INF.21

Economic Commission for Europe

Inland Transport Committee

English

19 August 2016

Working Party on the Transport of Dangerous Goods

Joint Meeting of Experts on the Regulations annexed to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (ADN Safety Committee)

Twenty-ninth session
Geneva, 22 - 26 August 2016
Item 3 (c) of the provisional agenda
Implementation of the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN):
Interpretation of the Regulations annexed to ADN

Explosion Safety – Proposal on subgroups flame arrestors IIB; (IIB-1, IIB-2 and IIB-3)

Submitted by EBU and ESO

Related documents:
http://www.unece.org/fileadmin/DAM/trans/doc/2016/dgwp15ac2/WP15-AC2-29-inf09e.pdf
http://www.unece.org/fileadmin/DAM/trans/doc/2016/dgwp15ac2/ECE-TRANS-WP15-AC2-2016-38e.pdf
http://www.unece.org/fileadmin/DAM/trans/doc/2016/dgwp15ac2/ECE-TRANS-WP15-AC2-2016-42e.pdf
http://www.unece.org/fileadmin/DAM/trans/doc/2016/dgwp15ac2/ECE-TRANS-WP15-AC2-2016-04e.pdf
http://www.unece.org/fileadmin/DAM/trans/doc/2016/dgwp15ac2/WP15-AC2-28-inf27e.pdf

I. Introduction

The working group Products has worked on the products list, ADN 3.2, Table C and added subgroups of explosion groups IIB in column 16. Explosion group IIB has a MESG (Maximum Experimental Safety Gap) of 0,5-0,9 mm.

The new subgroups describe in detail the required MESG:

- IIB3: 0,65-0,75mm
- IIB2: 0,75-0,85mm
- IIB1: 0,85-0,90mm

The new subgroups lead to major investments to adapt barges, while the safety level will likely not increase during the transport of these products.

The last years, products that have been transported safely in the existing tank barge fleet, equipped with flame arrestors of type IIB-3, cannot be transported anymore in the future with the same equipment, as a result of this proposal.

A fact is, this new type of required type IIB-flame arrestor are not available yet for the use on board of tank barges.

There are none incidents and accidents known, caused by “wrong” type of flame arrestors nor any incidents known, in which the impact has increased by the “wrong” type of flame arrestors.

Besides an extensive impact analyses is missing. EBU and ESO investigated and found new relevant information about assigning subgroups.

II. Inventory fleet

After an intensive inventory of EBU/ESO it came out that >90% of the existing fleet is equipped with flame arrestors of the type IIB-3 (0,65-0,75 mm), including all barges built last years.

III. Impact of the proposal

For most adapted positions of ADN 3.2, Table C, it has minor impact on the existing fleet and market. Proper products (non-mixtures and non - “N.O.S.-positions”) with only one single position in the Table C don’t lead to major problems although barges product lists have to be adapted in most cases.

In nearly all cases, barges will have to be adapted to remain the ability to carry all products that are on the existing barges’ product list of today. It will be the choice of a barge owner to decide to adapt the barge, to be able to carry certain products or not.

The proposal was initially presented as a “relief of requirements”, this is underestimated. Especially the N.O.S.-positions and “decision diagram”-positions do lead to a major impact for the existing tank barge fleet as under such positions, many different products are transported, daily.

Flame arrestors do make part of the vapor return piping system. Smaller openings in the flame arrestors decrease the maximum loading capacity of a barge, after adapting the barge, the loading instruction shall also be adapted.

According to flame arrestor and P/V-valves supplier Protego, this could result into a reduction of the loading speed from 20 to maximum 40%.

IV. Approach chosen of products with “unknown” composition (N.O.S.)

For many positions in the Table of C, the exact composition was unknown by the working group products; mainly positions of mixtures and “**N.O.S.”-positions** but also **“decision diagram positions”** that are often used to transport many mineral oil mixtures like nafta-related products. For example, which should not be underestimated, under one “decision diagram” position in the Table C, probably >20 different products are transported daily in the mineral oil market.

Because of the unknown specifications of the above mentioned type of positions, and to be as safe as possible, the “worst case scenario” approach was chosen in the form of “IIB” (0,5-0,65 mm MESG) and foot note 4 was added at 156 Positions. This means in practice of the mineral oil transport area, of which approx. 80% of the tank barge fleet is active, a need to adapt nearly all barges, to keep them able to stay flexible in this mineral oil market, and keep them allowed to transport the products that these barges already do for years, without any problems in this matter.

V. Unnecessary requirements for most N.O.S. / Decision diagram-positions

The worst case scenario approach is logical when no information is available, but unnecessary for the most of these products. The safety level does not increase if 0,5-0,65 MESG is used while not required, but it does impact loading speed capacity.

Example of some UN 1268 N.O.S- Positions for which “IIB” is required according to column 16:

1268	ERDÖLDESTILLATE, N.A.G. oder ERDÖLPRODUKTE, N.A.G.	3	F1	I	3+(N1, N2, N3, CMR, F)	*	*	*	*	*	*		*	ja	T4 [3]		II B [4]	ja	*	1	14; 27; 29 *siehe 3.2.3.3
1268	ERDÖLDESTILLATE, N.A.G. oder ERDÖLPRODUKTE, N.A.G	3	F1	II	3+(N1, N2, N3, CMR, F)	*	*	*	*	*	*		*	ja	T4 [3]		II B [4]	ja	*	1	14; 27; 29 *siehe 3.2.3.3
1268	ERDÖLDESTILLATE, N.A.G. oder ERDÖLPRODUKTE, N.A.G	3	F1	III	3+(N1, N2, N3, CMR, F)	*	*	*	*	*	*		*	ja	T4 [3]		II B [4]	ja	*	0	14; 27 *siehe 3.2.3.3

VI. Theoretical approach: when IIB (0,5-0,65) is indeed necessary

After an investigation of EBU/ESO, it became clear that according to the criteria of NEN-IEC 60079-20-1 there are only a few products for which IIB is described as maximum MESG, such as:

- Hydrogen
- Acetylene
- Carbon disulphide
- Mixtures including H2 (hydrogen) and CO (Carbon mono oxide)
- Dichloordiethylsilaan
- Ethyl nitrate
- Ethylene oxide
- Formaldehyde
- Paraformaldehyde
- Prop-2-yn-1-ol

(Source: IEC Publication 79). Most of these products are gases.

In a mixture, the above mentioned components can lead to a result of a required MESG of <0.65 mm (IIB). A turned around approach to gather these Positions of the Table C is logical; if those components are not present in a mixture, IIB will never be required and a wider MESG is applicable. This means that no adaption to barges is required, to keep them able to serve the transport market in the same way as they do today.

The EN-IEC 60079-20-1 has been replaced by EN-IEC 80079-20-1 from march 2016 and shall be mentioned in the new ADN-2017 as testing method.

VII. Proof of too strict approach by testing results

EBU/ESO (CBRB & BLN) have asked oil companies to join the discussion as producer / supplier of products, involved in this matter. They registrate their products within REACH,

provide Safety Data Sheets in line with 1907/2007/EC, are responsible for the correct classification and registration and they can confirm that most components that can lead to a IIB-type of flame arrestor, are not part of the composition of the mixture.

Oil companies have considered this matter and some of them have tested different products, for which in the proposal IIB is required, and after testing came out to be maximum the type IIB-3 and even two times II-A. These tests were carried out by the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig-Germany.

Hereby, the results of these testing results:

Product	Ch. 14 SDS	ADN Table C
Medium Platformate Avgas	UN 1268 PETROLEUM DISTILLATES, N.O.S. (NAPHTHA (PETROLEUM) FULL RANGE REFORMED) , 3, (N2, CMR,F) , PG I	1268 PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S. 3 F1 I 3+(N1, N2, N3, CMR, F) * * * * * * * yes T4 [b] II B [d] yes * 1 14; 27; 29 *see 3.2.3.3
Jet A1	UN 1863 DUSENKRAFTSTOFF, 3, (N2, F), PG III	1863 FUEL, AVIATION, TURBINE ENGINE 3 F1 III 3+(N1, N2, N3, CMR, F) * * * * * * * yes T4 [b] II B [d] yes * 0 14 *see 3.2.3.3
LCCR Gasoline/CCTops	UN 1268 PETROLEUM DISTILLATES, N.O.S. (NAPHTHA (PETROLEUM) LIGHT CATALYTIC CRACKED) , 3, (N2, CMR,F) , PG I	1268 PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S. 3 F1 I 3+(N1, N2, N3, CMR, F) * * * * * * * yes T4 [b] II B [d] yes * 1 14; 27; 29 *see 3.2.3.3

Product	Assigned Explosion group (Column 16)	Assigned explosion group as per Proposal	MESG as per proposal	PTB Test result, MESG in mm (IEC 60079-20-1)	Explosion Group in accordance with Test result	PTB Report
Medium Platformate	IIB(4)	**II B**	0.5 mm ≤NSW ≤0.65 mm	1.02	**IIA**	16-66033c
Jet A1	IIB(4)	**II B**	0.5 mm ≤NSW ≤0.65mm	0.88	**IIB1**	16-66033b
LCCR Gasoline/CCTops	IIB(4)	**II B**	0.5 mm ≤NSW ≤0.65 mm	0.93	**IIA**	16-66033a

VIII. Possible error in the proposal

Considering the new proposal, EBU/ESO has found a possible error within UN 3475, the mixture of ethanol and gasoline:

3475	ETHANOL UND BENZIN, GEMISCH oder ETHANOL UND OTTOKRAFTSTOFF, GEMISCH mit mehr als 10 % und nicht mehr als 90 % Ethanol	3	F1	II	3+N2+CMR+F	N	2	3	3	10	97	0,69 - 0,78 [10]	3	ja	T3		II A	ja	PP, EP, EX, TOX, A	1	
3475	ETHANOL UND BENZIN, GEMISCH oder ETHANOL UND OTTOKRAFTSTOFF, GEMISCH mit mehr als 90 % Ethanol	3	F1	II	3+N2+CMR+F	N	2	3	3	10	97	0,78 - 0,79 [10]	3	ja	T2		II B	ja	PP, EP, EX, TOX, A	1	

EBU/ESO asked the independent company HSE-Advies BV (independent safety advisor /ATEX-specialists) to calculate the MESG, based on the calculation mentioned in IEC 60079-20-1. Their official calculation is added to this document as “Appendix 1”.

$$MESG_{mix} = \frac{1}{\sum_i \left(\frac{X_i}{MESG_i} \right)}$$

In line with the proposal the mixture of UN 3475 >90% ethanol, should be transported in barges with “IIB”-flame arrestors (0,5-0,65 mm MESG), adaption of barges required.

MESG:

- UN 1203 Gasoline: IIA (0,9-1,14 mm)
- UN 1170 Ethanol: IIB-1 (0,85-0,90 mm)

According to the calculation, another type of flame arrestor is sufficient:

MESG 0,89 mm; this is type IIB-1, not IIB (0,5-0,65 mm): an example of a product that can be transported without any adaption of the current equipment.

It cannot be excluded that there could be any other mistakes in the proposal.

IX. Inventory of shore facilities

After an inventory it came out that most of the shore facilities are not equipped with IIB-flame arrestors, but mostly with “IIA”.

The obligation of the filler; ADN 1.4.3.3 sub #r:” *The filler shall ascertain that, when prescribed in ADN 7.2.4.25.5, there is a flame-arrestor in the vapour return piping to protect the vessel against detonations and flame-fronts from the landward side*”.

This shall be confirmed prior to loading, by filling in question 12.3 by the filler, on his part of the ADN Checklist (ADN 8.6.3) before a cargo operation:

“12.3 When anti-explosion protection is required in ADN Ch.3.2. , Table C column (17) does the shore installation ensure that its vapour return piping is such that the vessel is protected against detonations and flame fronts from the shore?”

X. Sea ships

The IMO has made an exception for vessels (MSC Circ. 1324), they are allowed to carry products for which IIB is required, in vessels equipped with “IIB-3”- protection systems. There are no incidents known with any explosions on seas vessels, caused by “wrong flame arrestors”.

XI. Conclusion

Within this report, it seems that not all information and data available, such as as testing results, calculation and theory of the impacting components) have been present or have been used correctly. Besides a mistake is found within the assignment of the subgroup within UN 3475.

The “worst case scenario approach” is used too swiftly, while more information is available and in our opinion, should be examined extensively, before this proposal is brought into the ADN.

Besides there are major differences in equipment between barges, shore facilities and sea vessels.

To prevent measures to be taken, based on insufficient information, which does not contribute to a higher safety level the EBU/ESO investigated this issue and likes to draw attention for it.

XII. Proposal

Herewith, we propose to ask the working group products to verify the Table C again, with special attention for the new information, mentioned under XI, XII and XIII, in relation to the relevant mixtures and “N.O.S.-” positions together.

The Oil industry should be contributing to the process of assigning the correct sub-explosiongroups together with ADN and ATEX-experts. The working group should get sufficient time to adapt the product list, based on more information available yet and in the future when more products are considered.

Appendix 1 M160629CBRB_Calculation of UN 3475.pdf

HSE-advies B.V.
Internationale veiligheidsadviseurs

Leyenseweg 113[G]
P.O. box 261, 3720 AG Bilthoven, the Netherlands
Telephone +31 30 274 88 55 | Fax +31 30 225 24 49
E-mail info@hse-advies.nl | www.hse-advies.nl

Centraal Bureau voor de Rijn- & Binnenvaart
Attn. Mr. M. Zevenbergen
Vasteland 78
3011 BN Rotterdam

Place and date	:	Bilthoven, 29 June 2016
Your reference	:	e-mail of 23 June 2016
Our reference	:	6218.400.01/Mke/Gja/Mke
Concerning	:	Centraal Bureau voor de Rijn- & Binnenvaart
Subject	:	Calculating the MESG of UN3475 (ethanol and motor spirit mixture)

Dear Mr. Zevenbergen,

With reference to your e-mail of 23 June 2016, we have calculated the Maximum Experimental Safety Gap (MESG) of flame arrestors for UN 3475 for you.
UN 3475 is the substance identification number for a mixture of Ethanol (UN 1170) and Motor spirit (UN 1203) and in this case a mixture with more than 90 vol. % of Ethanol.

For this calculation we used the following International standards:

- EN-IEC 60079-20-1:2010/C1:2012, Explosive Atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data;
- ISO/IEC DIS 80079-20-1:2015, Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data;
- ISO/DIS 16852:2014, Flame arresters - Performance requirements, test methods and limits for use.

Classification of mixtures of gases
According to clause 4.5 of EN-IEC 60079-20-1 and ISO/IEC DIS 80079-20-1, mixtures of gases should generally be allocated to a group only after a special determination of MESG or MIC ratio. One method to estimate the group is to determine the MESG of the mixture by applying a form of Le Châtelier relationship:

$$MESG_{mix} = \frac{1}{\sum_i \left(\frac{X_i}{MESG_i} \right)}$$

Where X_i is the percentage by volume of material i and MESG i is the MESG of material i.

Components of mixture
According to your e-mail of 23 June 2016 we have received the following information.

UN 1203 Motor spirit,	gas group IIA,	MESG 0,9 mm – 1,14 mm	≤ 10 vol. % in mixture
UN 1170 Ethanol	gas group IIB1	MESG 0,85 mm – 0,9 mm	≥ 90 vol. % in mixture

Using the formula of clause 4.5 of EN-IEC 60079-20-1 and ISO/IEC DIS 80079-20-1, the MESG can be calculated as follows:

$$\left(\frac{0,09}{0,9}+\frac{0,91}{0,85}\right)=\frac{1}{1,1705}=0,8543 \text{ mm}$$

In Table 2 of the ISO/DIS 16852 the range of application are specified as follows.

Range of Application	
Explosion group	MESG of mixture [mm]
IIA1	≥ 1,14
IIA	≥ 0,90
IIB1	≥ 0,85
IIB2	≥ 0,75
IIB3	≥ 0,65
IIB	≥ 0,50
IIC	< 0,50

The MESG of 100% Ethanol is determined at 0,85 mm. The MESG of a mixture of ethanol and motor spirit will never be smaller than 0,85 mm even if the mixture is near to a 100 % ethanol.

Conclusion:
The flame arrestor of explosion group IIB1 is suitable for a mixture of Ethanol (UN 1170) and Motor spirit (UN 1203) and in this case with more than 90 vol. % of Ethanol.

Sincerely,
HSE-advies B.V.

ing. G.A. Jansen
Manager HSE-advies
030-2748855

M. Kerremans
Senior Safety Engineer