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Economic Commission for Europe**Inland Transport Committee****Working Party on the Transport of Dangerous Goods****Joint Meeting of the RID Committee of Experts and the
Working Party on the Transport of Dangerous Goods**

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Item 2 of the provisional agenda

Tanks**Material used in vessels carrying UN No. 2031, concentrated
nitric acid (with more than 70% nitric acid) (special
provision TC 6 of section 6.8.4)**

Transmitted by the Government of the Russian Federation^{*}, ^{}**

Summary

Executive summary:	The purpose of this document is to clarify the requirements for the material used in tanks for the transport of UN No. 2031, concentrated nitric acid (with more than 70% nitric acid).
Proposed decision:	Add to special provision TC 6 of section 6.8.4 a requirement that aluminium alloys may be used for the production of tank-wagon tanks.

Introduction

1. For the transport of UN No. 2031, concentrated nitric acid (with more than 70% nitric acid), different requirements for the tank material apply to tank-wagons, tank-containers and portable tanks. Tank-wagon producers are to use aluminium not less than 99.5% pure for the production of the tanks in accordance with existing requirements. The mechanical performance of aluminium of such purity is low. This leads to a significant increase in the

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tank wall thickness of the tank-wagon and consequently to an increase in the tare weight of the tank-wagon. This puts producers and users of tank-wagons in a losing situation.

2. The carriage of UN No. 2031, concentrated nitric acid (with more than 70% nitric acid), is governed by special provision TC 6 of section 6.8.4. Containers are to be carried in accordance with the requirements of packing instructions P 001.

3. The current wording of the special provision TC 6, section 6.8.4, requires that, when aluminium is used for tanks, such tanks are to be made of aluminium not less than 99.5% pure (*emphasis added to the relevant reference below*).

TC 6 Where the use of aluminium is necessary for tanks, such tanks *shall be made of aluminium not less than 99.5% pure*; the wall thickness need not exceed 15 mm even where calculation in accordance with 6.8.2.1.17 gives a higher value.

4. The existing requirements for packagings for the carriage of UN No. 2031, concentrated nitric acid (with more than 70% nitric acid), allow for the possibility of packagings made of aluminium alloys (*emphasis added to the relevant references below*):

P 001 The packing instruction allows the use of aluminium drums and aluminium jerricans.

6.1.4.2 Aluminium drums.

6.1.4.2.1 Body and heads *shall be constructed* of aluminium at least 99% pure or *of an aluminium base alloy*.

6.1.4.4 Steel or aluminium jerricans.

6.1.4.4.1 Body and heads *shall be constructed of aluminium* at least 99% pure or *of an aluminium base alloy*.

5. The existing RID version does not set any requirements for the material used for portable tanks.

Proposals

Proposal 1 (the new wording is indicated in *underlined italics*):

TC 6 Where the use of aluminium is necessary for tanks, such tanks *shall be made of aluminium not less than 99% pure or of an aluminium base alloy*; the wall thickness need not exceed 15 mm even where calculation in accordance with 6.8.2.1.17 gives a higher value.

Justification

6. An analysis of existing requirements and recommendations on the use of materials for nitric acid of different concentrations was carried out covering the following:

- Bruce D. Craig and David B. Anderson. *Handbook of Corrosion Data*. Materials Park: ASM International, 1995, 990 pp.
- Christian Vargel. *Corrosion of Aluminium*. First edition. 2004, 700 pp.
- Stephen D. Cramer and Bernard S. Covino, eds. *ASM Handbook, Volume 13C: Corrosion – Environments and Industries*. 2006, 1,342 pp.
- J.R. Davis. *Corrosion of Aluminium and Aluminium Alloys*. ASM International. 1999, 313 pp.
- M.B. Altman, Y.P. Arbuzov, B.I. Babichev et al. *Alyuminiyevye cplavy. Primenenie alyuminiyevykh splavy* (Aluminium alloys: the use of aluminium alloys). Reference manual. Moscow: Metallurgia, 1973, 408 pp.
- V.P. Barannik. *Kratky spravochnik po korrozii* (Brief guide to corrosion: chemical resistance of materials). Moscow: Goskhimizdat, 1953, 456 pp.

- V.M. Beletsky and G.A. Krivov *Alyuminievyye splavy (sostav, svoystva, tekhnologiya, primeneniye)* (Aluminium alloys: composition, properties, technology, application). *Guide*. 2005, 365 pp.
- G.Y. Vorobieva. *Korroziionnaya stoikost materialov v agressivnykh sredakh khimicheskikh proizvodstv* (Corrosion resistance of materials in aggressive chemical industry environments). Moscow: Khimiya, 1975, 816 pp.
- V.N. Dyatlova, I.M. Zolotnitsky and N.A. Dollezhal. *Korroziionnaya i khimicheskaya stoikost materialov* (Corrosion and chemical resistance of materials). *Guide*. Moscow: MASHGIZ, 1954, 570 pp.
- A.S. Zubchenko and Y.V. Kashirsky *Marochnik stalei i splavov* (Steel and alloy grade guide). 2014, 1,216 pp.
- K. Rachev and S. Stefanova *Spravochnik po korrozii* (Guide to corrosion), translated from Bulgarian, S.I. Neikovsky, translator. I.I. Isaev, ed., with a foreword. Moscow: Mir, 1982, 520 pp.
- D.G. Tufanov *Korroziionnaya stoikost nerzhaveyushchikh stalei, splavov i chisykh metallov* (Corrosion resistance of stainless steels, alloys and pure metals). *Guide*. Moscow: Metallurgia, 1990, 320 pp.

7. The following can be pointed out from the analysis of the foregoing Russian and international literature:

- Aluminium or aluminium alloys, including the Al-Mn and Al-Mg alloying systems, may be recommended for high concentrations of nitric acid.
- A “satisfactory” corrosion rate (comparable to an aluminium purity of at least 99.5%) can be achieved with an aluminium alloy content of at least 91%.

8. Laboratory studies were carried out to determine the rate of total corrosion of various aluminium alloys in a 99% nitric acid environment. AD0 aluminium (with Al \geq 99.5%) was used as the reference. The results obtained from the tests on the aluminium alloys from the Al-Mn and Al-Mg alloying systems corroborated the information contained in the Russian and international literature. With proper selection of an alloy (alloying), its corrosion rate in high-concentration nitric acid can be comparable to AD0 aluminium (with Al $>$ 99.5%):

<i>Alloy</i>	<i>Aluminium content (%)</i>	<i>Corrosion rate in 99% HNO₃, mm/year</i>
AD0	99.5	0.02
Al-Mn	97.7	0.02
Al-Mn	98.0	0.03
Al-Mg	96.7	0.04

9. It is proposed to allow the possibility of producing tanks of tank-wagons for the carriage of UN No. 2031, strong nitric acid (with more than 70% nitric acid), from aluminium alloys similar to the requirements that apply to packagings.