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Proposals for amendments to Annexes A and B of ADR: miscellaneous proposals

Increase of amount of explosives per transport unit

Transmitted by the Government of Spain*

Introduction

1. At the 101st session Spain submitted an informal document (INF.13) about a possible increase in the total quantities of explosives, which could be transported in vehicles, of the EX/III type.

2. The objective of the mentioned informal document was to know if the Working Party could consider an increase of the authorized quantities for transport of explosives in EX/III vehicles from the current 16 tons up to the authorized capacity limit for the corresponding type of truck

3. In the aforesaid document it was also explained that this type of vehicles are mainly used for long distances, fully loaded, to supply explosives to the magazines for a posterior retail distribution to mines, quarries and civil works. They are also used to send containers of these for further transport through ships or trains.

4. During the meeting a number of delegates expressed their opinions and comments; some of them expressed their support to the proposal; others commented that they needed more time to study the proposal and others stated different types of concerns, like additional provisions for accident prevention and protection in case of accident, provisions related to security and risk analysis.

* In accordance with the programme of work of the Inland Transport Committee for 2016-2017, (ECE/TRANS/2016/28/Add.1 (9.2)).

5. The conclusion was that Spain should present a formal document for the next session, after receiving comments by the delegates in writing. Written comments were received from Switzerland, the Netherlands, United Kingdom and Sweden, for which we are very thankful, and which are already partially included into the present text.

Justification

6. The current requirements for transport of explosives are limited to 5 t for EX/II vehicles, and to 16 t for EX/III vehicles. These requirements have been in place since 1968, when the ADR entered into force. In addition, the general requirements for those vehicles have been enhanced repeatedly in the ADR and therefore improved more than significantly in the past 50 years.

7. On the other hand, the quality of the roads has also improved significantly all around Europe in the last 50 years; most of the roads which years ago passed through cities and towns were re-routed to the outskirts. Also the most important heavily used roads in most of the cases and countries were converted into motorways.

8. While the reasons for restricting quantities to 5 and 16 tons are unclear, they seem to be related to limiting the consequences of an explosion (area affected by an explosion).

9. In the informal document submitted by Spain to the 101st session (INF.13) a detailed risk analysis of the effects of an explosion in terms of "affected area" was developed. This analysis was based, on one hand in the ATF (USA, Bureau of Alcohol, Tobacco, Firearms and Explosives) tabulated quantities / distances of influence for the case of vehicle explosions and, on the other hand, on the principle that an increase in the quantities which can be transported means a reduction in the same proportion of the number of the trips and consequently a decrease in the probability of having an accident. The results of the aforementioned analysis are shown in the following curves (see figure 1).

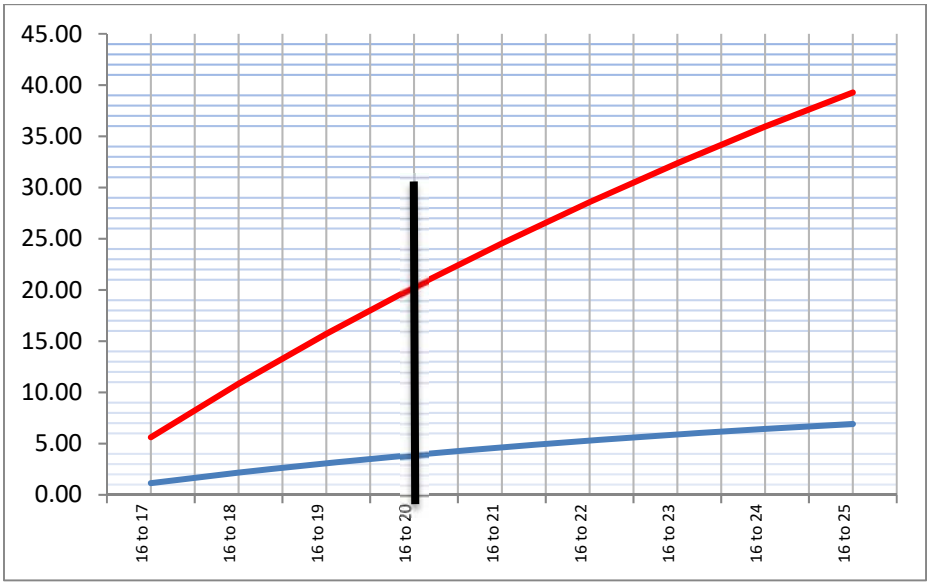

Figure 1**: % of DECREASE of the affected area in an accident (Y axis) in relation with the increase in the amount of the transported quantities (X axis).* ***Red curve: Decrease (%) of affected area. Blue curve: Decrease (%) of the lethality area. Black line: Example for 20 tons.

10. To better understand the meaning of the curves in the figure, an increase, for example, of the quantities which could be transported per transport unit from 16 tons to 20 tons (black line), would mean a decrease a little more than 20% of the damaged area and a decrease of 4% of the lethality area for the case of an explosion, according to the criteria of the ATF. For further explanations on this figure, see reasoning and calculations in Annex I, already introduced in informal document INF.13 (101st session). In this figure, already the combined effect of considering both the decrease in risk caused by reducing the number of trips and the slight increase of risk caused by the potential explosion of more explosives has been considered.

11. It is important to stress the significant improvement in regard to safety that would be achieved by increasing the maximum mass of explosives per transport unit, which is without a doubt the focus of the ADR.

12. The approval of an increase in the quantities to be transported would not need to take into consideration any additional provisions for accident prevention and protection in case of accident since the ADR does not establish measures in regards to safety distances in case of risk of explosion, nor fire nor others.

13. Even so, by increasing the quantities of explosives transported in a vehicle, a slight increase in the area that would be affected in case of a potential explosion would occur, which should be taken into account by the emergency services. This increase of the safety distance is not proportional to the increase in mass, but to the cubic root of the increase in mass; for example (in the event that the reference to calculate the distances were the tables by ATF, but ATF criteria is very restrictive): for an increase from 16 to 20 tons (30% more or less of increase in the quantity), the emergency services should consider the increase in the safety distance from 2027 m to 2073 meters (less than 2,5 % in the safety distance); this information and calculations are detailed in the Annex I. Nevertheless, the emergency services which have provided comments on this proposal have valued the proposal as positive, strongly supporting the principle of decreasing the global risk by decreasing the number of trips.

14. The ATF table was used in informal document INF.13 (101st session) as a baseline or reference to estimate the distance or area of damages caused by an explosion in different settings of quantities. This choice was made basically due to the fact that it refers specifically to vehicles and the transport of explosives, main concern of the ADR. Using different tables or studies, the result would nevertheless have been similar (See conclusions of UK study "An Investigation into the Relative Risks from the Road Transport of Blasting Explosives in Maximum Loads of 5 Tonne and 16 Tonne", available only as a copyright book, concluding that "*movements of explosives in large size loads cause, in the long run, fewer damages than more numerous movements of explosives in smaller size loads"*).

15. It is convenient to remember other aspects mentioned in the informal document INF.13 since they provide additional arguments to support the increase in the authorized quantities for transport, objective of this proposal.

- Higher limits for the transport of explosives in other no-ADR countries, in some of them, because of similar studies to the one presented in this paper.
- Reduction of the volume of greenhouse gas emissions as a consequence of reducing the number of trips.
- Evolution of the quality of the explosives in the last years in the vast majority of ADR countries due to the evolution of the regulatory requirements applying to them.
- Change in technical requirements in road vehicles over the years, such as new ADR requirements for approval of trucks, location systems, or response times in case of emergency have improved transport conditions significantly.

16. Additionally, in comparison to the RID, there might be a lack of coordination; rail often uses the same transport corridors than road, in parallel to motor ways transiting the center of cities and towns etc. and RID (and the other modal regulations) does not establish a maximum quantity of explosives which can be transported. But due to the fact that the ADR fixes it, it is impossible to load –or unload- a container containing more than the current limited quantity established (16 tons) on rail, and by sea, which finally implies certain loss of competitiveness for the countries applying the ADR, concerning exports.

17. Finally it is also convenient to mention, as a reminder, that only organic peroxides (class 5.2) and the self-reactive substances (class 4.1) have limited the net quantities which can be transported in a transport unit according to ADR -20 tons- , supposedly, because the risk of explosion but also others. The limit in the quantities which can be transported for the aforesaid classes was increased considerably in 2007.

Limitation of the increase to specific UN Numbers

18. Class 1 “explosives” comprises dozens of articles, devices and substances of a very a different nature and behaviour.

19. Nevertheless, in line with the main use mentioned in paragraph 3, taking into account the basis for the calculations mentioned in paragraph 10 and Annex I and the additional arguments mentioned in the paragraph 15 , the list of items for which the increase of the limit which could be transported would be most significant, according to present transport practices, could be reduced to a few UN numbers. The proposed UN numbers cover the blasting explosives usually used in mining, quarries and civil works, excluding both those where their low explosives content does not allow to reach 16 t in one vehicle (detonators, detonating cord) and those specially powerful explosives (boosters). These are the following:

- *UN 0027 BLACK POWDER (GUNPOWDER), granular or as a meal*
- *UN 0081 EXPLOSIVE, BLASTING, TYPE A*
- *UN 0082 EXPLOSIVE, BLASTING, TYPE B*
- *UN 0083 EXPLOSIVE, BLASTING, TYPE C*
- *UN 0084 EXPLOSIVE, BLASTING, TYPE D*
- *UN 0241 EXPLOSIVE, BLASTING, TYPE E*
- *UN 0331 EXPLOSIVE, BLASTING, TYPE B (AGENT, BLASTING, TYPE B)*
- *UN 0332 EXPLOSIVE, BLASTING, TYPE E (AGENT, BLASTING, TYPE E)*

Additional limitation for security reasons

20. Even though the core of the ADR is not security, it is true that it is addressed briefly in the chapter 1.10 and that an increase of the quantities per transport unit could be a matter of concern for some authorities. Because the approach of the mentioned 1.10 chapter is protection, not limitation, the solution could be making compulsory the use of the devices mentioned in Note to the ADR 1.10.3.3 “transport telemetry or other tracking methods or devices” to be able to apply this increase. This would considerably strengthen the control of these dangerous goods by the authorities, and would therefore enhance security.

Proposal

21. On the basis of all the above justifications and considerations it is proposed to approve an increase, up to 20 t of net mass, in the quantities of explosives which can be transported in EX/III units. Therefore, it is proposed to make the following amendments to the current edition of the ADR:

1. Add at the end of Note 1 to paragraph 1.10.3.3 the following wording:

"… Nevertheless, in the case of vehicles type EX/III for explosives, carrying more than 16 tons of explosives, the previously mentioned tracking devices must be used (see Note b to table in 7.5.5.2.1)"

2. Modify the table in paragraph 7.5.5.2.1 as follows:

Maximum permissible net mass in kg of explosives in Class 1 goods per transport unit

Transport Unit	**Division**	**1.1**		**1.2**	**1.3**	**1.4**		**1.5 and 1.6**	**Empty uncleaned packagings**
	Compatibility group	**1.1A**	**Other than 1.1.A**			**Other than 1.4.S**	**1.4.S**		
EX/II[a]		6.25	1000	3000	5000	15000	Unlimited	5000	Unlimited
EX/III[a]		18.75	**16000**[b]	**16000**[b]	**16000**[b]	**16000**[b]	Unlimited	**16000**[b]	Unlimited

[a] *For the description of EX/II and EX/III vehicles see Part 9*

[b] ***For the transport of UN 0027, 0081, 0082, 0083, 0084, 0241, 0331and 0332, and the mixed loading of these UN numbers in between them, the maximum permissible net mass per transport unit will be 20.000 kg, provided that the provisions set out in the Note to the point 1.10.3.3 are met.***

Annex I

When restricting the amount of explosives to be transported per vehicle, the interaction of the transported amount, the range of affection in case of an explosion and the number of trips necessary to transport the explosives has to be analysed.

The limitation of the quantity of transported explosives has positive aspects (smaller affected area in case of an explosion) and negative aspects (the need to make a larger number of trips to transport a given quantity of product).

Given the same type of truck and the same route, the probability of the occurrence of an accident or incident of any type is directly proportional to the number of trips.

Calculation of affected area

The area affected by an explosion can be calculated using tables designed for this purpose, considering the amount of explosives transported.

The ATF (USA, Bureau of Alcohol, Tobacco, Firearms and Explosives) has tabulated quantities / distances of influence for the case of vehicle explosions (see Figure 1).

ATF	VEHICLE DESCRIPTION	MAXIMUM EXPLOSIVES CAPACITY	LETHAL AIR BLAST RANGE	MINIMUM EVACUATION DISTANCE	FALLING GLASS HAZARD
	COMPACT SEDAN	500 Pounds 227 Kilos *(In Trunk)*	100 Feet 30 Meters	1,500 Feet 457 Meters	1,250 Feet 381 Meters
	FULL SIZE SEDAN	1,000 Pounds 455 Kilos *(In Trunk)*	125 Feet 38 Meters	1,750 Feet 534 Meters	1,750 Feet 534 Meters
	PASSENGER VAN OR CARGO VAN	4,000 Pounds 1,818 Kilos	200 Feet 61 Meters	2,750 Feet 838 Meters	2,750 Feet 838 Meters
	SMALL BOX VAN *(14 FT BOX)*	10,000 Pounds 4,545 Kilos	300 Feet 91 Meters	3,750 Feet 1,143 Meters	3,750 Feet 1,143 Meters
	BOX VAN OR WATER/FUEL TRUCK	30,000 Pounds 13,636 Kilos	450 Feet 137 Meters	6,500 Feet 1,982 Meters	6,500 Feet 1,982 Meters
	SEMI-TRAILER	60,000 Pounds 27,273 Kilos	600 Feet 183 Meters	7,000 Feet 2,134 Meters	7,000 Feet 2,134 Meters

Figure 1: Influence of amount of explosives and range of influence (ATF)

Since the quantities included in the table cover large ranges intermediate segments can be easily calculated taking into account that the effects of an explosion are a function of the cube root of the quantity that explodes (D = K * Q 1/3), where D is the radius of the affected area, K a constant, and Q the quantity of explosive. Although the value that is normally assigned to the constant K differs significantly from one country to another, it is true that the values chosen by the ATF are very restrictive, or in other words, very high K values. For example, in Spain, the value used for the affected area is 34, and as shown in table 1, the ATF uses K values between 69 and 82.

It is interesting to note that the ATF table includes “lethal” and “evacuation” (damage) distances, which is not common in this type of table. This means that for the purposes of this study, there are two different distances to be analysed / compared.

Taking all of this into account, the K values used by the ATF in Figure 1 to calculate the range of influences for the explosions are the ones included in Table 1.

Tons	Lethal K	Evacuation K
14	5.7	82.5
15	5.8	81.5
16	5.8	80.4
17	5.8	79.4
18	5.8	78.4
19	5.9	77.4
20	5.9	76.3
21	5.9	75.3
22	5.9	74.3
23	6.0	73.3
24	6.0	72.3
25	6.0	71.2
26	6.0	70.2
27	6.1	69.2

Table 1: Values of K used for Figure 1, deduced by inverse calculation

Probability of occurrence of an accident

As mentioned earlier, the probability of the occurrence of an accident will decrease or increase in the same measure as the time of presence on the road decreases or increases. Since EX III trucks are used for supply deliveries between factories and magazines, or between magazines, they are normally fully loaded, so the probability of occurrence of an accident will be reduced in the same measure as the number of trips needed to transport the same quantity. These values are shown in the table below (Table 2).

Increase of tons per trip	% decrease number of trips
from 16 to 17	5.88
from 16 to 18	11.11
from 16 to 19	15.79
from 16 to 20	20.00
from 16 to 21	23.81
from 16 to 22	27.27
from 16 to 23	30.43
from 16 to 24	33.33
from 16 to 25	36.00

Table 2. Decrease of probability of occurrence of an accident (directly related to the decrease of number of trips) with increase of the transported t

Influence of explosion

With the values specified in tables 1 and 2 above, and by applying the formula for the calculation of distances influences by an explosion (D = K * Q 1/3), the following figures are obtained.

Tons	Radius of lethal area for 16 t (m)	Radius of lethal area for the increase (m)	Lethal area for 16 t (m2)	Lethal area for the increase (m2)	Corrected area for the increase	% decrease of lethal area
16 to 17	146	150	66972	70345	66207	1.14
16 to 18	146	153	66972	73714	65524	2.16
16 to 19	146	157	66972	77083	64912	3.08
16 to 20	**146**	**160**	**66972**	**80454**	**64363**	**3.90**
16 to 21	146	163	66972	83829	63870	4.63
16 to 22	146	167	66972	87210	63426	5.30
16 to 23	146	170	66972	90600	63026	5.89
16 to 24	146	173	66972	93999	62666	6.43
16 to 25	146	176	66972	97409	62342	6.91

Table 3 Lethality

Tons	Radius of damage area for 16 t (m)	Radius of damage area for the increase (m)	Damage area for 16 t (m2)	Damage area for the increase (m2)	Corrected area for the increase	% decrease of damage area
16 to 17	2027	2042	12910158	13102743	12331993	4.48
16 to 18	2027	2055	12910158	13263100	11789422	8.68
16 to 19	2027	2065	12910158	13393215	11278496	12.64
16 to 20	**2027**	**2073**	**12910158**	**13494894**	**10795915**	**16.38**
16 to 21	2027	2078	12910158	13569795	10338891	19.92
16 to 22	2027	2082	12910158	13619447	9905052	23.28
16 to 23	2027	2084	12910158	13645265	9492359	26.47
16 to 24	2027.170789	2084.338121	12910158.29	13648573	9099048	29.52
16 to 25	2027.170789	2082.965612	12910158.29	13630604	8723586	32.43

Table 4. Damage area

In both tables, the following columns have been included, in table 3 for the lethal affection, and in table 4 for the damage affection:

1. Increase of explosives per transport unit

2. Radius (m) for the lethal/damage area for the specific case of transport of 16 t (maximum limit according to present ADR regulation)

3. Radius (m) for the lethal/damage in case the increase shown in column (1) would be permitted

4. Area (m2) for the lethal/damage are for the specific case of transport of 16 t (maximum limit according to present ADR regulation)

5. Area (m2) for the lethal/damage in case the increase shown in column (1) would be permitted

6. Corrected area (m2) for the increase: area corrected with the factor obtained in table 2. In this column, the combined effect of considering both the decrease in risk caused by reducing the number of trips and the slight increase of risk caused by the potential explosion of more explosives is considered.

7. Percentage of decrease of lethal/affected area per transported ton: decrease of area, compared to the case of transport of 16 t, expressed in %. In this column, the combined effect of considering both the decrease in risk caused by reducing the number of trips and the slight increase of risk caused by the potential explosion of more explosives is considered

To summarize the information above, the increase in transported quantities would, in statistical terms, decrease both the risk of lethality as well as of damage if an explosion were to occur. Figure 2 shows the evolution of the decrease in the lethality and damage areas that correspond to increases of 1 ton in the quantity transported, with respect to the current value of 16 tons.

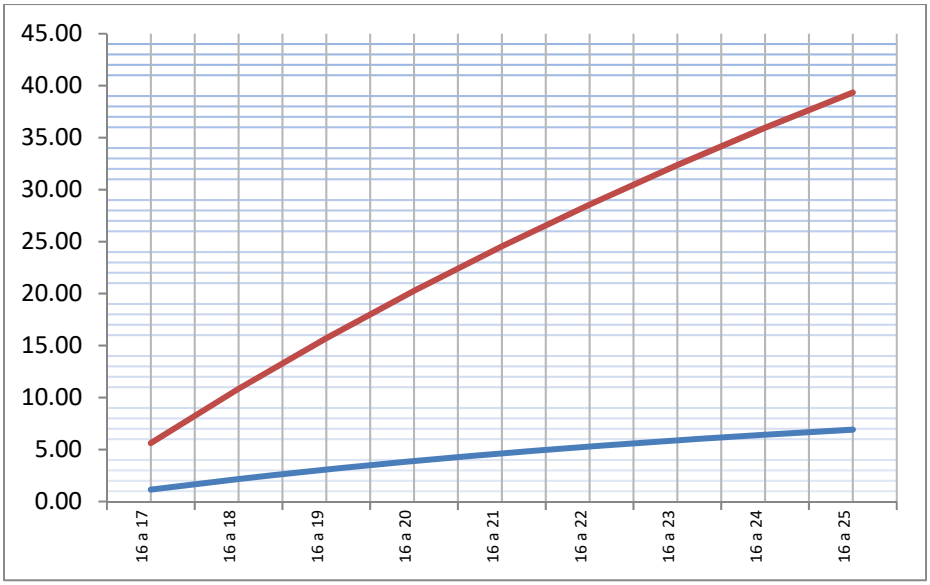

Figure 2: % of DECREASE of the affected area in an accident (Y axis) in relation with the increase in the amount of the transported quantities (X axis).