, for example the securing of tanks, bulk containers and special compartments on the vehicle for the carriage of regular transport loads, some special requirements are laid down for earthing, anti-tilt stability and rear impact protection. In addition and among other things automatic fire extinguishers are required for the engine compartment to protect against fire hazards and metallic guard plates against the impact of burning tyres. All the special compartments and the manufacturing equipment on the MEMUs have to be locked.

#### **Safety implications**

27. The amendment to the ADR concerning MEMUs serves the harmonisation of the European MEMU fleet and, due to the inclusion into the dangerous goods legislation, the increase of public safety.

#### **Feasibility**

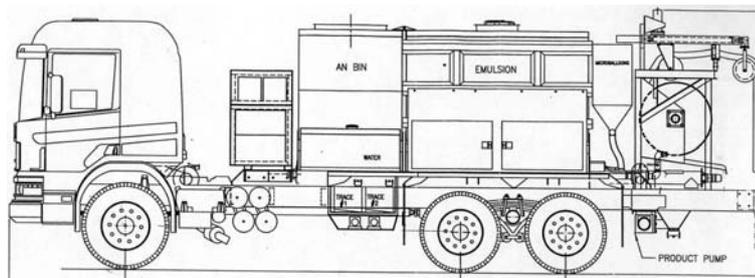
28. Since many countries where MEMUs already exist have contributed their experience to the informal working group it is assumed that it will be possible to realise the MEMU requirements through the ADR.

#### **Enforceability**

29. No problems are expected since the wording of the new provisions has already been harmonised, also with the participation of the industry.

Annex 1: Examples of MEMUs

Picture 1: Diagram of a mobile explosives manufacturing unit



Picture 2: Example of a mobile explosives manufacturing unit



Annex 2: New provisions for mobile explosives manufacturing units (MEMUs)

**Part 1**

**Chapter 1.2**

1.2.1 Add a new definition to read as follows:

“ *“Mobile explosives manufacturing unit” (MEMU)*, means a unit, or a vehicle mounted with a unit, for manufacturing and charging explosives from dangerous goods that are not explosives. The unit consists of various tanks and bulk containers and process equipment as well as pumps and related equipment. The MEMU may have special compartments for packaged explosives.

*[NOTE: Even though the definition of MEMU includes the expression “manufacturing and charging explosives” the requirements for MEMUs apply only to carriage and not to manufacturing and charging of explosives.]”*

**Chapter 1.6**

Add new paragraph 1.6.5.xx to read as follows:

“1.6.5.xx MEMUs which have been constructed and approved before 1 January 2009 in accordance with the provisions of national law but which do not, however, conform to the construction and approval requirements applicable as from 1 January 2009 may be used with the approval of the competent authorities in the countries of use.”

**Part 4**

Add a new Chapter 4.6 to read as follows:

**“CHAPTER 4.6**

*(Reserved)”*.

Add a new Chapter 4.7 to read as follows:

**“CHAPTER 4.7**

**USE OF MOBILE EXPLOSIVES MANUFACTURING UNITS (MEMUs)**

**NOTE 1:** *For packagings, see Chapter 4.1; for portable tanks, see Chapter 4.2; for fixed tanks (tank vehicles), demountable tanks, tank-containers and tank swap bodies with shells made of metallic materials, see Chapter 4.3; for fibre-reinforced*

*plastics (FRP) tanks, see Chapter 4.4; for vacuum operated waste tanks, see Chapter 4.5.*

**NOTE 2:** *For requirements concerning construction, equipment, type approval, tests and marking, see Chapters 6.7, 6.8, 6.9, 6.11 and 6.12.*

#### **4.7.1 Use**

4.7.1.1 Substances classified in Classes 3, 5.1, 6.1 and 8 may be carried on MEMUs conforming to Chapter 6.12, in portable tanks if their carriage is permitted according to Chapter 4.2; or in fixed tanks, demountable tanks, tank containers or tank swap bodies if their carriage is permitted according to Chapter 4.3; or in fibre-reinforced plastics (FRP) tanks if their carriage is permitted according to Chapter 4.4; or in bulk containers, if their carriage is permitted according to Chapter 7.3.

4.7.1.2 Subject to the approval of the competent authority (see 7.5.5.2.3) explosive substances or articles of Class 1 may be carried in packages, in special compartments conforming to section 6.12.5, if their packaging is permitted according to Chapter 4.1 and their carriage is permitted according to Chapter 7.2 and 7.5.

#### **4.7.2 Operation**

4.7.2.1 The following provisions apply for operation of tanks:

(a) For tanks with a capacity of 1 000 litres or more, the provisions of Chapter 4.2 or 4.3, except 4.3.1.4, 4.3.2.3.1, 4.3.3 and 4.3.4, or Chapter 4.4 apply to the carriage on MEMUs, and are supplemented by the provisions of 4.7.2.2, 4.7.2.3 and 4.7.2.4 below.

(b) For tanks with a capacity of less than 1 000 litres, the provisions of Chapter 4.2 or 4.3, except 4.3.1.4, 4.3.2.1, 4.3.2.3.1, 4.3.3 and 4.3.4, or Chapter 4.4 apply to the carriage on MEMUs, and are supplemented by the provisions of 4.7.2.2, 4.7.2.3 and 4.7.2.4 below.

4.7.2.2 The thickness of the walls of the shell shall not, throughout its use, fall below the minimum figure prescribed in the appropriate construction requirements.

4.7.2.3 Flexible discharge pipes, whether permanently connected or not, and hoppers shall be empty of mixed or sensitised explosive substances during carriage.

4.7.2.4 When applicable to carriage in tanks, the special provisions (TU) of 4.3.5 shall also apply as indicated in Column (13) of Table A in Chapter 3.2.

4.7.2.5 Operators shall ensure that the locks specified in 9.8.9 are used during carriage.”

## Part 5

### Chapter 5.1

5.1.3 Insert “, MEMUs” after “vehicles”

5.1.3.1 Insert “, MEMUs” after “MEGCs” and before “)”.

### Chapter 5.3

5.3 In the heading, insert “MEMUs,” after “MEGCs,”.

5.3.1.1.1 In the first sentence, insert “MEMUs,” after “MEGCs,”.

In the second sentence, insert “MEMU,” after “MEGC,”.

5.3.1.1.2 Replace the first and second sentences to read as follows:

“For Class 1, compatibility groups shall not be indicated on placards if the vehicle, container or special compartments of MEMUs are carrying substances or articles belonging to two or more compatibility groups. Vehicles, containers or special compartments of MEMUs carrying substances or articles of different divisions shall bear only placards conforming to the model of the most dangerous division in the order:

1.1 (most dangerous), 1.5, 1.2, 1.3, 1.6, 1.4 (least dangerous).”

5.3.1.1.4 Insert “MEMUs,” after “MEGCs,”.

5.3.1.4 In the heading, insert “MEMUs,” after “battery vehicles,”.

Re-number the existing text after the heading, including the note, as 5.3.1.4.1.

After the note, add new paragraphs to read as follows:

“5.3.1.4.2 MEMUs with tanks and bulk containers shall be placarded in accordance with 5.3.1.4.1 for the substances contained therein. For tanks with a capacity of less than 1 000 litres placards may be replaced by labels conforming to 5.2.2.2.

5.3.1.4.3 For MEMUs carrying packages containing substances or articles of Class 1 (other than of Division 1.4, Compatibility group S), placards shall be fixed to both sides and at the rear of the MEMU.

Special compartments for explosives shall be placarded in accordance with the provisions of 5.3.1.1.2. The last sentence of 5.3.1.1.2 does not apply.”

5.3.1.6 Insert “MEMUs,” after “MEGCs,”.

5.3.1.6.1 Insert “MEMUs,” after “MEGCs,”.

5.3.2.1.2 Add a new last sentence to read as follows:

“For MEMUs these requirements shall only apply to tanks with a capacity of more than 1 000 litres and bulk containers.”

5.3.2.1.7 Insert “, MEMUs, uncleaned” before “as well as”.

## **Chapter 5.4**

5.4.1.1.6.2.2 Insert “ “EMPTY MEMU”, “ after “ “EMPTY MEGC”, “.

## **Part 6**

Add a new Chapter 6.12 to read as follows:

### **“CHAPTER 6.12**

#### **REQUIREMENTS FOR THE CONSTRUCTION, EQUIPMENT, TYPE APPROVAL, INSPECTIONS AND TESTS, AND MARKING OF TANKS, BULK CONTAINERS AND SPECIAL COMPARTMENTS FOR EXPLOSIVES OF MOBILE EXPLOSIVE MANUFACTURING UNITS (MEMUs)**

**NOTE 1:** *For portable tanks, see Chapter 6.7; for fixed tanks (tank-vehicles), demountable tanks and tank containers and tank swap bodies, with shells made of metallic materials, see Chapter 6.8; for fibre-reinforced plastics tanks see Chapter 6.9; for vacuum operated waste tanks see Chapter 6.10; for bulk containers see Chapter 6.11.*

**NOTE 2:** *This Chapter applies to fixed tanks, demountable tanks, tank-containers, tank swap bodies, which do not comply with all requirements of the Chapters mentioned in Note 1 as well as bulk containers and special compartments for explosives.*

#### **6.12.1 Scope**

The requirements of this Chapter are applicable to tanks, bulk containers and special compartments intended for the carriage of dangerous goods on MEMUs.

## 6.12.2 General provisions

- 6.12.2.1 Tanks shall meet the requirements of Chapter 6.8, notwithstanding the minimum capacity defined in section 1.2.1 for fixed tanks, as modified by the special provisions of this Chapter.
- 6.12.2.2 Bulk containers intended for the carriage of dangerous goods on MEMUs shall comply with the requirements for bulk containers of type BK2.
- 6.12.2.3 Where a single tank or bulk container contains more than one substance each substance shall be separated by at least two walls with drained air space between.

## 6.12.3 Tanks

### 6.12.3.1 *Tanks with a capacity of at least 1 000 litres*

- 6.12.3.1.1 These tanks shall meet the requirements of section 6.8.2.
- 6.12.3.1.2 Where a safety valve is required by the provisions of section 6.8.2, a tank shall also have a bursting disc, or other suitable means of pressure relief, approved by the competent authority.
- 6.12.3.1.3 For shells not of a circular cross-section, for example box-shaped or elliptical shells, which cannot be calculated according to 6.8.2.1.4 and the technical code mentioned therein, the ability to withstand the permissible stress may be demonstrated in a suitable manner by a pressure test specified by the competent authority.

These tanks shall meet the requirements of sub-section 6.8.2.1 other than 6.8.2.1.3, 6.8.2.1.4, 6.8.2.1.13 to 6.8.2.1.22 inclusive.

The thickness of these shells shall not be less than the values given in the table below:

<b>Material</b>	<b>Minimum thickness</b>
Stainless austenitic steels	2.5 mm
Other steels	3 mm
Aluminium alloys	4 mm
Pure aluminium of 99.80%	6 mm

Protection of the tank against damage through lateral impact or overturning shall be provided. Protection shall be provided according to 6.8.2.1.20 or the competent authority shall approve alternative protection measures.

6.12.3.1.4 By derogation from the requirements of 6.8.2.5.2 tanks do not need to be marked with the tank code and the special provisions, as applicable.

**6.12.3.2 Tanks with a capacity of less than 1 000 litres**

6.12.3.2.1 The construction of these tanks shall meet the requirements of sub-section 6.8.2.1 other than 6.8.2.1.3, 6.8.2.1.4, 6.8.2.1.6, 6.8.2.1.10 to 6.8.2.1.23 inclusive and 6.8.2.1.28.

6.12.3.2.2 The equipment of these tanks shall meet the requirements of 6.8.2.2.1. Where a safety valve is required by the provisions of 6.8.2, a tank shall also have a bursting disc, or other suitable means of pressure relief, approved by the competent authority.

6.12.3.2.3 The thickness of these shells shall not be less than the values given in the table below:

<b>Material</b>	<b>Minimum thickness</b>
Stainless austenitic steels	2.5 mm
Other steels	3 mm
Aluminium alloys	4 mm
Pure aluminium of 99.80%	6 mm

6.12.3.2.4 Tanks may have constructional parts that are without a radius of convexity. The longest non-supported measurement of such parts shall not be greater than 100 times the wall thickness. Such supportive measures may be curved walls, corrugated walls or ribs.

6.12.3.2.5 Welds shall be skilfully made and shall afford the fullest safety. Welding shall be performed by skilled welders using a welding process whose effectiveness (including any heat treatments required) has been demonstrated by test.

6.12.3.2.6 The requirements of 6.8.2.4 do not apply. However, the initial and periodic inspections of these tanks shall be carried out under the responsibility of the user or owner of the MEMU. Shells and their equipment shall be subject to visual examination of their external and internal condition and a leakproofness test to the satisfaction of the competent authority at least every three years.

6.12.3.2.7 The requirements for type approval of 6.8.2.3 and for marking of 6.8.2.5 do not apply.

#### **6.12.4 Items of equipment**

- 6.12.4.1 Tanks with bottom discharge for UN 1942 and UN 3375 may have only two closures. One of these closures may be the product mixing or discharge pump or auger.
- 6.12.4.2 Any piping after the first closure shall be of a fusible material (i.e. rubber hose) or have fusible elements.
- 6.12.4.3 In order to avoid any loss of contents in the event of damage to the external pumps and discharge fittings (pipes), the first closure and its seatings shall be protected against the danger of being wrenched off by external stresses or shall be so designed as to withstand them. The filling and discharge devices (including flanges or threaded plugs) and protective caps (if any) shall be capable of being secured against any unintended opening.
- 6.12.4.4 Venting systems in accordance with 6.8.2.2.6 on tanks for UN 3375 may be substituted by “goose necks”. Such equipment shall be protected against the danger of being wrenched off by external stresses or shall be so designed as to withstand them.

#### **6.12.5 Special compartments for explosives**

Compartments for packages of explosives containing detonators and/or detonator assemblies and those containing substances or articles of compatibility group D shall be designed to provide effective segregation such that there is no danger of transmission of detonation from the detonators and/or detonator assemblies to the substances or articles of compatibility group D. Segregation shall be achieved by the use of separate compartments or by placing one of the two types of explosive in a special containment system. Either method of segregation shall be approved by the competent authority. If the material used for the compartment is metal, the complete inside of the compartment shall be covered with materials providing suitable fire resistance. The explosives compartments shall be located where they are protected from impact and from damage on rough terrain and dangerous interaction with other dangerous goods on board and from ignition sources on the vehicle e.g. exhausts etc..

***NOTE:** Materials classified as class B-S3-d2 according to standard EN 13501-1:2002 are deemed to fulfil the fire resistance requirement.”*

## Part 7

### Chapter 7.5

Add a new paragraph to read as follows:

“7.5.5.2.3 *Carriage of explosives on MEMUs*

Carriage of explosives on MEMUs is only permitted subject to the following conditions:

- (a) The competent authority shall authorize the transport operation within its territory.
- (b) The type and quantity of packaged explosives carried shall be limited to those necessary for the quantity of material to be manufactured on the MEMU, and in any case shall not exceed
  - 200 kg of explosives of compatibility group D and
  - a total of 400 units of detonators or detonator assemblies, or a mixture of bothunless otherwise approved by the competent authority.
- (c) [MEMUs shall not be used for general (non specific) carriage of explosives.]
- (d) Packaged explosives shall only be carried in compartments that meet the construction and placing requirements of 6.12.5.
- (e) No other dangerous goods may be carried in the same compartment as the packaged explosives.
- (f) Packaged explosives shall only be loaded onto the MEMU once the loading of other dangerous goods has been completed and immediately prior to carriage.
- (g) When mixed loading is permitted between explosives and substances of Class 5.1 (UN 1942 and UN 3375) the aggregate is treated as blasting explosives under Class 1 for the purposes of segregation, stowage and maximum permissible load.”.

## **Part 8**

### **Chapter 8.2**

8.2.1.3 Insert “or MEMUs” after “drivers of vehicles” (twice).

8.2.1.4 Insert “MEMUs carrying mixed loads of substances and articles of Class 1 and substances of Class 5.1 (see 7.5.5.2.3)” after “(see additional requirement S1 in Chapter 8.5),”.

### **Chapter 8.4**

Renumber the existing text after the heading as 8.4.1.

Add a new section to read as follows:

“8.4.2 Loaded MEMUs shall be supervised or alternatively may be parked, unsupervised, in a secure depot or secure factory premises. Empty uncleaned MEMUs are exempted from this requirement.”

## **Part 9**

### **Chapter 9.1**

9.1.1.2 Add a new definition to read as follows:

“ “MEMU”: see section 1.2.1.”.

9.1.2 In the heading and in the note, replace “and” with “,” and insert “and MEMU” after “AT”.

9.1.2.1 In the first sentence, replace “and” by “,” and insert “and MEMU” after “AT”.

9.1.2.3 Replace the first “and” by “,” and insert “and MEMU” after “AT”.

9.1.3.1 Replace “and” by “,” and insert “and MEMU” after “AT”.

9.1.3.5 In the model for certificate of approval for vehicles carrying certain dangerous goods, add “MEMU” at the end of row 7.

## **Chapter 9.2**

Renumber the existing 9.2.1 as 9.2.1.1.

Add a new 9.2.1.2 to read as follows:

“9.2.1.2 MEMU vehicles shall comply with the requirements of this Chapter applicable to EX/III-vehicles.”

## **Chapter 9.8**

Add a new Chapter 9.8 to read as follows:

### **“CHAPTER 9.8**

#### **ADDITIONAL REQUIREMENTS CONCERNING COMPLETE AND COMPLETED MEMUs**

##### **9.8.1 General provisions**

In addition to the vehicle proper, or the units of running gear used in its stead, a mobile explosives manufacturing unit (MEMU) comprises one or more tanks and bulk containers, their items of equipment and the fittings for attaching them to the vehicle or to the running-gear units.

##### **9.8.2 Requirements concerning tanks and bulk containers**

Tanks, bulk containers and special compartments for packages of explosives of MEMUs shall meet the requirements of chapter 6.12.

##### **9.8.3 Fastenings**

Fastenings shall be designed to withstand static and dynamic stresses in normal conditions of carriage, and for tanks with a volume of 1000 litres or more, meet the minimum stresses as defined in 6.8.2.1.2, 6.8.2.1.11 to 6.8.2.1.16.

##### **9.8.4 Earthing of MEMUs**

Tanks, bulk containers and special compartments for packages of explosives made of metal or of fibre-reinforced plastics material shall be linked to the chassis by means of at least one good electrical connection. Any metal contact capable of causing electro-chemical corrosion or reacting with the dangerous goods carried in the tanks and bulk containers shall be avoided.

### 9.8.5 Stability of MEMUs

The overall width of the ground-level bearing surface (distance between the outer points of contact with the ground of the right-hand tyre and the left-hand tyre of the same axle) shall be at least equal to 90% of the height of the centre of gravity of the laden tank-vehicle. In an articulated vehicle the mass on the axles of the load-carrying unit of the laden semi-trailer shall not exceed 60% of the nominal total laden mass of the complete articulated vehicle.

### 9.8.6 Rear protection of MEMUs

A bumper sufficiently resistant to rear impact shall be fitted over the full width of the tank at the rear of the vehicle. There shall be a clearance of at least 100 mm between the rear wall of the tank and the rear of the bumper or the rear wall of built in vehicles (this clearance being measured from the rearmost point of the tank wall or from projecting fittings or accessories in contact with the substance being carried). Vehicles with a tilting shell with rear discharge do not require a bumper if the rear fittings of the shell are provided with a means of protection which protects the shell in the same way as a bumper.

*NOTE: This provision does not apply to MEMU vehicles where the tanks are protected adequately against rear impact by other means, e.g. machinery or piping not containing dangerous goods.*

### 9.8.7 Combustion heaters

9.8.7.1 Combustion heaters shall meet the requirements of 9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5, 9.2.4.7.6 and the following:

- (a) the switch may be installed outside the driver's cab;
- (b) the device shall be switched off from outside the MEMU compartment;  
and
- (c) it is not necessary to prove that the heat exchanger is resistant to the reduced afterrunning cycle.

9.8.7.2 No fuel tanks, power sources, combustion air or heating air intakes as well as exhaust tube outlets required for the operation of the combustion heater shall be installed in the compartment of MEMUs with built in tanks. It shall be ensured that the heating air outlet cannot be blocked. The temperature to which any equipment is heated shall not exceed 50 °C. Heating devices installed inside the compartments shall be designed so as to prevent the ignition of any explosive atmosphere under operating conditions.

**9.8.8 Additional safety requirements**

9.8.8.1 MEMU vehicles shall be equipped with automatic fire extinguisher systems for the engine compartment.

9.8.8.2 Protection of the load by metal thermal shields against tyre fire shall be provided.

**9.8.9 Additional security requirements**

Process equipment and special compartments in MEMUs shall be fitted with locks.”

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